

Materials and Components:

The construction of buildings usually requires large quantities of materials and components. These may require large amounts of energy to produce. Their development may also require processes that are harmful to the environment and consume non-renewable resources.

Embodied energy

80% of building materials and components will have low embodied energy. Low embodied energy materials include locally made and sourced (i.e. Within the country), timber, concrete, concrete blocks timber windows and doors.

Material / component sources

90% of materials and resources will come from renewable resources

Manufacturing processes

Environmental damage should be limited during product component development. **No** green house **gases** should be released, and **no pollution** should be caused.

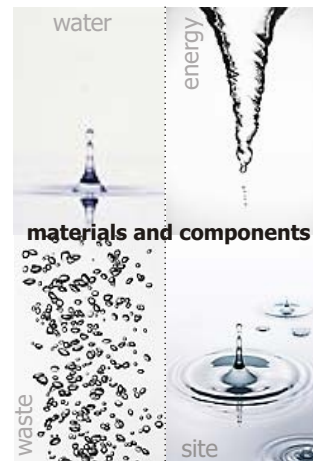
Recycled / reused materials and components

10% of building materials and components are reused or come from recycled sources.

Construction processes

Building and construction processes are designed to **minimally impact** the environment. Requirements for large scale vegetation clearing and earth movement is minimised.

ENVIRONMENT



MATERIAL	FOR 1 TON
Brick uses 1.3 % of the total water consumption for steel	2 200 L
Concrete (for 42.5kg cement)	23 L

Fig 134. Water used in materials

MATERIAL	
Wood	From nearest dealers, which get stock from Lowveld
Concrete	From local PPC; stone and sand from nearest dealer
Glass	Pilkington Glass in Koedoespoort
Bricks	From local brick manufacturer or Demolition company
Sheet metal	Identified local dealer

Fig 135. Where materials come from



Fig 136. Wood

ECONOMIC ISSUES:

Local Economy

The construction and management of buildings can have a major impact on the economy of an area. The economy of an area can be stimulated and sustained by buildings that make use of and develop local skills and resources.

Local contractors

90% of the construction should be carried out by contractors based within 40km of the building.

Local building material supply

75% of construction materials: cement, sand, bricks, etc, should be produced within 200km of site.

Local component manufacturers

90% of building components i.e. windows and doors should be produced locally (within 200km).

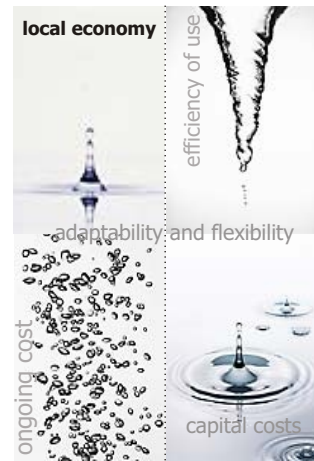
Outsource opportunities

Opportunities should be created and provision made for small emerging businesses. This includes outsourcing of catering, cleaning services and security, as well as making space and equipment available for businesses to use for retail, education, etc.

Repairs and maintenance

All repairs and maintenance required by the building (including servicing of mechanical plant) can be carried out by contractors based **within 200km** of site.

ECONOMIC



	% Local
Support Local Economy	80
Local contractors	90
Materials and suppliers	75
Component manufacturing	90
Outsource opportunities	80
Repairs	70

Fig 137. Local economy

IF NECESSARY, CARRY OUT TRAINING:

- to reduce transport output
- to create a stronger diversified economy
- to develop the local skill base

RECYCLE MONEY IN LOCAL SECTOR



Fig 138. Strength of local economy

Efficiency of Use

Buildings cost money and make use of resources, whether they are used or not. Effective and efficient use of buildings supports sustainability by reducing waste and the need for additional buildings.

Useable space

Non-useable spaces such as plants, w.c.'s. and circulation spaces do not make up more than **20%** of the total area of the building.

Occupancy

The building and all working/living spaces are occupied for an average equivalent minimum of **30 hours per week**.

Space use

The use of space should be intensified through a space management approach and policy, by creating spaces with dual functions. The areas marked in blue are spaces that can be implemented for whatever is needed according to the user. These spaces are usable and available even after official closing hours of the building. More specifically the yellow part - the theatre, which can be used after hours as a venue for various kinds of performances.

Use of technology

Communications and information technologies are used to reduce space requirements. Spaces are designed for human use with the human proportions as basis. According to the NBR the whole design complies with the requirements for use by disabled people.

Space management

A policy should be implemented to ensure that space is well used. This should include regular audits and a space management system.

ECONOMIC

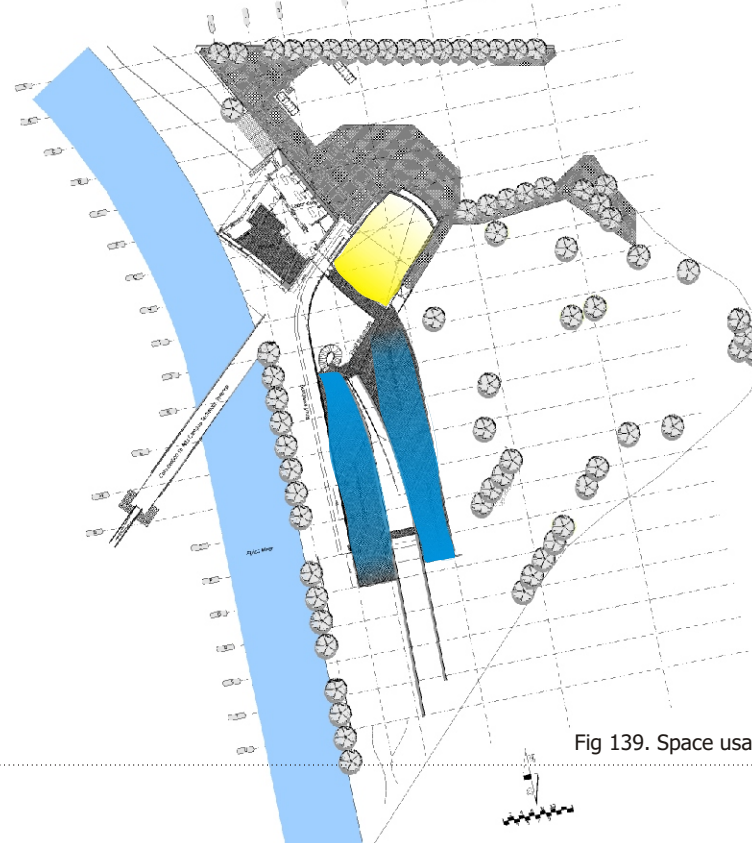


Fig 139. Space usage of the building

Adaptability and Flexibility

Most buildings can have a life-span of at least 50 years. It is likely that within this time the use of the building will change, or that the feasibility of this will be investigated. Buildings which can accommodate change easily support sustainability by reducing the requirements for change (energy, costs, etc) and the need for new buildings.

Vertical dimensions

The minimum structural dimension from the floor to the underside of roof, or to the slab of the floor above is **3m**. This will allow for many different options when changes to the building have to be made. See figure below.

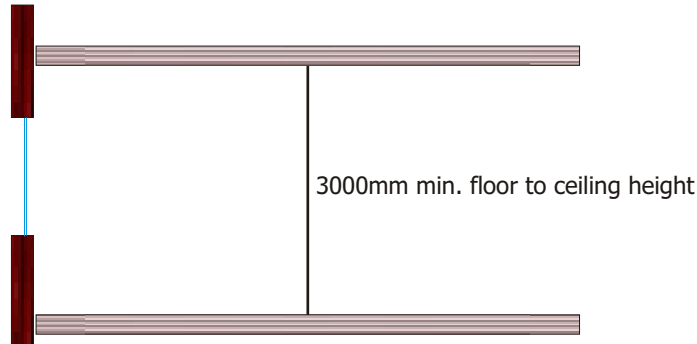


Fig 140. Floor to ceiling height

Many of the spaces can easily accommodate an optional mezzanine level if so required.

