Baseline Criteria & Technical Report

Baseline Criteria & Technical Report

BASELINE CRITERIA:

Non-renewable resources are being depleted and there is increasing environmental damage as a result of human activities. It is therefore increasingly important that this is addressed, and sustainability becomes a key issue in the way society live and work. Buildings can play an important role in supporting sustainability. This is done through careful planning in which design decisions, material specifications and so on are carefully evaluated in terms of their long term impact on the economic, social and environmental sustainability of a society and the natural environment.

The Sustainable Building Assessment Tool (SBAT) has been designed to help evaluate the sustainability of buildings. This is done by assessing the performance of a building in relation to a number of economic, social and environmental criteria. The tool is particularly appropriate for use in developing countries, and therefore includes aspects such as the impact a building on the local economy, as economic issues are often a priority.

The tool can be used in the design stages of a new building, or for the refurbishment of an existing building. It is designed to encourage the development of more sustainable buildings by enabling different options to be rapidly evaluated and compared. The tool also enables buildings to be rated in terms of their sustainability, and to be compared to each other in order to set up baseline criteria with which the end product should comply.

The following graph shows the different criteria that need to be addressed to achieve a sustainable design:

(Gibbert, 2002)

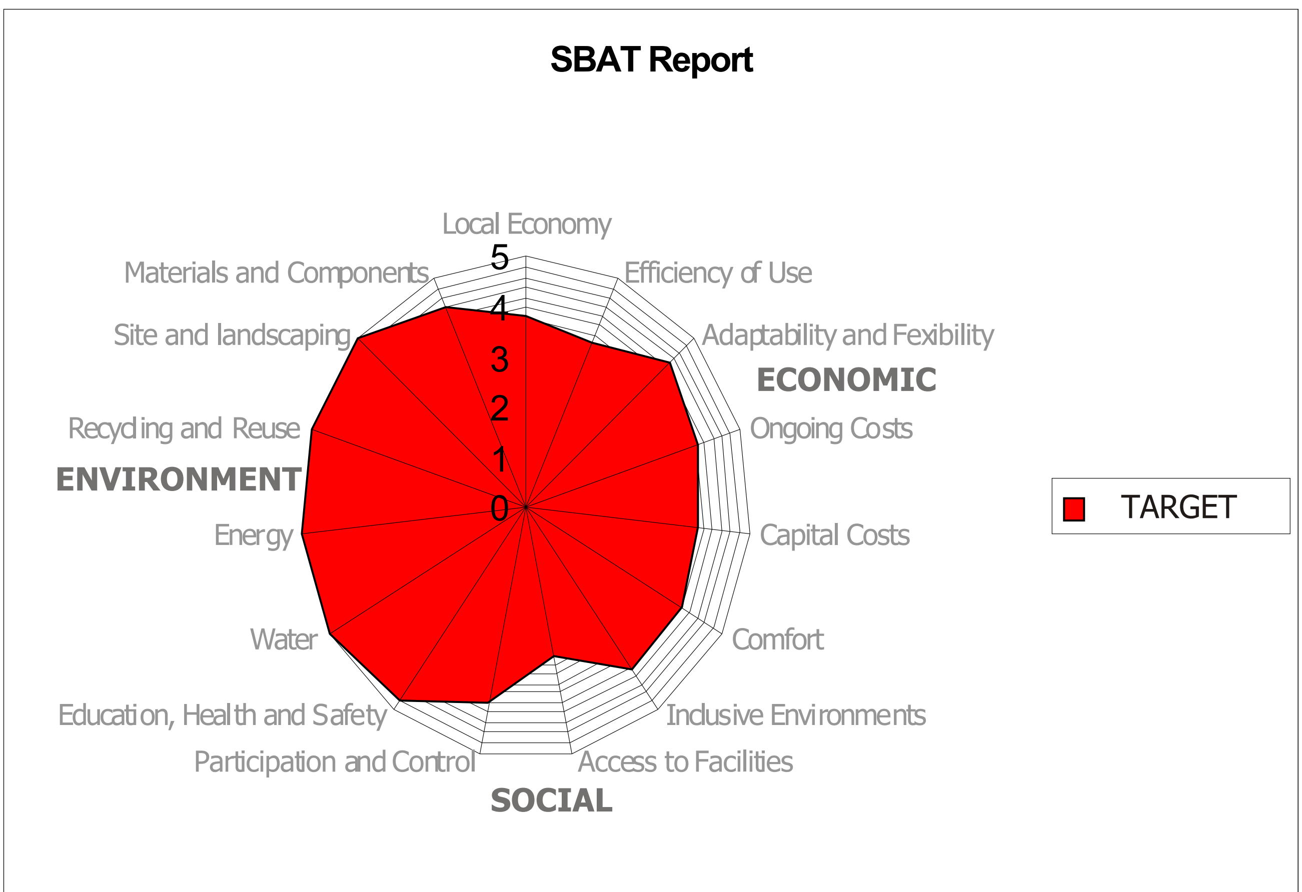


Fig 101 Sustainanable Building Assessment Tool

ENVIRONMENTAL ISSUES:

Water:

Water is required for many activities. However, the large-scale of the conventional water supply has many environmental implications. Water needs to be stored (sometimes taking up large areas of valuable land and disturbing natural drainage patterns with associated problems due to erosion etc). It also needs to be pumped (using energy) through a large network of pipes (that need to be maintained and repaired). Having delivered the water, a parallel effort is then required to dispose of it after it is used, i.e. Through sewerage systems. Reducing water consumption supports sustainability by reducing the environmental impact required to deliver water, and dispose of it after use in a conventional system.

- Rainwater

Water harvesting:

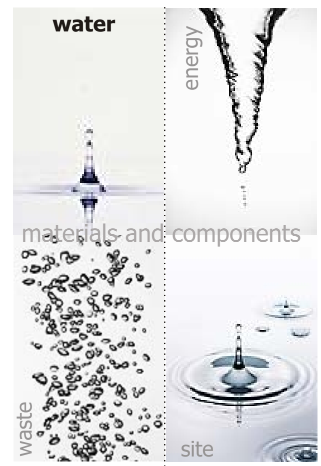
The population of the proposed building will vary through the day. The maximum population has been calculated to be **+- 400 people**. Part of the roof structure of the building is used to collect water for purifying and usage in the building. A baseline of 200 occupants, thus **50%** of the total population, should be used to calculate the capacity of the water catchment system.

Population:
200 people

Water use per person:
+- 20l per person per day, thus 4000l per day.
For a month a quantity of 1**20 000l** of water will be needed.

A storage tank of adequate size, is used to store water after it is purified by the cistern system described below:

ENVIRONMENT



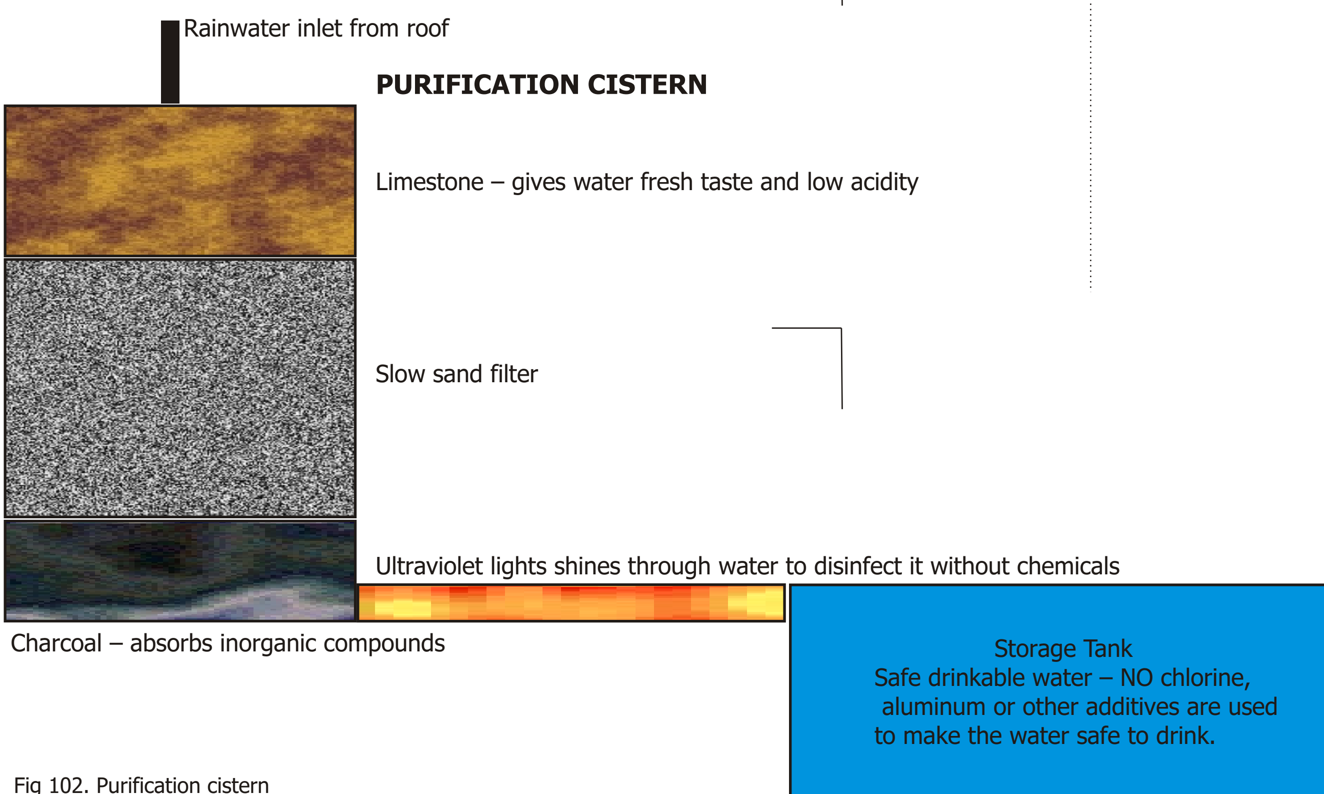


Fig 102. Purification cistern

Rainwater

The average rainfall f or 8 sites next to the Apies River is 204l per month on a site of average size, 3650m2 (according to the precipitation table below).
Thus it is assumed that a site with size 8894.3m2 will receive an average of 497l of rainwater per month.

From this it is clear that the demand on water, generated by this building, would not be met only by the collection of rainwater. The rainwater that is being harvested by this building will merely reduce the bulk amount that it will receive from the municipal connection.

The roof structure of the office and laboratory building will harvest water for conducting experiments in the laboratory as seen in Fig. below.

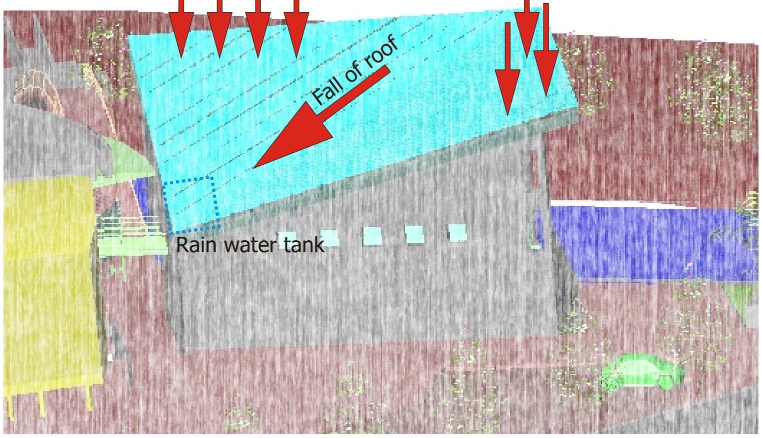


Fig 103. Rainwater harvesting on northern roof

Water harvesting:

The roof with an area of 393m2, will harvest an average of 22l of water per month.

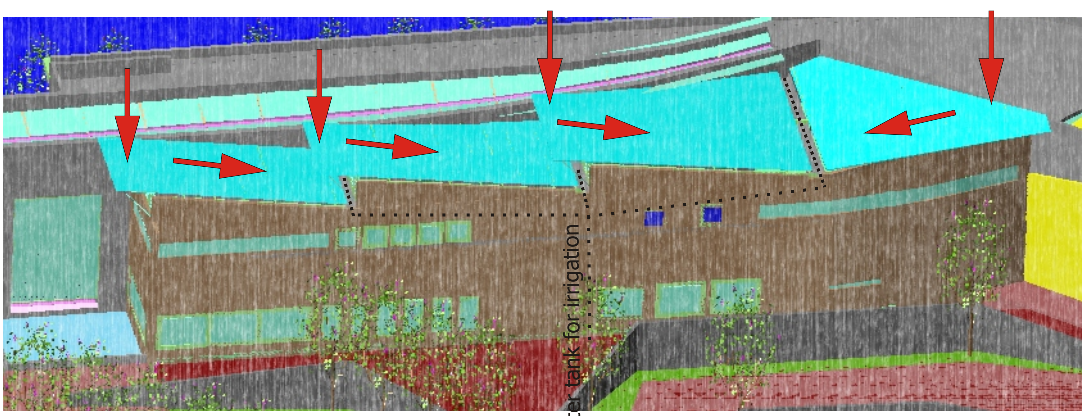


Fig 104. Rainwater harvesting on eastern roofFig 104. Rainwater harvesting on eastern roof

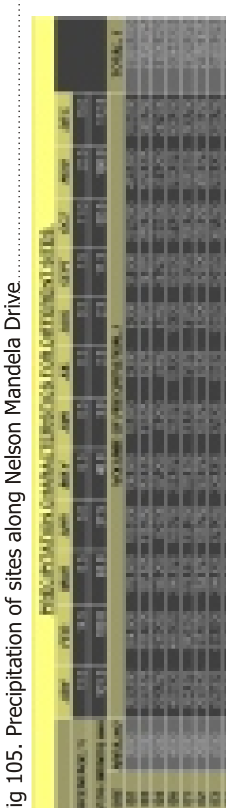


Fig 105. Precipitation of sites along Nelson Mandela Drive.

Water harvesting:

The eastern roof area are used to harvest water for irrigation. The water from the 3 gutters are collected and stored in a tank for the sole purpose of irrigation.

Grey Water Recycling

In addition to the reduction of the water demand, the collection, storage, treatment and redistribution of grey effluent is used for sanitary applications. Any excess water could be added to the irrigation or laboratory tank and visa versa.

Benefits:

- water consumption is reduced
- sewerage charges are reduced

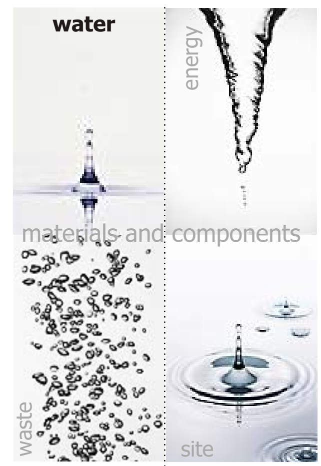
As water can be recycled multiple times for various purposes, the water demand can be reduced drastically.

Recycling System:

- collection of waste water:
  all grey water are channelled into a central storage tank.
- treatment:
  before the water enters the storage tank it is filtered through a very simple and basic sand filter system.
- storage:
  it is stored in a large tank where it is ready to be redistributed.
- redistribution:
  grey water is only redistributed for use in sanitary systems.

All grey water produced by the building is harvested and recycled for reuse.

ENVIRONMENT



Very important:
This is not a building focussing on the availability of water technology in the built environment and the demonstration thereoff.
This building demonstrates exactly the opposite - that we don't have enough water to let them run over gabion wall structures to evaporate in the quest of cooling down our buildings.