ECONOMIC

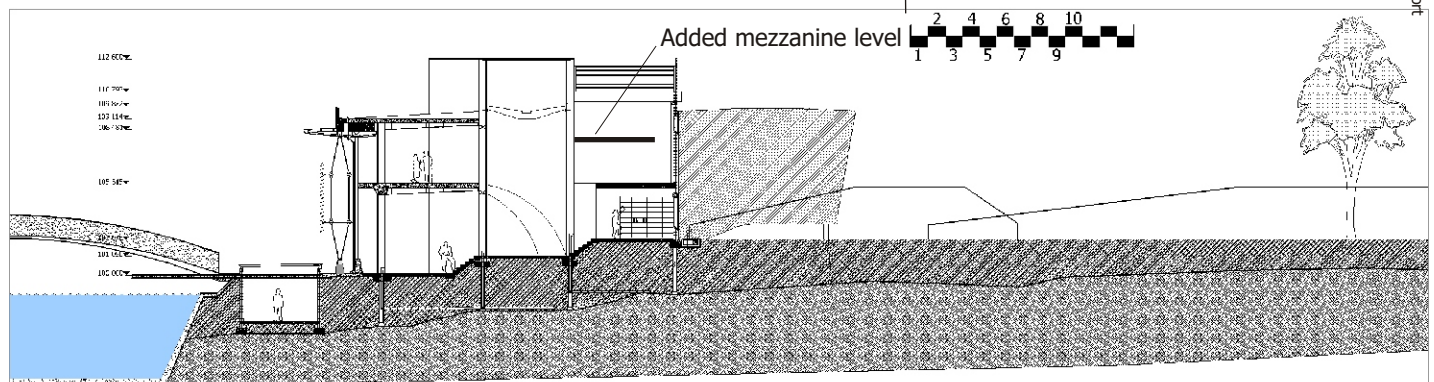
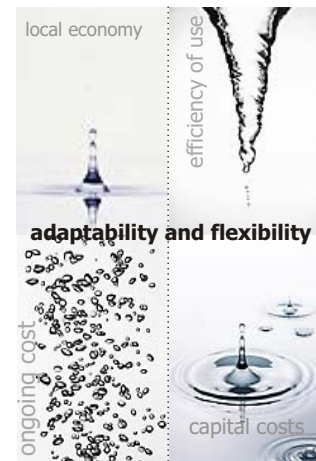


Fig 141. Adaptability of spaces

Adaptability and Flexibility

Internal partitions

Internal partitions between work spaces are non-load-bearing, especially in the office areas (i.e. non-load bearing brick / block or plasterboard partitions) and are easily demountable.

Services

Access to services is easy. Services include: electrical and communication. Provision is made to allow easy modification of systems.

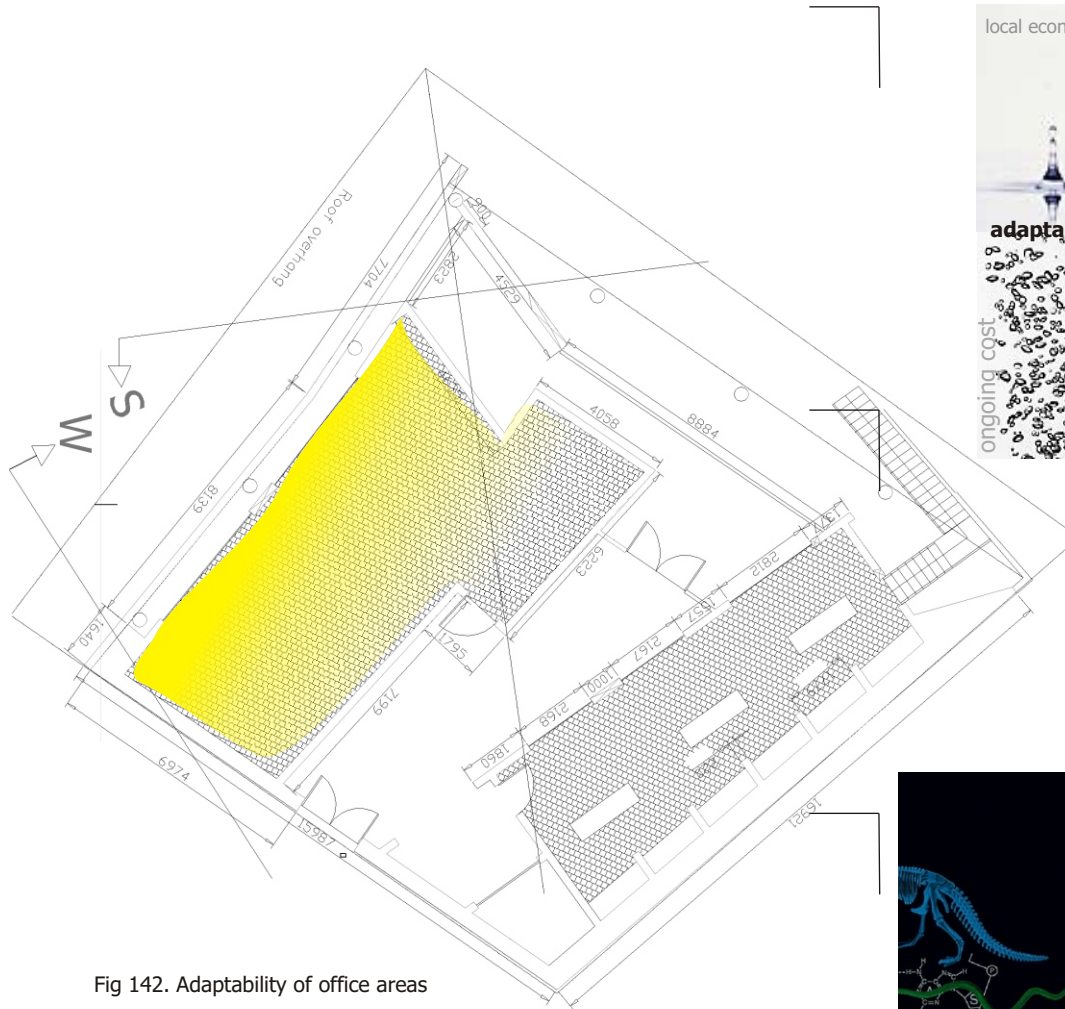


Fig 142. Adaptability of office areas

An open area is provided for the offices on the second floor. This area can be subdivided by the client as they wish and for the purpose they need.

ECONOMIC

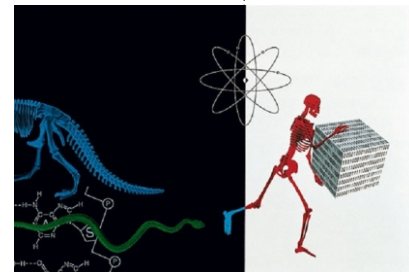
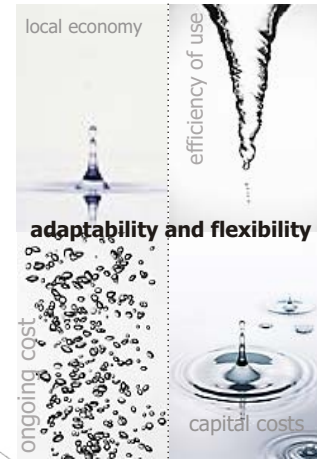


Fig 143. Adaptability

ONGOING COSTS

Maintenance

Concrete and brick are materials with low maintenance and low maintenance cost. The maintenance cycle is set to a period of 2 years. Maintenance can be carried out cost effectively.