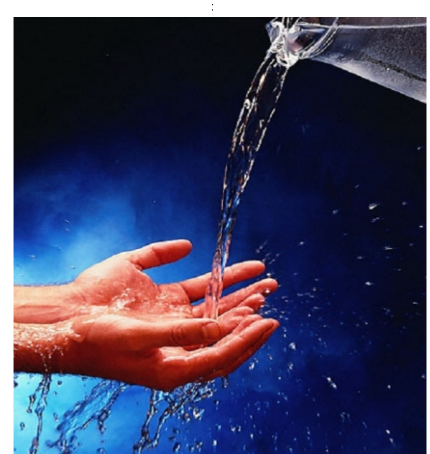


Fig 106. Purified water

Water use:

Only **water-efficient devices** are used throughout the building, especially where sanitary devices are concerned.

- Ultra-low-flush toilets (low-flush toilets are designed to use six litres of water per flush, significantly less than conventional toilets)
- Urinals that are manually flushed when required
- Taps that automatically stop after a few seconds
- A **40 %** reduction in water use can be achieved
- **Long term water conservation** strategies are employed

ENVIRONMENT


Fig 107. Ultra-low-flush toilet


Fig 108. Water-efficient urinal

Run-off

Run-off is reduced by the use of pervious or absorbent surfaces around the building. Remaining spaces are landscaped to fit the principles of a Water Wise garden. Hard landscaping is minimised, and pervious surfaces are used for car parking and paths.

Grass paving systems are used as an alternative to asphalt. They are strong enough to support heavy vehicle loads and yet are water permeable.

Benefits:

- they reduce surface temperatures around buildings
- they permit surface water filtration/drainage
- they eliminate the need for a catch basis system

Grass paving installations are used in any situation where low to medium use parking surfaces are required. The open cell system is used to support the load of heavy vehicles. Grass paving is appropriate for both drive aisle and parking stall applications.

The grass paving is designed to suit the soil conditions and loading requirements while allowing for drainage. Wood blocking is not used, to prevent a dam effect in heavy rain.

Parking stalls are marked with buttons that clip into the support structure. Concrete curbs are installed with lines to contain and designate stalls.

The installation takes 2-3 months to develop a root system from seed, so construction installation must be timed for the opening of the building. The installation can be ready for immediate use if turf is installed.

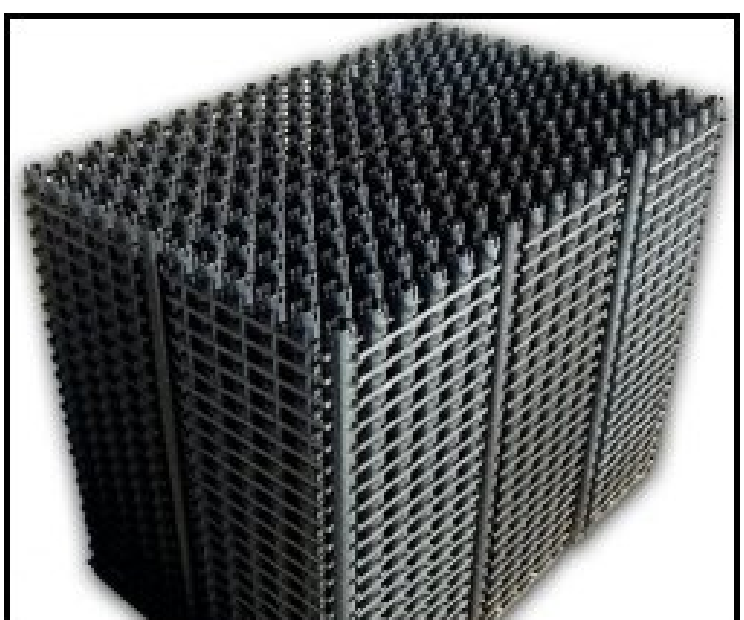
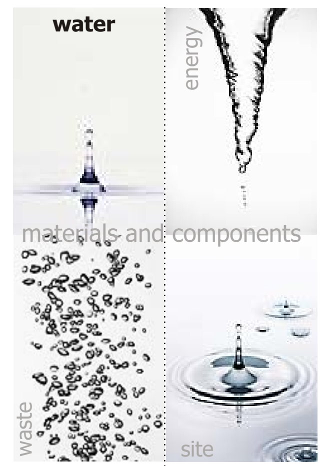


Fig 109. Grass paving system

ENVIRONMENT



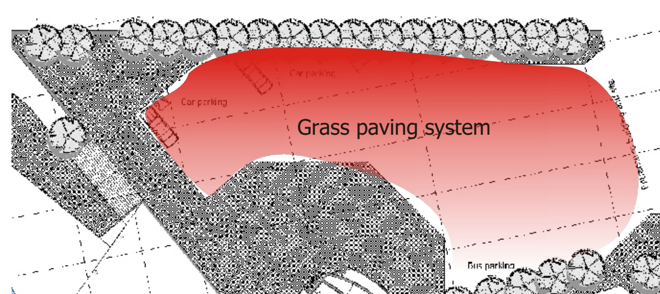


Fig 110. Grass paving system used at parking lot

Planting

Planting is incorporated into Water Wise gardens to serve as examples to demonstrate Water Wise principles. Plants with low water requirements, such as indigenous species, are used. The gardens are planned to be water efficient.

Fig 111. Example of a Water Wise garden

ENVIRONMENT

Principles of Water Wise Gardening

Design:
A Water Wise design maximises the use of water in the landscape. It takes into consideration microclimates, functional utilization, and aesthetics.

Mulching:
Nature's blanket slows down wasteful evaporations of water.

Watering:
Water should always be applied efficiently. Grey and lag water from the bathrooms should be reused. Rainwater should be collected and channelled into the garden..

Appropriate lawn:
The "hardiest" variety of lawn suited to the particular circumstances should be chosen. Narrow strips of lawn should be replaced with mulch, paving or ground covers.

Plant selection:
Attractive plants that cope with the local climate can form a sustainable bulk structure in the garden. Plant water thirsty varieties in focal points to create interesting areas in the garden.

Zoning:
The overall water consumption of the garden can be reduced by grouping plants with similar water requirements together.

Soil improvement:
Healthy soil is fertile with plant nutrients; it holds enough water and air for the plant, and does not compact easily.

Watering efficiently

Maximise rainwater:
Water can be directed to a settling pond, depressed lawn areas or a wetland by using stone-packed or grassed water channels. The stones help to slow and desilt the flow of the rainwater. These channels can be used to create a "dry riverbed". Trees planted in hollows will often flourish with no extra water.

Re-use water:
Excess grey water that is not recycled for sanitary use can be used for watering the garden.

Watering:
A well-designed irrigation system must be installed. The bigger the droplets from the sprinkles the less likely that the water will evaporate or get blown away by the wind. (High pressure causes fine droplets). Irrigation should be switched off during rainy weather or when soil is moist. Watering should be done in the early morning, or early evening, not in the heat of the day. Sprinkler water is wasted when it falls onto paving and not on the plants. Large, wide sprinklers for individual plants should be avoided. A direct hose or watering can should preferable be used.

Zoning

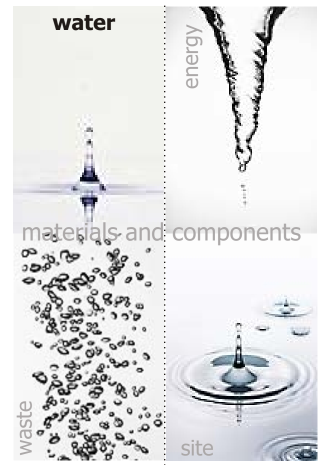
The overall water consumption of the garden can be reduced by grouping plants with similar water requirements together.