Cleaning

Measures are taken to limit requirements for cleaning. Hard-wearing solid flooring (limiting carpets to offices and theatre) is specified. Windows are easily accessible for cleaning.

Type of building	Side Windows	Rooflights
Office	Every 3 months	Every 12 months
Shops:		
Outside	Every week	Every 6 months
Inside	Every 2 weeks	

Fig 144. Recommendations for frequency of washing of particular building types

With the building having to comply with a height restriction of 19 m, it is necessary to keep to simple, easy and cheap methods of cleaning windows.

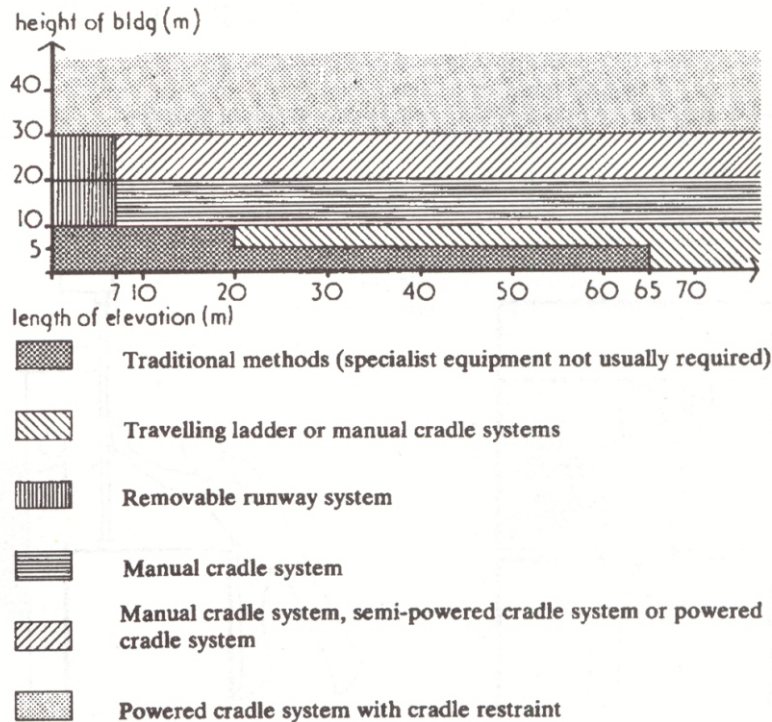


Fig 145. Chart for selecting system for external access

ECONOMIC

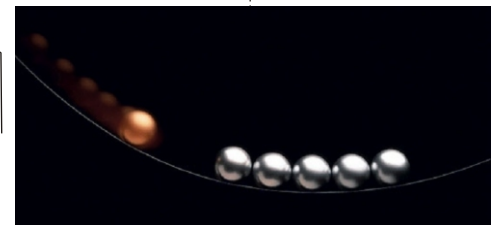


Fig 146. Ongoing costs

Security / care taking

Measures should be taken to limit the requirements. This would include neighbouring buildings, like the Nurses' Training College, overlooking the building and it's exterior spaces.

Insurance / water / energy / sewerage

Costs of insurance, water, energy and sewerage are monitored. Consumption and costs are regularly reported to management and users. It is more efficient to have the security guard go through the building, switching off the lights that have been left on, than to install an automatic system.

Disruption and 'downtime'

Electrical and communication services are located where they can be easily accessed with a minimum of disruption to the occupants of the building. Access is maximised to form circulation areas rather than work/living areas.

ECONOMIC



MAINTENANCE	Low maintenance cost due to materials selection – 5% of building cost
CLEANING	Salaries for 4-5 cleaners working full time @ R 1500 per month per worker. THUS R 72 000 per year
SECURITY/CARETAKING	Two 24 hour security guards, patrolling @ R 2500 per month each, THUS R 60 000 per year
SHARED COSTS	Transport system to be arranged by client for collecting workers and taking them home, depending on quote by transport company
COST MONITORING	The monitoring of building costs must be planned even before the design process starts. A FEASIBILITY STUDY should be done in order to determine the amount of money needed and to set the timetable of which amount would be needed at what stage of construction.

Fig 147. Controlling ongoing costs

Ongoing costs should be minimised to 18% of the building cost

Capital Costs

A building should be one of the most valuable assets to client and users. Money spent on buildings is not available for other uses such as health. This building is a huge investment in the education of the nation. Buildings that are cost-effective support sustainability by helping to provide access to services for low-income areas, and by enabling money to be spent on other areas that support sustainability.

Consultant fees

Consultant fees are not just calculated on a total project cost basis. Incentives are provided to consultants to reduce capital cost and ongoing costs.

Build-ability

The building is designed to be easily built. The building form is not too intricate. The replication of elements and components lower the costs.

Construction

A construction approach to design is used to reduce the initial capital cost of the building. The building processes are undertaken in a series of phases. The building is first built as a shell with finishes added later. The building can be split into 4 main phases. The main body of the building as phase one, and the theatre as phase two. The northern office block as phase three, and the Water Wise garden as phase four.

Shared costs

The cost of the building is shared with other users (such as those hiring the auditorium, laboratory and information centre).

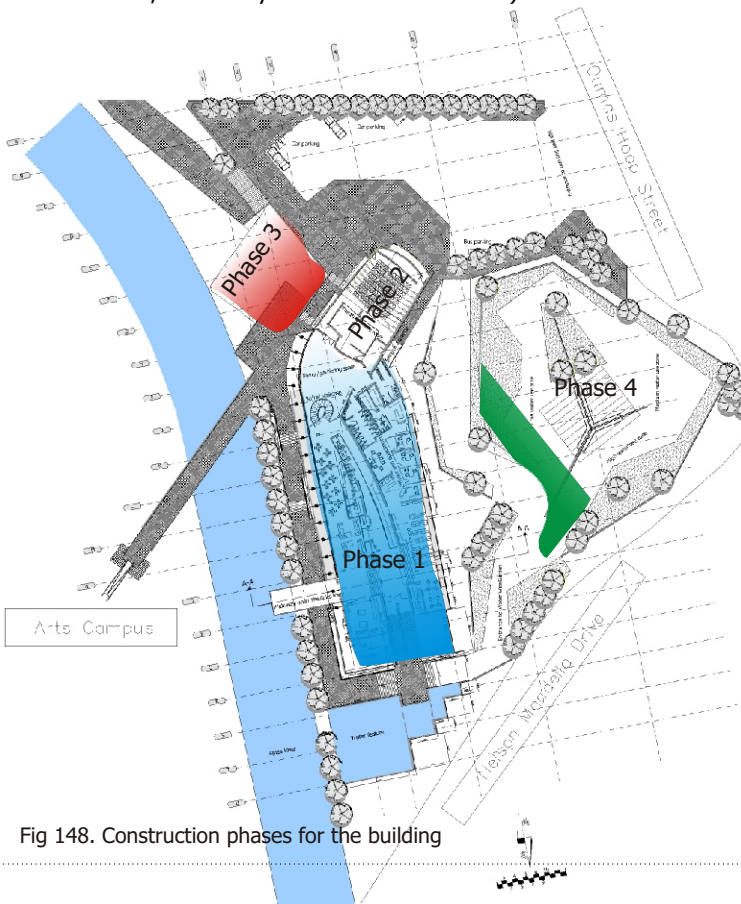


Fig 148. Construction phases for the building

ECONOMIC



Fig 149. Capital costs

SOCIAL ISSUES

Occupant Comfort

The quality of environments in and around buildings have been shown to have a direct impact on the health, happiness and productivity of people. Healthier, happier, more effective people contribute to sustainability by being more efficient, and therefore reduce resource consumption and waste. However the quality of this environment needs to be achieved with minimal cost to the environment.

Lighting

All work and living environments are provided with ample daylight. Daylighting is controlled and glare is minimised. There are no spaces that require constant electric lighting.

Daylight potential of the new development:

The site has no obstructions on its boundaries that will limit direct daylight falling on the building. Odd trees could be ignored. There is no obstruction that projects above the 25° horizontal roofline, thus a target vertical sky component of at least 27% is achieved.

- Window-wall face should be within 90° of north

Colour of light:

The appearance of any light source can be categorised as: warm, intermediate or cool. This fact links directly to the three phases of water: gas, liquid, and solid. The different phases of the building correspond to the following colours of light:

Phase of building	Apperance of light
Gas	Warm
Liquid	Intermediate
Solid	Cool

Fig 150. Appearance of light sources

Type of space	Lux
Parking	50
Walkways	100
Reception	100
Offices	300
Storage	200
Conference rooms	100

Fig 151. Standard maintained illuminance

SOCIAL



87°

Baseline Criteria & Technical Report

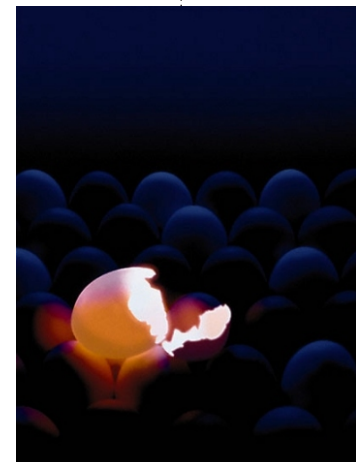
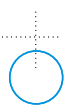


Fig 152. Occupant comfort



Ventilation

Ventilation is provided by natural means. **No mechanical** ventilation is used in the building other than in toilets and kitchens.

Air filtration:

Air filtration is the term used to describe the fortuitous leakage of air through a building, due to imperfections in the structure such as:

- cracks around doors, windows, infill panels
- service entries, pipes, ducts, flues, ventilators
- through porous construction, bricks, blocks, mortar joints

These conditions are **limited** early in the design stage and caution is applied, throughout the whole building process.

Natural ventilation:

Natural ventilation entails the **movement of outdoor air** into a space through intentionally provided openings, such as windows, doors and non-powered ventilators. This in addition to the ventilation due to air infiltration. In many cases, for much of the year, infiltration alone will provide sufficient outdoor air to ventilate the building. However, it is uncontrollable, and if excessive, it can incur a high-energy penalty and/or make the building difficult to heat (or cool) to comfort levels.

Ventilation in spaces is maximised by keeping to the following dimensions and ventilation patterns:

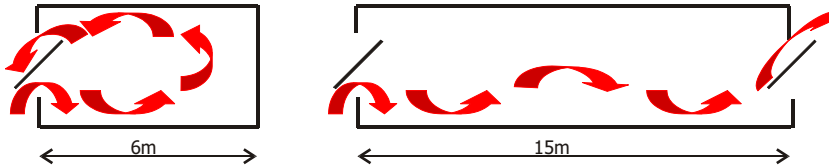


Fig 153. Single sided & cross ventilation

Noise

It is estimated that the new extension of Nelson Mandela Drive would be a source of high noise levels.

Since the building will be located on the western side of the site, the only portion of the building that would need to accommodate high noise levels would be its lowest end on the **southern side** of the site.

The formal working areas are located further from this noise risk and therefore no drastic measures need to be taken. The southern side of the building responds to this problem by incorporating **thicker walls** (which will be effective in terms of the **mass law**), and a **vegetation barrier** between the road and the building. This effectively reduce any levels above **55dB** to a level, fit for communicating normally.

Views

All living and work areas have access to a **view of the outside**. All users located in 6m or less from a window.

Access to green outside

Access is provided to green outside spaces

SOCIAL

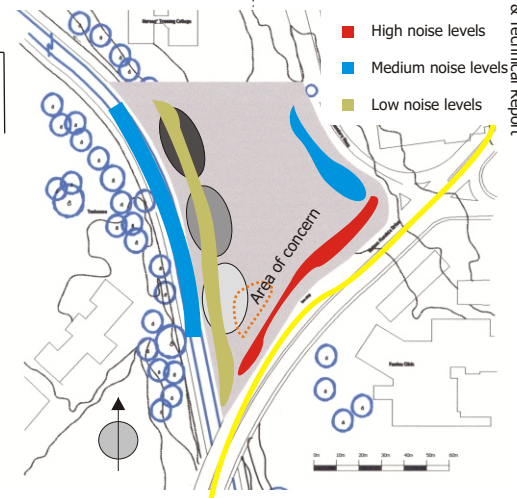


Fig 154. Noise levels on site

Inclusive Environments

This buildings is designed to accommodate disabled persons.

Public Transport

The building is located no further away than 400m from **disabled-accessible public transport**. The centre has a mini- bus that provides a service of collecting and dropping off, of disabled people at the nearest public transport node. Arrangements are made in advance by the person needing the service to avoid unnecessary trips.

Routes

All routes between and within buildings are of a **smooth and even** surface to be easily navigable by wheelchair.

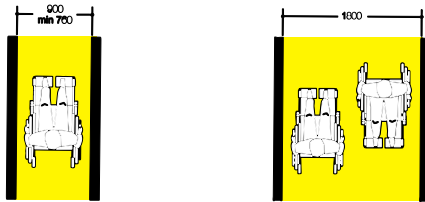


Fig 155. Comfortable widths of aisles for disabled users

Changes in level

All changes in level are catered for with appropriate **ramps of 1:12 fall**.

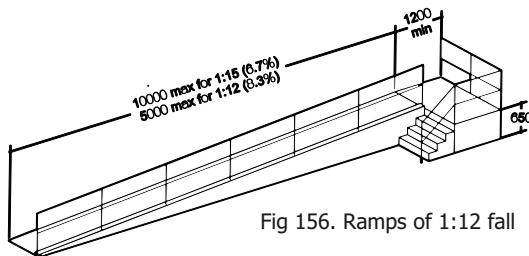


Fig 156. Ramps of 1:12 fall

Edges

All edges between walls, and floors and stair nosings are **clearly distinguished** through the use of contrasting colour, to aid the visually impaired.

Toilets

A **minimum of one** disabled toilet is provided in each of the men's and ladies' toilets.

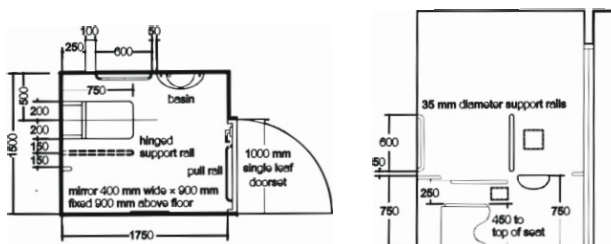


Fig 157. Layout of sanitary facility for disabled people

SOCIAL

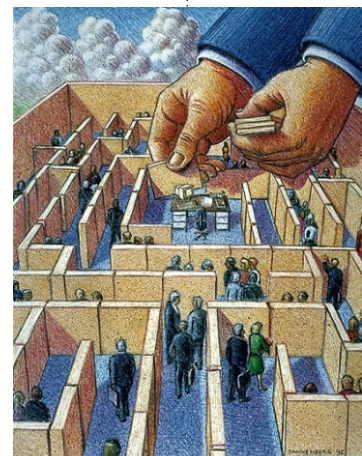


Fig 158. Inclusive environments

Access to Facilities

Conventional living and working patterns require regular access to a range of services. Ensuring that these services can be accessed easily and in environmentally friendly ways supports sustainability by increasing efficiency and reducing environmental impact.