High water use zone:
Focal areas are where the garden is most apprecieted, for example at the gate, doorways and areas for relaxation, where garden furniture is situated). Focal areas can be high water use zones. This can be achieved by adding extra detail using colour and exciting features.
The way to make thirsty plants (like annuals) more Water Wise is to position them in the shade and in containers, if possible.

Medium water use zone:
Most plants in the garden can receive rationed water to keep them well maintained. A large variety of perennials can be used to create colour.

Low water use zone:
Areas should be created that will survive mostly on rainwater. These zones only receive occasional watering. Hardy ground covers under shrubs can be added to fill up large bare spaces.

ENVIRONMENT



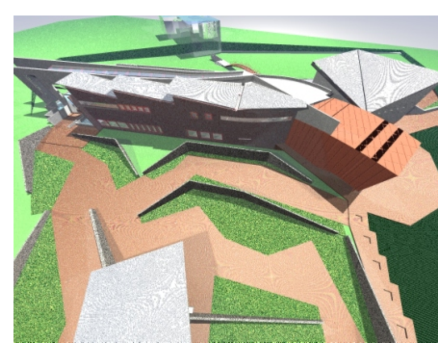


Fig 112. Water Wise garden at the Centre

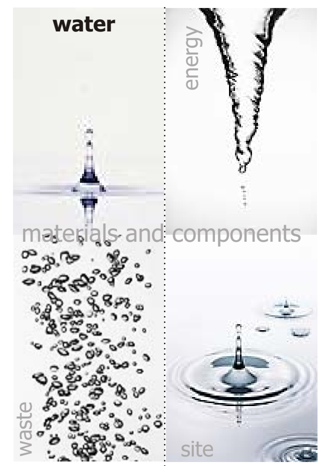
Watering efficiently

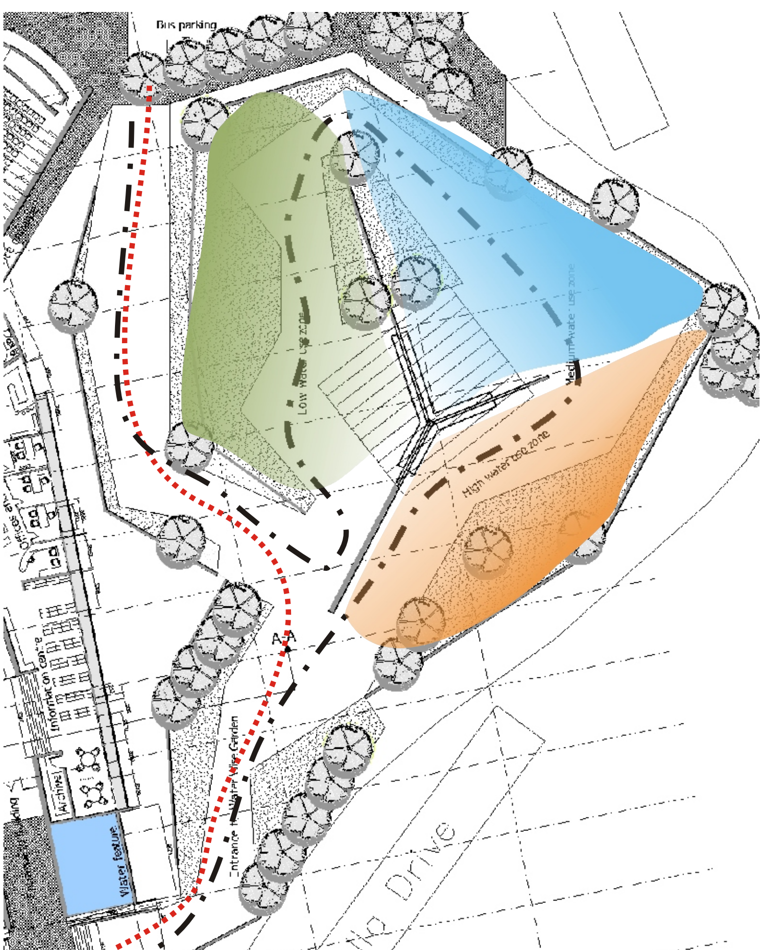
The layout of the Water Wise Garden is done in accordance to the prescriptions given in the previous pages. Suggestions by Rand Water were also taken in consideration.

It was split into three zones - high water use zone, medium water use zone and low water use zone.
The garden is used as a very important part of the learning process, while visiting the building.
A shaded are is provided by a simple roof structure and each 'sector' is provided with enough seating for a group of 25 people.
There are water drinking point at regular intervals during the walk through the garden.

The garden also forms part of the final stage of the circulation route as one exits the building and walk back to ones car/transport.

ENVIRONMENT





Low water use zone

Medium water use zone

High water use zone

End of circulation route

Circular route through garden

Fig 113. Water Wise Garden

ENERGY:

Buildings consume about 50% of all energy consumed by man. Conventional energy production is responsible for making a large contribution to environmental damage and non-renewable resource depletion. Using less energy or using renewable energy in buildings therefore, can make a substantial contribution to sustainability.

Location:
The building/site is located **within 500m** of a large **public transport** node. See figure below.

Fig 114. Public transport node

ENVIRONMENT

Fig 115. Panoramic view of the taxi rank

Natural Ventilation System:
Outdoor air flow should be used in buildings to provide ventilation and space cooling. Windows that can be opened and closed as desired by the occupants to provide better control of office space conditions.

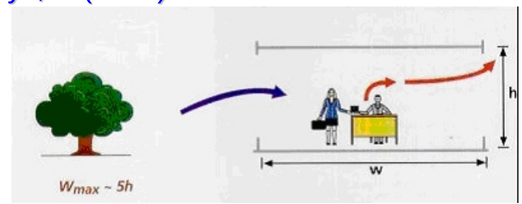


Fig 116. Natural ventilation

Benefits:

- gives occupant control over some work space conditions
- improves occupant satisfaction with the work space
- provides free cooling with use of fans
- operates as a back-up ventilation system
- connects to the outdoors
- provides ventilation (outdoor air) to ensure safe, healthy and comfortable conditions for building occupants without the use of fans
- provides free cooling without the use of mechanical systems
- reduces building construction costs and operation costs
- reduces energy consumption for air conditioning and circulating fans
- eliminates fan noise

At least 20% of the facade windows should be openable.

Further discussions will follow under the occupant comfort section of this document.

ENVIRONMENT

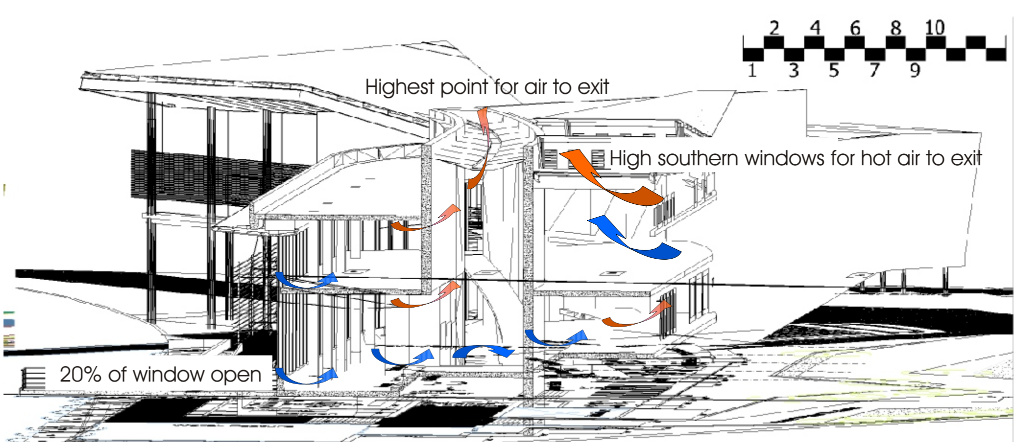


Fig 117. Natural ventilation through building


Fig 118. Occupant comfort

Heating and cooling systems:

Passive solar heating:

The building will make use of solar energy to meet it's heating demands.

Criteria:

- windows should have a U-value of 2 W/m²K
- west windows which receives the most heat should be shaded
- morning light from southern windows should be maximised
- window to wall ratio should be: 0.4 to prevent OVERHEATING

Displacement heating:

AN AIR DISTRIBUTION SYSTEM IS USED. IN THIS SYSTEM, INCOMING AIR ORIGINATES AT FLOOR LEVEL AND RISES TO EXHAUST OUTLETS AT THE CEILING.

BENEFITS:

- removes internal heat gains and entrain pollutants

HEAT EXCHANGE PIPES ARE BURIED IN THE GROUND THAT HEAT OR COOL VENTILATION AIR.

The earth, at a depth of 3,5 m, retains at a fairly constant temperature year-round,+-15 degrees Celsius. Thus during summer the ground temperature will be lower than room temperature and during winter the ground temperature will be higher than room temperature. Passing incoming air through the buried pipes, heats or cools the air to close to ground temperature. The ventilation air is distributed throughout the building using the displacement duct system.

A 120mm PVC pipe system is installed underneath the floor slabs.

This system will guarantee a systemic flow of fresh air through the building and will keep the process running throughout the day. This will be done by a simple and energy efficient mechanical fan.

ENVIRONMENT

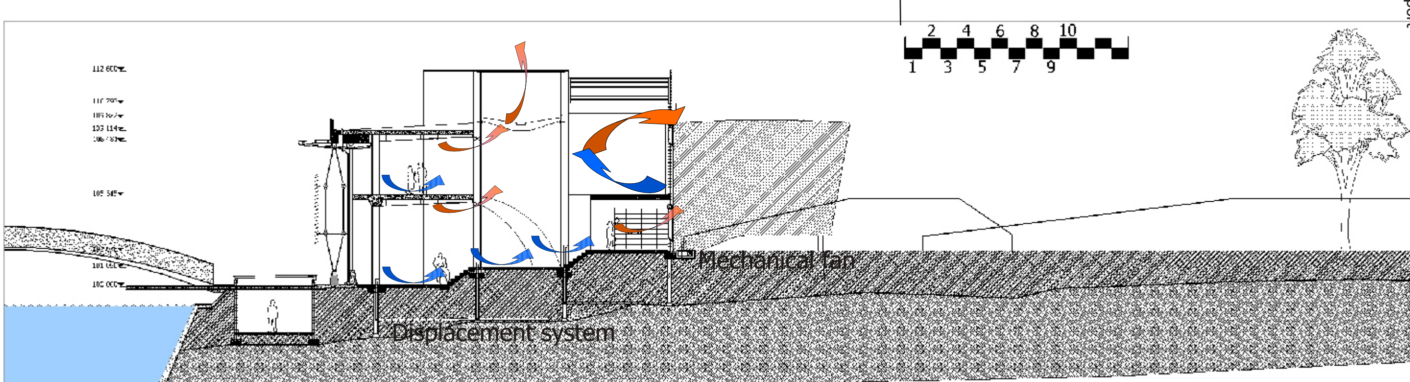


Fig 119. Displacement ventilation in building

External shading devices:

Western and northern windows will be shaded to limit internal heat gain resulting from radiation.

Benefits:

- reduces cooling loads
- increases occupant thermal comfort
- reduces glare
- increases architectural design

The extended western facade is shaded by a steel and aluminium louvre system. This system also provides the "scaffolding" needed to clean the windows on the outside. The office block are protected by a overhang on the northern facade and a simpler shading device on the western facade.

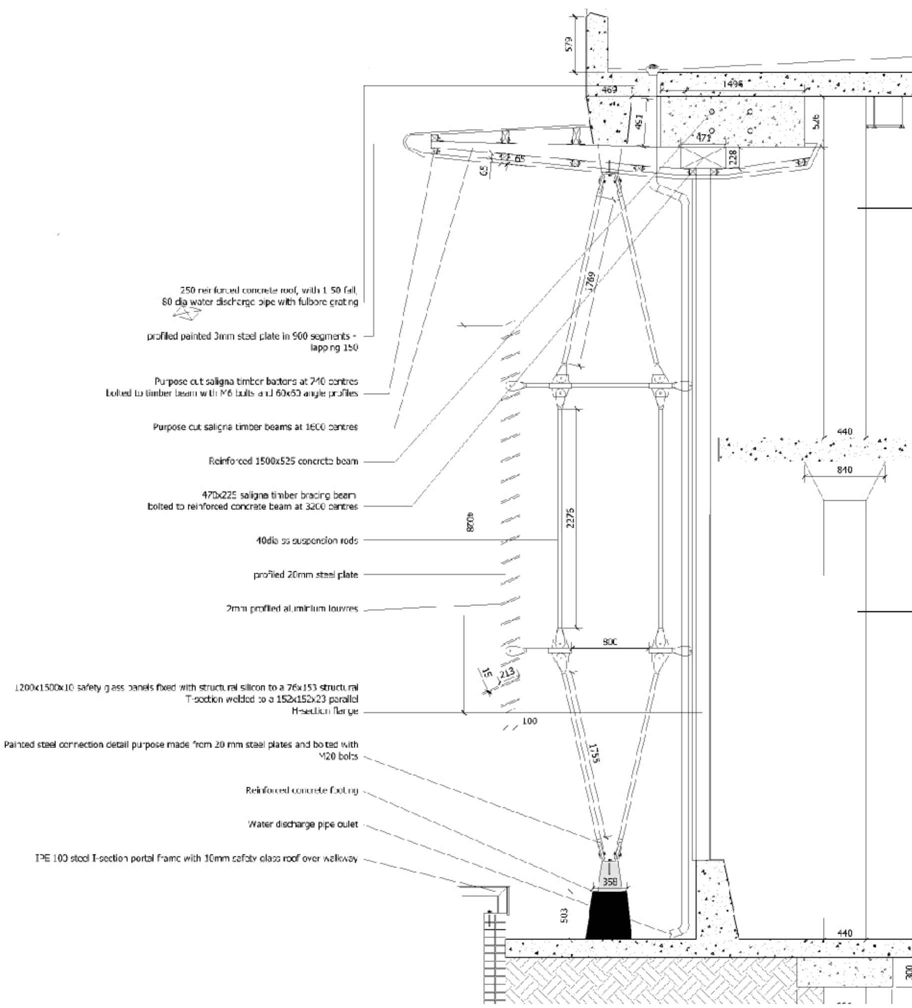


Fig 120. Detail of sun screen on western facade of the building

ENVIRONMENT

External shading devices:

The following 3D shows the structure and assembly of the shading device:

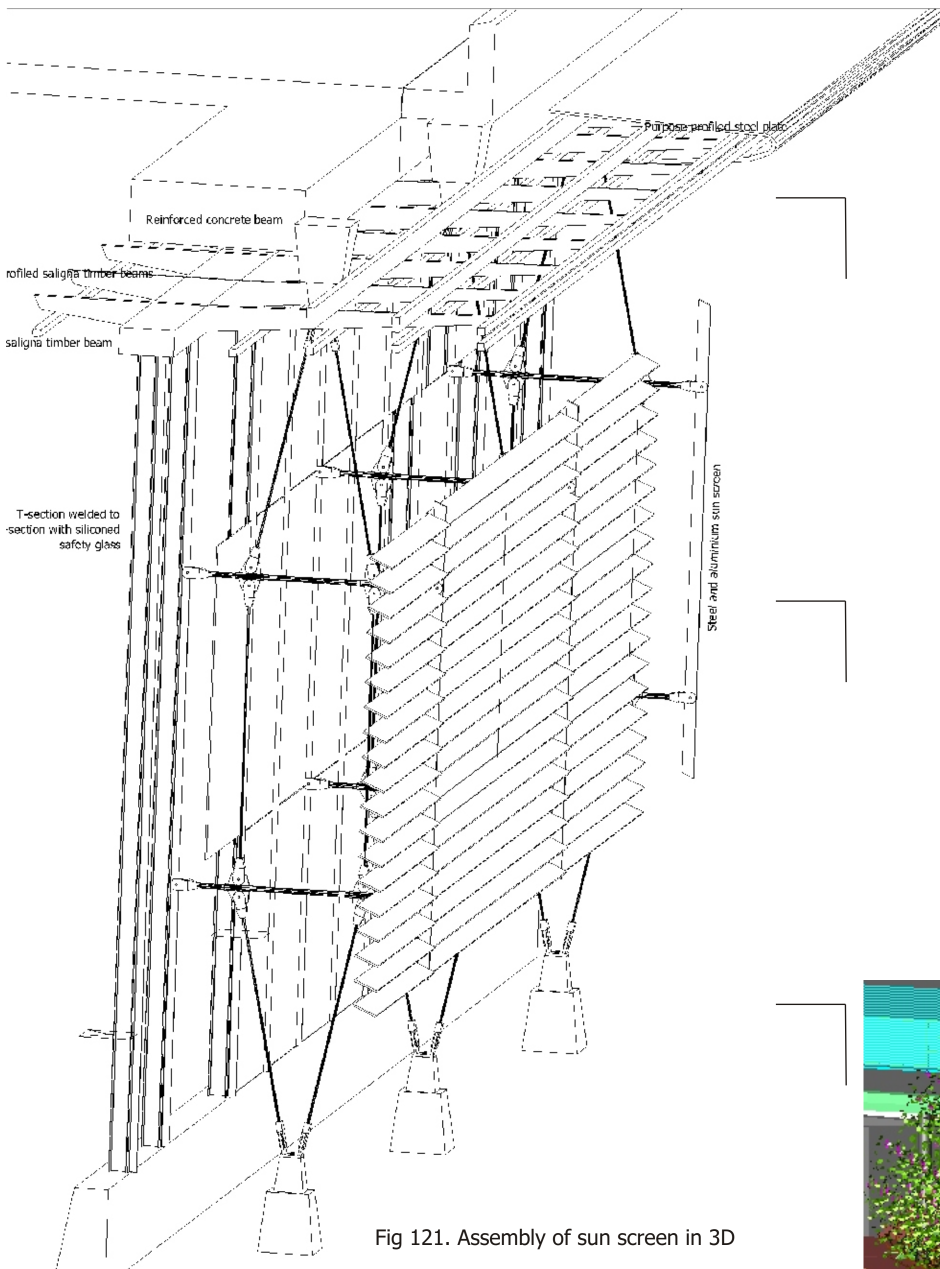


Fig 121. Assembly of sun screen in 3D

Additional precautions:

- On the western side of the second floor it is advised to have a simple internal blind system to shade off the late afternoon sun.
- A boulevard of trees on the western side of the building also shades off the late afternoon sun.

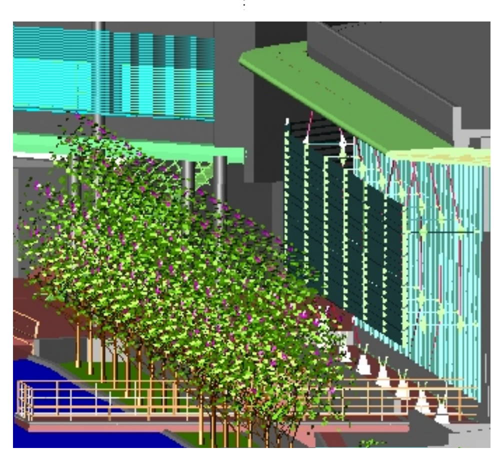


Fig 122. Boulevard of trees to shade western facade.