Childcare

Childcare will not be provided in the building, due to the small number of permanent staff working in the building. There are adequate childcare facilities located **within 3km** of the site.

Banking

Banking services such as an ATM are located **within 3km** of the building.

Retail

Grocery, items required on a day to day basis are available **within 3km** from the building.

Communication

Postal, telephone or e-mail facilities are provided by the **information centre** within the building.

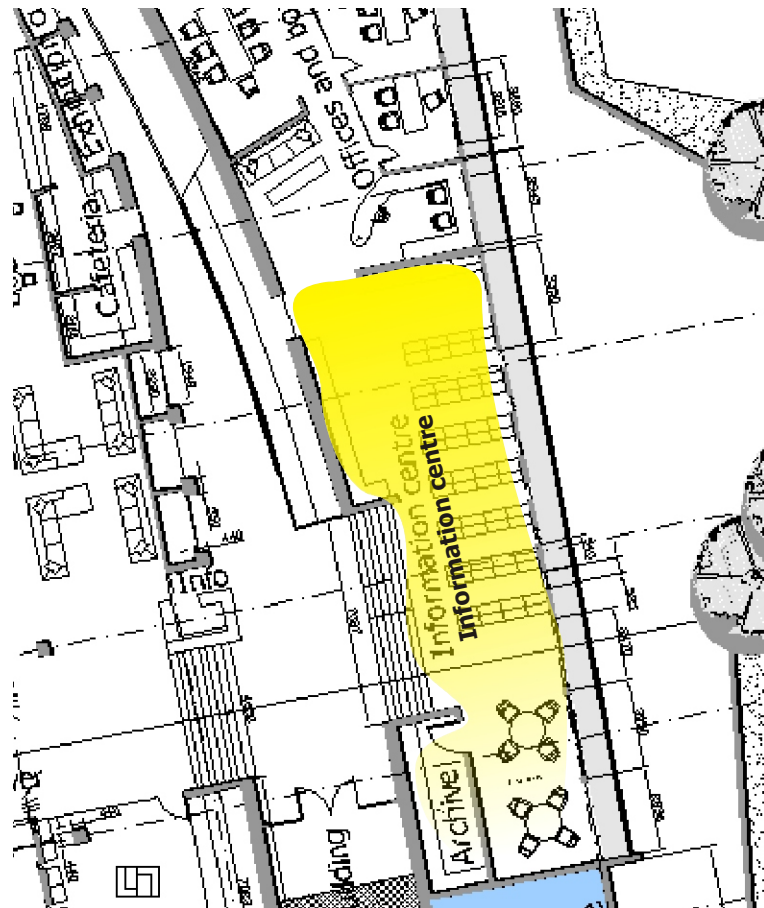


Fig 159. Information centre

SOCIAL



90°



Fig 160. Access to facilities

Participation & Control

Ensuring that users participate in decisions about their environment helps to ensure that they care for and manage it this properly. Control over aspects of their local environment enhances personal satisfaction and comfort. Both these aspects support sustainability by promoting proper management of buildings and increasing productivity.

Environmental control

The users of the building have reasonable **control** over their environmental conditions. This includes openable windows and adjustable blinds.

User adaptation

Furniture and fittings, tables, chairs, and internal partitions are designed or specified to allow for **arrangement/rearrangement** by the user. Provision is made for **personalisation** of spaces. This includes the provision of pin boards, a choice of colours, places for plants and personal storage.

Social spaces

There are spaces for easy informal / formal **social interaction** in the building. A tea room with comfortable seating and en suite kitchenette is provided for this function. The spaces that will be shared between occupants/users, such as the photocopying rooms, are large enough to allow for comfortable social interaction. The dining area and foyer on the ground floor are the main areas for social gathering.

Amenity

Easy access to the refreshment facilities such as the tea room, kitchenette or even vending machines and water closets is provided for all users of the building.

Community involvement

Spaces and services of this building should be shared and made available to the **local community** for its **use**. This includes access to the information centre, and thus to the computers, the teaching and learning spaces, the leisure facilities, as well as the auditorium for community theatre.

SOCIAL



Education, Health and Safety

Buildings need to cater for the wellbeing, development and safety of the people that use them. Awareness and environments that promote health can help reduce the incidence of diseases such as AIDS. Safe environments and first aid can help limit the incidence of accidents and their effect. Learning and access to information is increasingly seen as a requirement of a competitive work force. All of these factors contribute to sustainability by helping to ensure that people remain healthy and economically active, thus reducing the 'costs' (to society, the environment and the economy) of unemployment and ill health.

Education

Access to support learning is provided by the information centre. This takes the form of Internet access, structured courses, learning materials such as books, journals and newspapers.

Security

Measures are taken to ensure that all areas of the buildings and routes to and from the **building are safe**, and feel safe. This entails well-lit routes, routes and spaces overlooked by occupied areas, and clear visual links between spaces.

Health

A **first aid kit** is provided in a central location, and is effectively handled by one of the permanent staff that has undergone a first aid course.

Information is readily available on health, education, and career development issues. This takes the form of a well serviced notice board located in a central position.

Smoking

No smoking is allowed in public spaces. Spaces **allocated** for smoking are placed where other users will not be affected by it, thus away from the building's air intakes.

Safety

The building complies with all health and safety **requirements** set by the **NBR**. The user had a policy in place, and regular checks will be made to ensure that these are complied with.

SOCIAL



Fig 161. Education



Structure

Decisions related to the structure and sizes of elements in the building, were made in consultation with Mr. Pieter Strobos of PSBK consulting Engineers, Pretoria. Structural tables set up by Mr. Johan Smit, lecturer, University of Pretoria were also used for the necessary calculations.

The bulk structure of the building consists of reinforced concrete, if possible - recycled bricks, wood and steel. These materials are logical choices as construction materials in South Africa since skilled workers in all the different fields are readily available. Not only does the use of concrete have its advantages as far as thermal mass in concerned, but the plasticity of the material also allows moulding of intricate forms. Such forms and shapes are apparent in the two high curving walls forming the back-bone of the main structure.

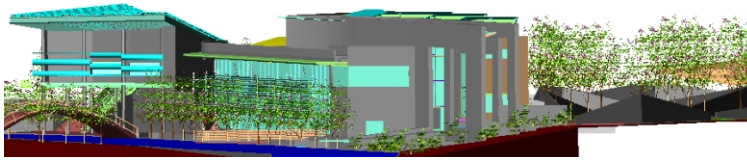


Fig 162. View showing prominent concrete construction

The following images show the concrete structure that forms the greater part of the buildings structure.

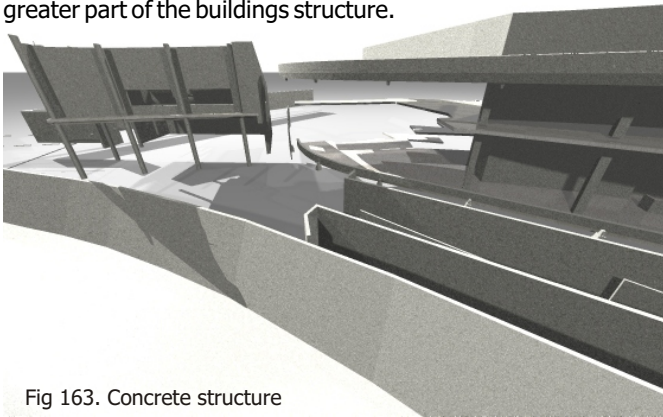


Fig 163. Concrete structure

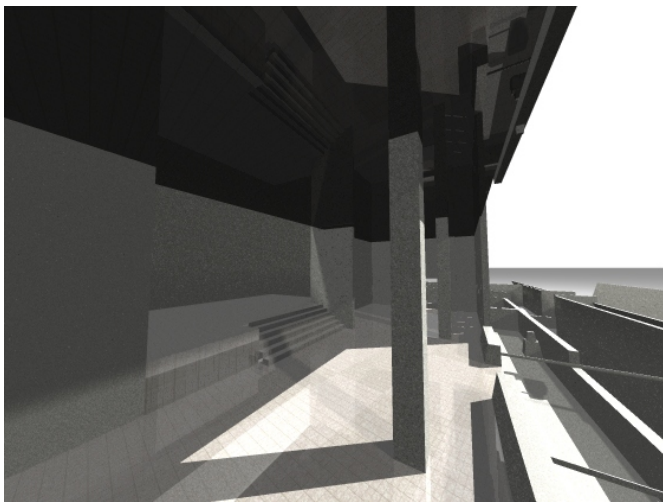


Fig 164. Concrete structure

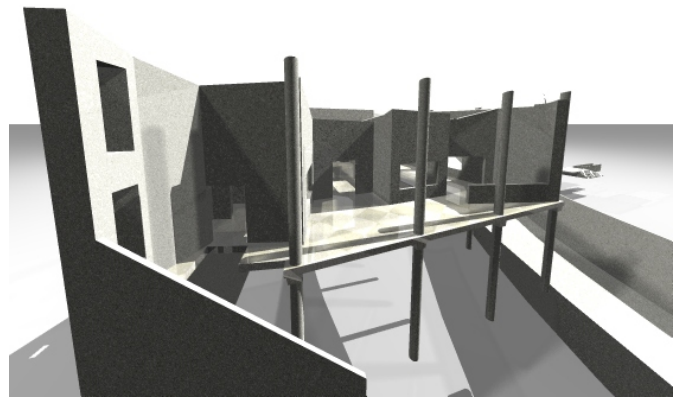


Fig 165. Concrete structure

STRUCTURE



Foundations

After discussions with Mr. Strobos the assumption was made that the soil conditions next to the Apies River might consist mainly of clay. Therefore a piling system should be used. The piling should be driven in to a depth where a stable substrate is found. A regular strip foundation could be used on top of the piling system. A size of 900x400 was adopted for the strip footings. A typical load for one story of height - 3.5m is roughly 10KN/m².

STRUCTURE

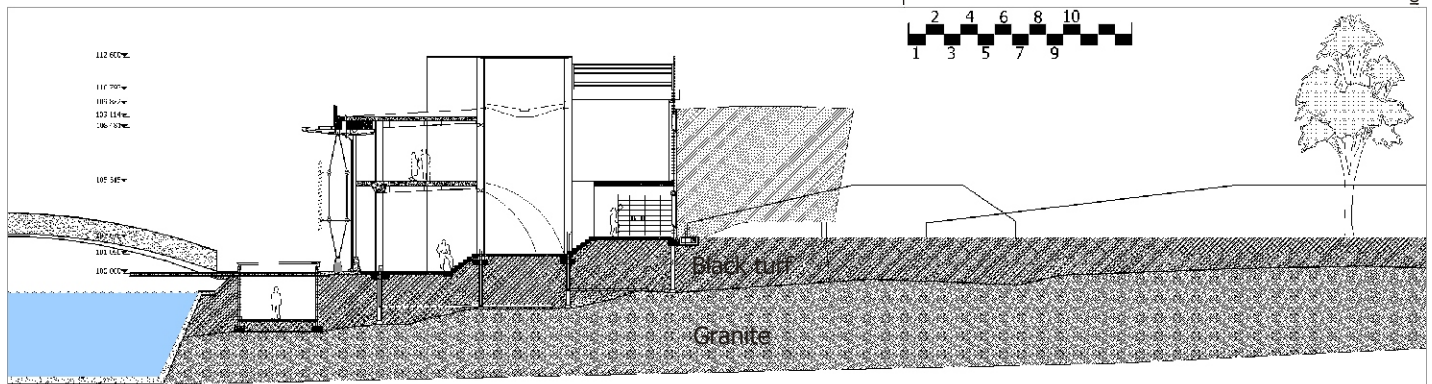
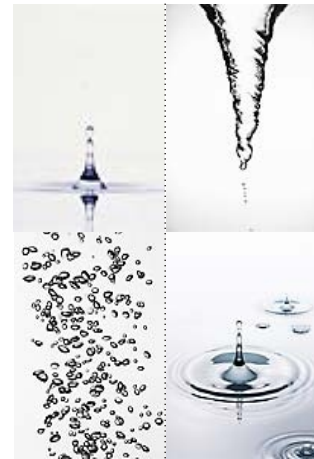


Fig 166. Piling for strip foundation

Floor slabs

On ground floor level the floor slabs are reinforced concrete slabs and span a maximum of 6 metres in one direction. The height of a story varies from 3 metres upwards. The roof slabs of the western wing are 5000x1200x250 precast concrete slabs, supported by 400x400 reinforced concrete columns on the one end, and built in, in a 440 reinforced concrete wall on the other.

The decision to use precast elements for the roof is both practical and economical.

All precast elements are to be fabricated and erected according to SABS 12 GE - 1984 standards. Ease and speed of construction is insured.

The roof slab of the theatre also consist of precast elements, as shown on drawing. It is topped with a structural concrete finish of 100mm.

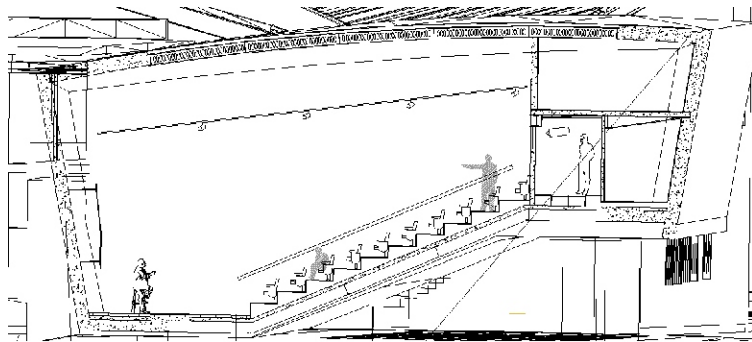
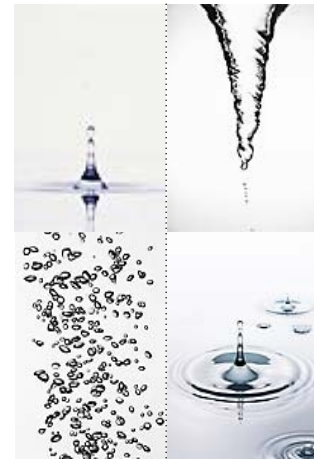


Fig 167. Structure of the theatre

STRUCTURE



95°

Atrium

The atrium is planned mainly as circulation space, an intermediate between the three main areas of each floor. Since the inhabitants of the building seldom spend long hours in this space one can afford to have less thermal mass in this part of the building, in contrast to other parts that require a greater level of thermal comfort. It was therefore decided to use a glass and steel skylight system for this space. The skylight / atrium also operates as a stack system, providing the highest point for heated air to escape the building. A profiled I-section beam bolted into the 440 reinforced concrete wall at both ends is used for the main structure of the skylight. 10mm safety glass panels are fastened to the flanges of the I-beams with structural silicone.