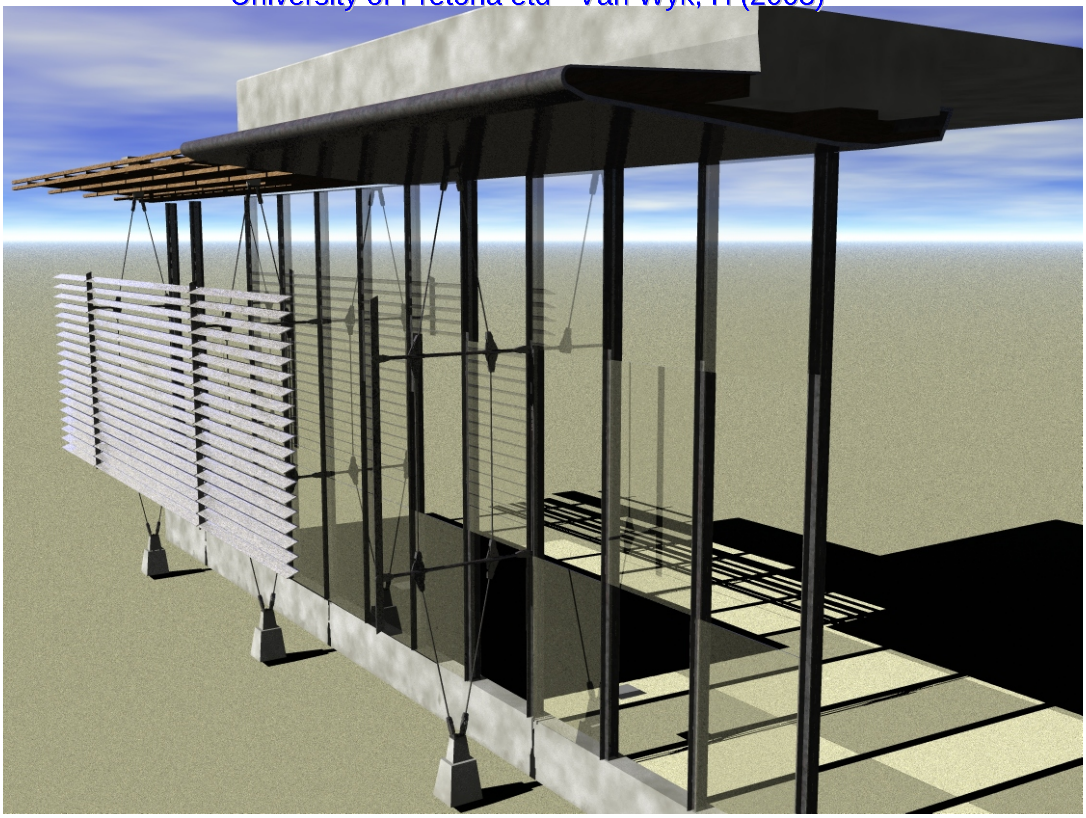


Fig 123. Assembly of sun screen in 3D

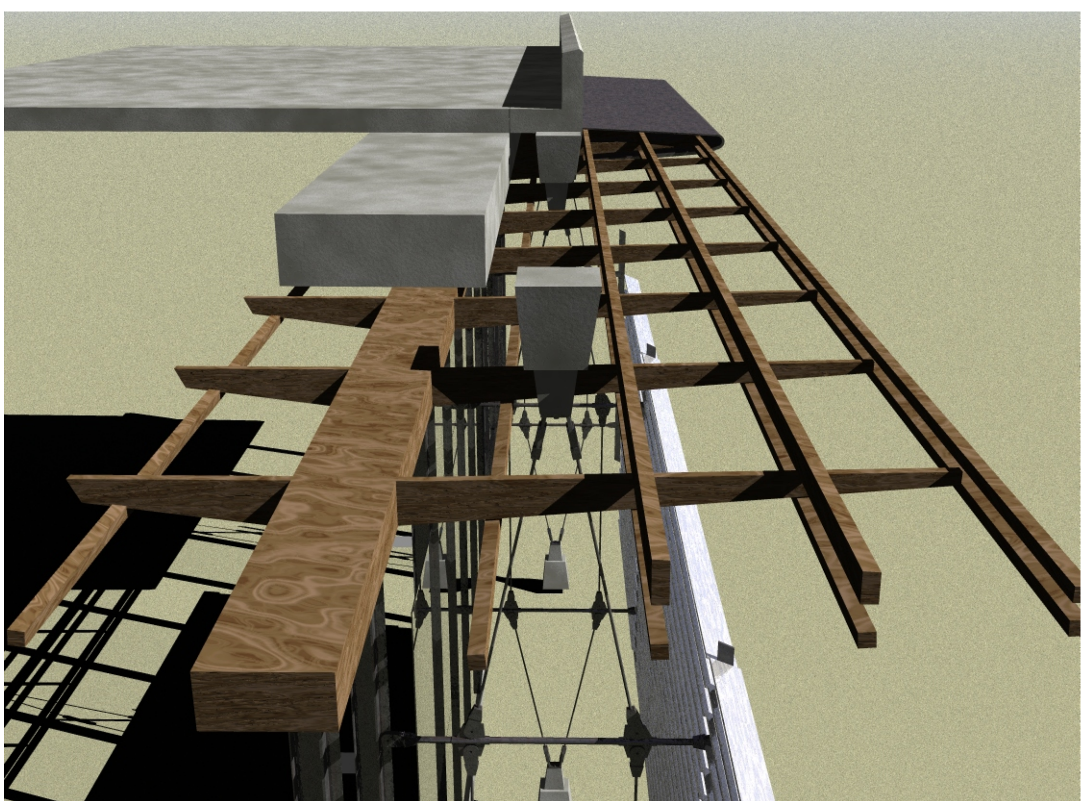


Fig 124. Assembly of sun screen in 3D

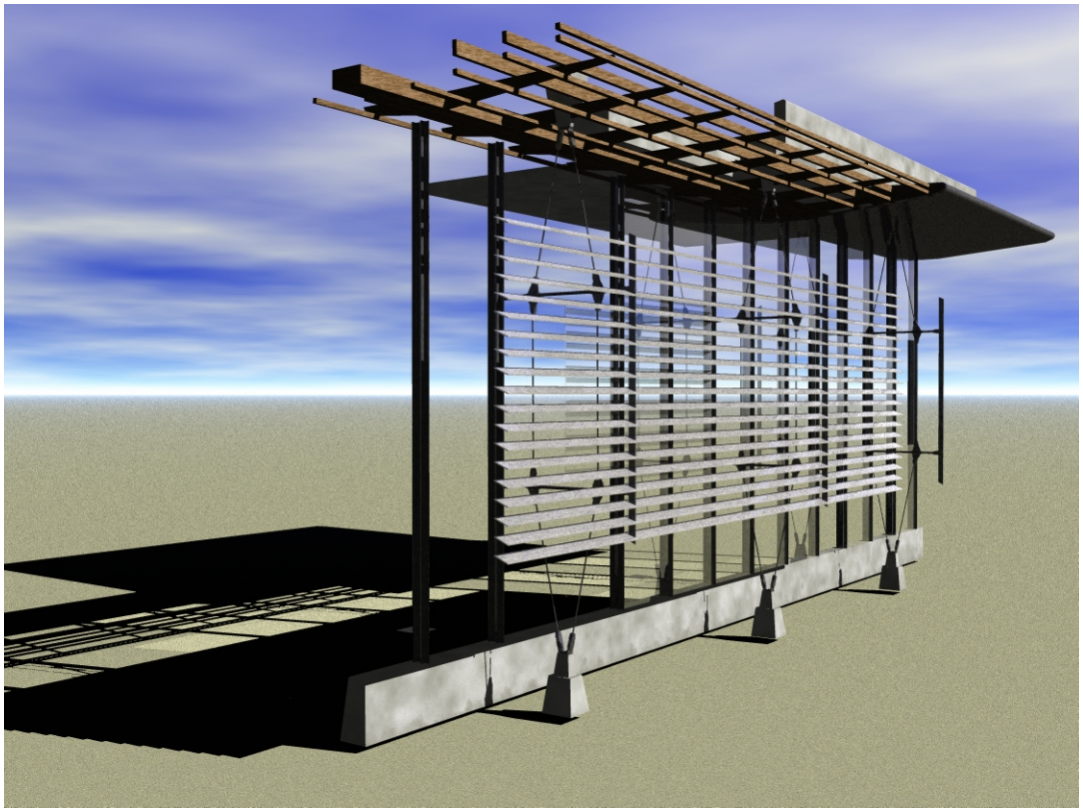


Fig 125. Assembly of sun screen in 3D

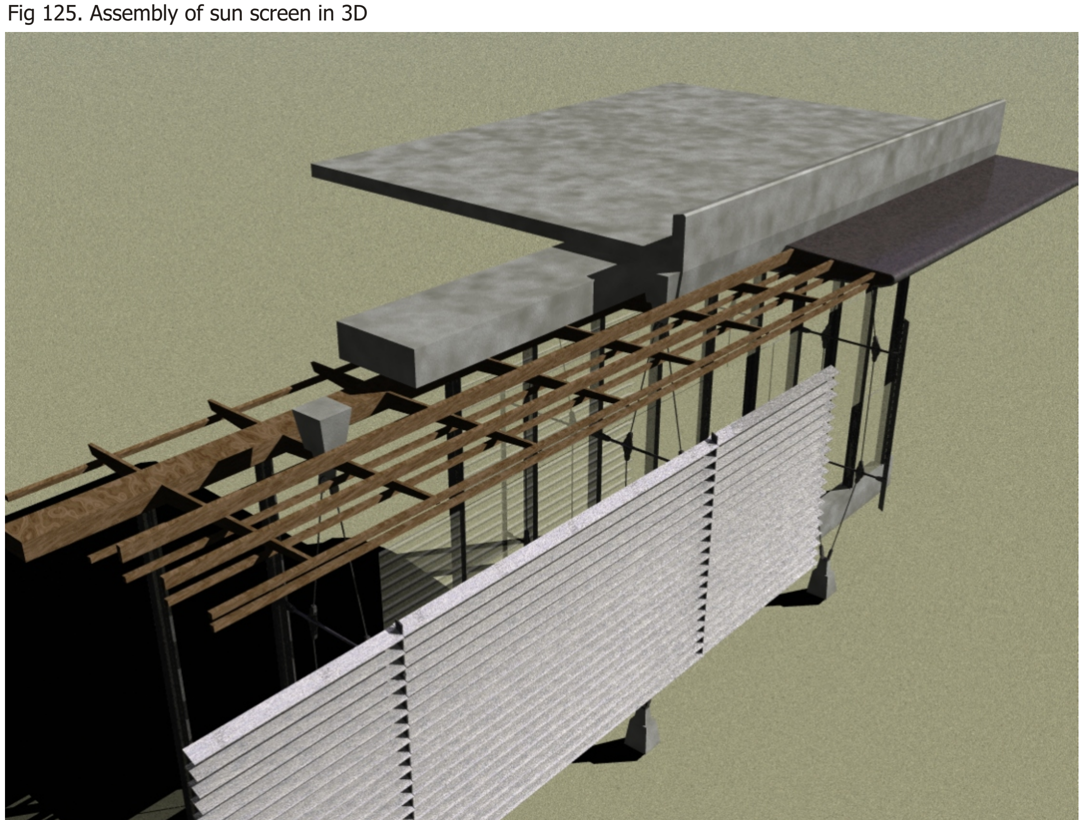


Fig 126. Assembly of sun screen in 3D

Appliances and fittings:

Energy efficient office equipment:

Computers, printers, photocopiers and fax machines equipped with power management settings, and printers and photocopiers capable of double-sided printing will be used.