Fig 168. Structure of the skylight

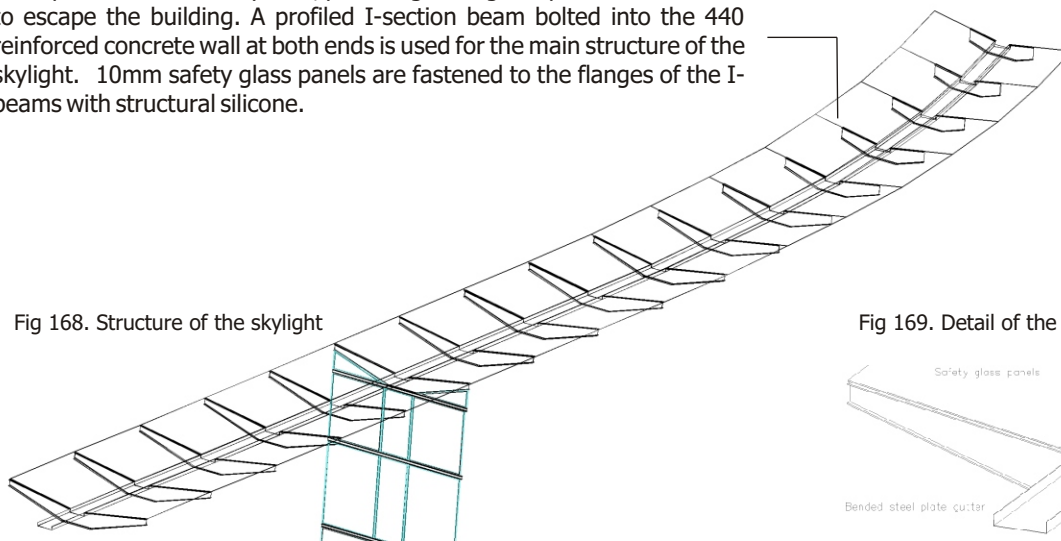
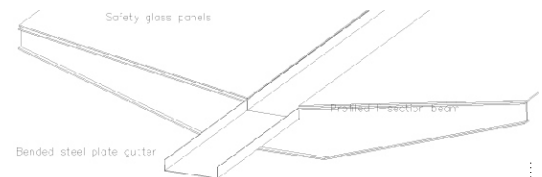


Fig 169. Detail of the skylight



Access and security

Access to the site

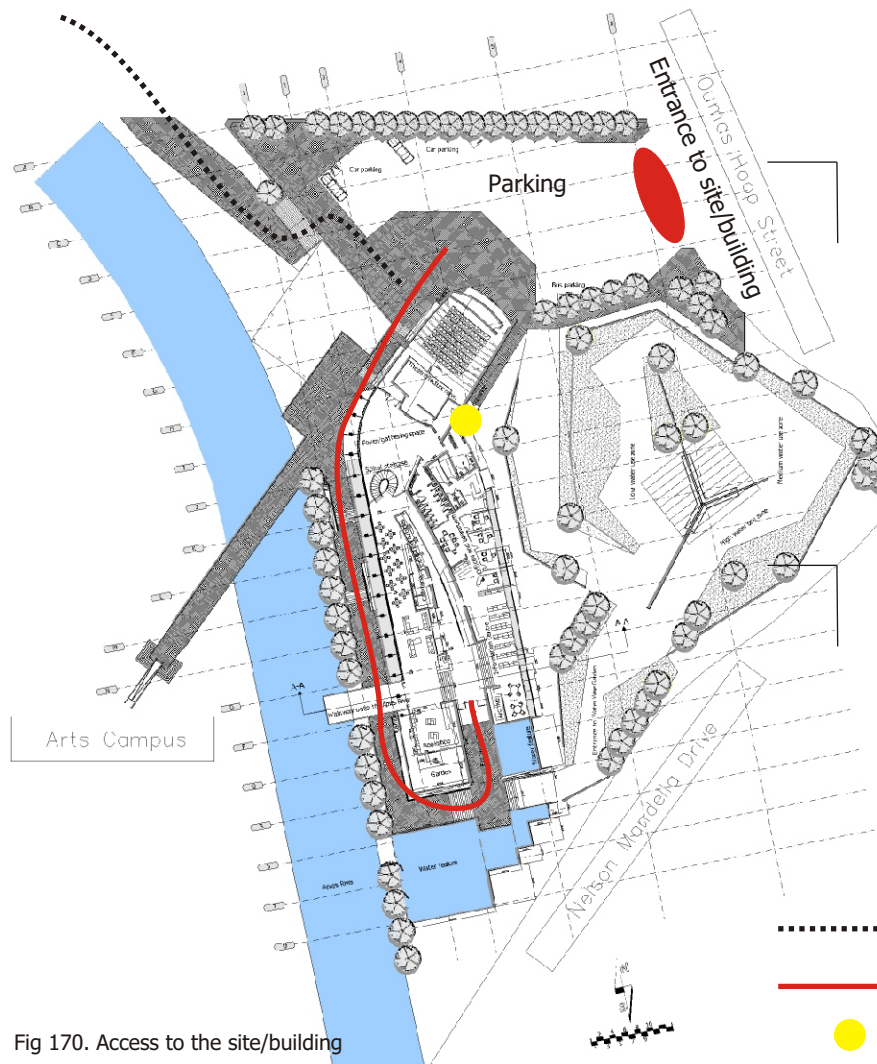
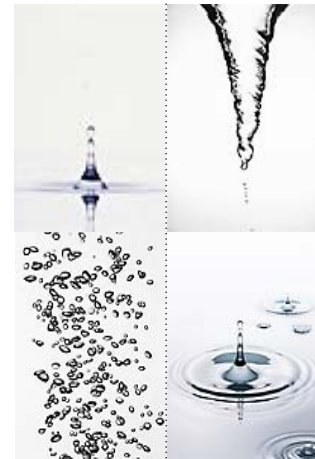
There is one permanent vehicular entrance to the site: the main entrance on Oumas Hoop Steet. Visitors use this entrance and park in the parking lot on the northern side of the building. Pedestrians enter the site via the route along the Apies River, linking the site with the public transport node. Visitors follow the route past the western facade of the building, all the way down to the entrance located on the southern end of the building.

The existing footpath running along the Apies River along the western boundary of the site is kept open to the public.

Access to offices

The offices in the main building are accessed through the same route, visitors take during the day, or they can access the building from the staff entrance on the eastern side of the building. The offices on the northern sector of the building can be accessed via the fire stair located on the northern end of the building or via the main route followed by visitors.

ACCESS AND SECURITY



- Pedestrian route from transport node
- Route to entrance of building
- Service entrance

Fig 170. Access to the site/building

Water

The objective is to provide water for the user for drinking, washing etc. At a comfortable pressure and flow rate. Acceptable flow rates are 1-2m/s inside a building to 3m/s externally. It is also assumed that water is provided to the site at a pressure of 250-600kPa.

The municipal water connection is on Oumas Hoop Street. A valve box with pressure control valve and a water meter with stopcock and in line filter is provided. This is accessible from street level. A valve box with pressure control valve is also provided for each wing.

Water is reticulated on site through a ring system. The system makes isolation possible when conducting maintenance or repairs.

Electricity

Main supply

A standard electrical service consisting of mains supply, reticulation and sub distribution is installed.

Reticulation

The following wire was are required:

- Sleeves cast into slabs or in access floor void
- 500x500 riser shafts
- Trenches with covers for external lighting

Sub distribution

Second stage wiring originates from distribution boards, typically 1800x800, at central points in the building. One located on the inside of the building, at the service entrance and one at the offices in the northern block. Services branching from here are small power systems, security systems, smoke detection units and lighting.

Emergency power

An automatic start diesel generator provides back up to normal electricity supply. The unit is situated underneath the northern office block. Ventilation and room for diesel storage tanks are provided.

Electricity generated by the photovoltaic cells can be used to back up small electrical systems such as external lights or even computer stations.