EQUIPMENT	DESCRIPTION
Computer	3.3 volt components, which use 40-50% less energy
Printers	Powering down to 15-45 W, which reduces energy by 50%
Photocopiers	Heat and pressure uses the most energy. In idling mode, an energy saver can reduce consumption by 50%
Fax Machines	Powering down to 15-45 W. Inkjet printing is more energy efficient

Fig 127. Energy efficient office equipment

Benefits:

- reduces operating costs and energy consumption
- occasionally increases mobility (for example, laptop computers)
- reduces paper and printing costs
- Reduces filing space

ENVIRONMENT

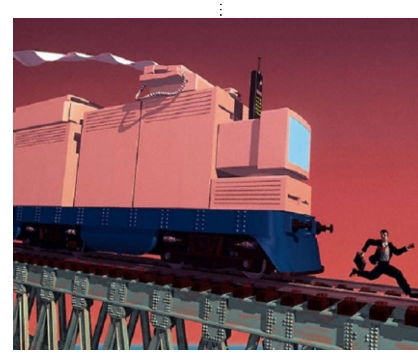


Fig 128. Office equipment

Renewable energy:

Photovoltaic cells:

A solid-state semi-conductor device produces direct current electricity through radiation.

Benefits:

- reduces non-renewable energy demand
- lowers electricity consumption costs
- reduces peak electrical demand charges
- reduces infrastructure costs

Uses:

- parking lot lights
- pathway lights
- sign lighting

Space should be provided on the roof for **140m²** of photovoltaic cells. The energy produced by this system would be sufficient for the use of smaller functions and can be used as mentioned above.

On the western roof of the building there is ample space for the placement of the necessary photovoltaic cells. From there it will have an undisturbed exposure to northern light to maximise performance.

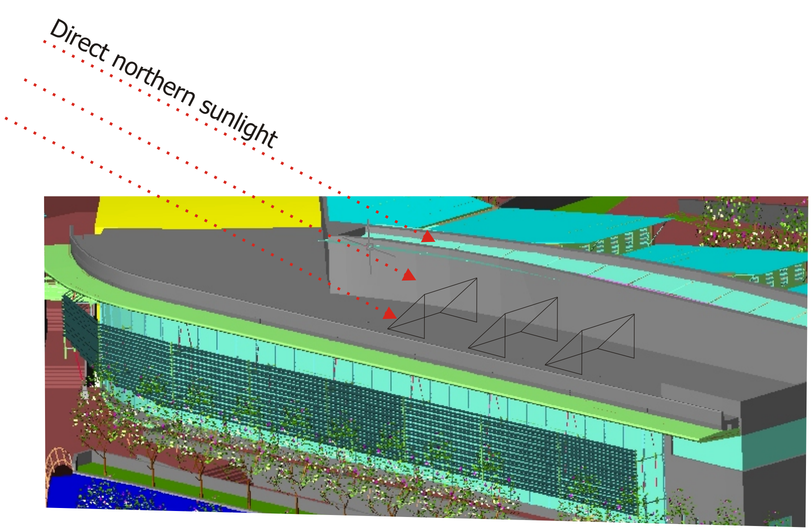


Fig 129. Placement of photovoltaic cells

Fig 130. Photovoltaic cells

WASTE:

Recycling and reuse:

- **ORGANIC WASTE**
  Organic waste produced by the canteen is collected in air-tight containers, stored and given to local pig farmers as food for their animals. Collection takes place once a week by the farmer himself, and the collection by him counts as payment. Transforming organic waste collected from toilets into methane gas was considered, but storage and environmental impact on the Apies River was a bigger concern.

- **INORGANIC WASTE**
  Inorganic materials are sorted into different bins in each office. The main source of inorganic waste in offices is – paper. Bins would be provided for the collection of these materials and collection and removal thereof would take place once a week.

- **TOXIC WASTE**
  Toxic materials like batteries are collected in a separate bin. This could be sold to battery companies, for the reuse of whatever they see fit.

- **SEWERAGE**
  Removal of sewerage will be handled by the municipal service.

- **CONSTRUCTION WASTE**
  After construction, building waste is sold to demolishing companies in the area, which can sort and resell it as used building materials.

Recycling bins should be provided for use by visitors. These should be clearly marked to streamline the recycling process.

ENVIRONMENT

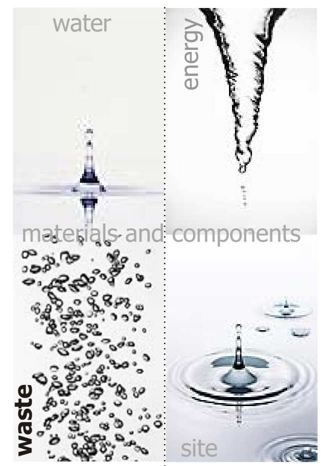


Fig 131. Recycling bin used at Rand Water Nature Reserve

Fig 132. Waste management

SITE:

Buildings have a footprint and a size that take up space that could otherwise be occupied by natural ecosystems which contribute to sustainability by helping create and maintain an environment that supports life. Buildings can support sustainability by limiting development to sites that have already been disturbed, and working with nature by including aspects of natural ecosystems within the development.

Brownfield site:
The chosen site has never been developed. It is in a dilapidated state and the development will focus on environmental sensitivity. This will have a effect on the site and its surroundings.

Neighbouring buildings:
The new building's scale does not impose on surrounding buildings by casting shadows where access to sunlight is important. The new building stays within the height limit of 19m. See figure below.

Vegetation:
The site should have extensive vegetation. Most of the indigenous vegetation is retained. New plants are planted in car parking areas, and in the atrium and Water Wise garden.

Habitat:
The site and newly created landscape has immense possibilities for being habitats for various animal and insect species. A coordinated landscaping strategy is followed, as discussed in the Water Wise garden principles.

Landscaping inputs:
The input into creating this new landscape was done with the most natural methods possible. The specifics thereof were suggested by a Landscape Architect. The otherwise heavy artificial input, i.e. fertiliser, insecticides and pesticides, is to be limited.

ENVIRONMENT

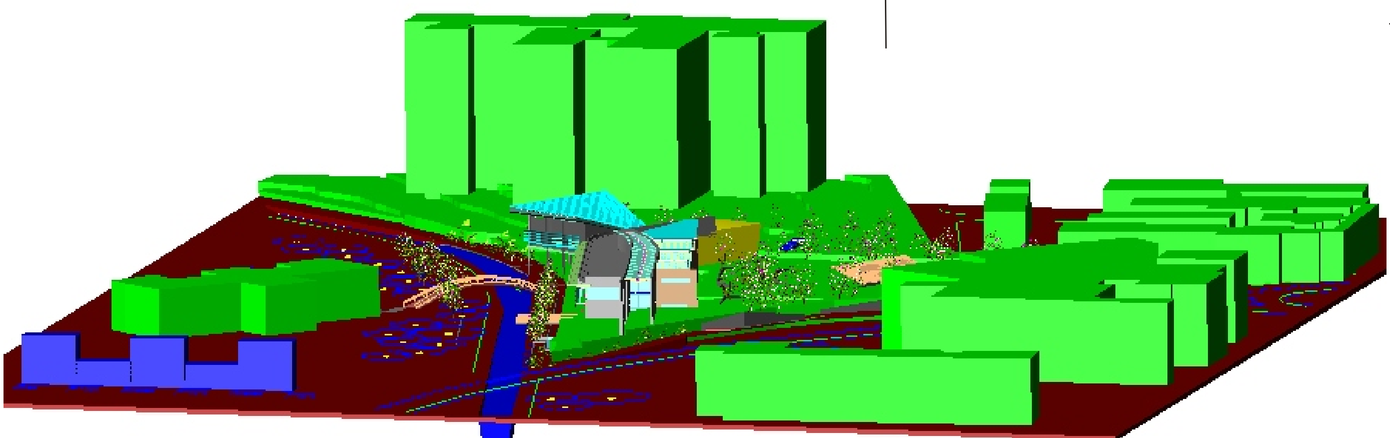


Fig 133. Scale of new building to existing buildings