Load estimations

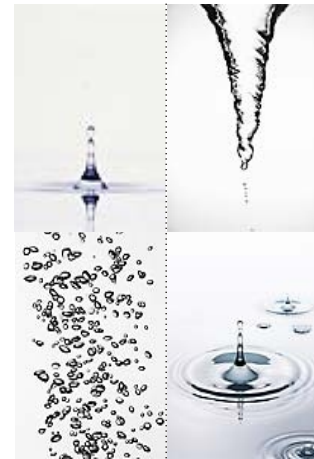
Main supply

Load, 500 VA (0-3000m²)- Low voltage (400Volts)

Lighting	20 VA/m ²
Normal power	10 VA/m ²
IT Equipment	30 VA/m ²
Auxiliary	5 VA/m ²

Total	65 VA/m²
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SERVICES



Internal finishes

Walls

The following images give an idea of the durability, quality and texture of the internal finishes applied.



Fig 171. Internal finishes

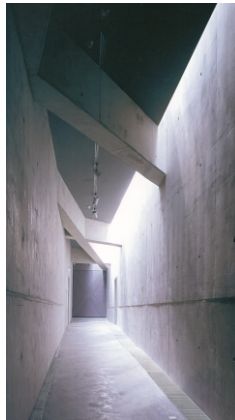


Fig 172. Internal finishes

Floors

Floors are covered with a pigmented epoxy finish on top of the concrete screed. Therefore, no tiling of the floors needed. In the laboratory the screed is power floated to give an extra smooth floor finish. In the offices an additional carpet can be used to soften and personalise the space.

Lighting

Offices are provided with fluorescent uplighters. Fluorescent lamps produce less heat than tungsten lamps and use up to five times less electricity. By making use of reflective luminaires the harsh light quality normally associated with fluorescent tubes is softened. Desks are also provided with standards for individual task lighting.

INTERNAL FINISHES

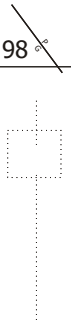


Fig 173. Fluorescent uplighter

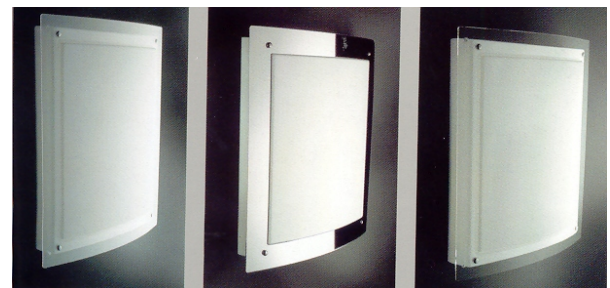


Fig 174. Fluorescent uplighter - different types



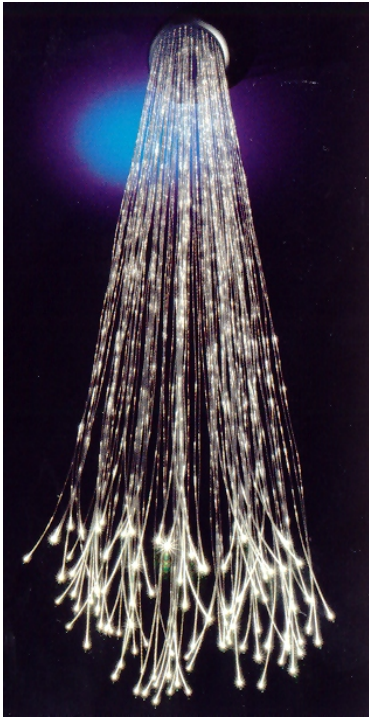


Fig 175. Lighting for foyer



Fig 176. Corridors lighting on floor level

INTERNAL FINISHES

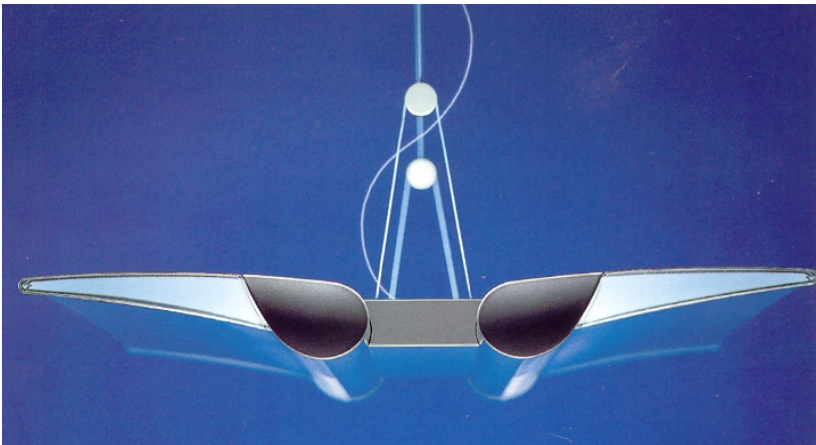
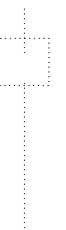
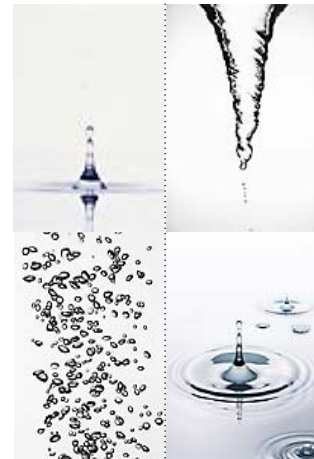


Fig 177. Boardrooms and reception desks are fitted with low energy use fluorescent lamps. The exhibition areas are fitted with lows voltage halogenlamps.



Fig 178. Individual task lighting



Fig 179. Individual task lighting



Ceilings

Patent suspended ceilings are fitted in the offices and conference venue as well as the exhibition spaces. These consist of a typical grid system of hangers fixed to the underside of the concrete slabs. The ceiling panels are 600dx600 perforated metal panels fitted with acoustic panel absorbers. They have a sound absorption coefficient of 0.7 and class O fire rating. The ceiling void of 475mm is adequate for electrical service pipes.

External finishes

Most of the external walls are left with an off shutter concrete finish. The recycled bricks of the eastern wing are left exposed en thus a rough irregular pattern of colour will immerge. The western facade will consist mainly of steel and glass. Some of the walls in the Water Wise Garden are gabions.

EXTERNAL FINISHES



100°

Baseline Criteria & Technical Report



Fig 180. Off-shutter concrete finish



Fig 181. Gabions / Stone walls



Fig 182. Off-shutter concrete finish



Rational fire design

General aspects

Generally speaking the building can be regarded as a double story building. As far as fire design is concerned there are considerable differences between two and three story buildings. Above three storeys one is for example limited to materials with specific fire ratings. Multi-storey open volumes inside a building such as atriums can also affect fire design.

Cement flooring is used throughout. These have a better fire rating than plastic coated floors. Metal ceiling panels also have a better rating as opposed to panels made from synthetic materials.

Fire hose reels and sprinkler systems

In general, sprinkler systems are not required for a two-storey building. Sprinkler systems have proven to fail under fire conditions. Firstly smoke tends to accumulate at floor level where sprinklers are activated. Secondly structural elements such as steel beams that fail under high temperature cut off ceiling mounted fire water pies and consequently jeopardise the system. A possible solution is to keep fire water pipes at floor level and to supply vertical pipes to the ceiling at regular intervals. This ideal may however influence space planning to a great extent and it is hence not always possible to implement a system in this manner.

Fire hose reels and extinguishers are marked clearly with appropriate signage. Fire hose reels are provided at 30m intervals.

Fire escape routes

Escape routes are in accordance with part T of the National Building Regulations. This means that no escape route may exceed a length of 15m in one direction.

Emergency routes

Once entering an emergency route there are two escape options. The total length of an escape route plus the emergency route up to a safe point outside the building does not exceed 45m.

RATIONAL FIRE DESIGN



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Fig 183. Fire escapes

