

Incorporating **PILLARS** of **SUSTAINABILITY**

The new sustainable I-CAT campus being developed at the N4 Gateway Park in Pretoria will feature a 914 m² office building, and a 1 035 m² warehouse. Earthworld Architects designed the building by incorporating the three pillars of sustainability: Environmental resilience, economic demands, and social sustainability were key focuses of the building's design.

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The result is a corporate office and warehouse that has a minimal impact on the receiving environment. The building harnesses natural solar energy in an environmental efficient manner to create a comfortable working environment, thus increasing the reuse of natural resources. The building design will also improve positive visual and noise impacts on the receiving environment and building occupants.

Architect Rudie Botha notes that it was important to understand the local climate, and the type of structure, as well as its occupants when designing the building. "The design of the building in relation to the local climate and environment can have a significant impact on the energy consumption of the building," he explains.

All materials that are being used in the construction of the building have been locally sourced, thereby reducing the energy needed to get them to site. Furthermore, the building has been designed to use as little energy as possible.

"The orientation of the building places the offices closer to the northern side of the building. This ensures greater solar access during winter, while the specially designed roof and overhang reduces solar gain during the summer months," adds Botha.

Shading devices will be utilised on the northern, eastern and western sides of the building, to limit direct sunlight. However, natural light will still be used during the day, in addition to solar power. Botha adds: "The optimum running stage of the building has been established. If the natural light during the day is not sufficient in terms of light levels, the artificial lighting will automatically be switched on."

In addition to solar electricity, water in the offices and the showers in the warehouse will be solar heated to reduce energy consumption. To reduce water consumption, rain water will be harvested from the roof and stored in a tank, which will be used in the landscaping around the building. The harvested rain water will further be filtered and purified allowing it to be used in the water cisterns.

When designing the building, the overall level of comfort was considered. Botha reveals that this relates to thermal comfort, visual comfort, acoustical comfort and comfort of air quality. "Several systems were designed to ensure optimum occupant comfort at all times."

In summer months the building would be nocturnally ventilated. This will happen in the early hours of the morning, allowing the internal temperature to drop. The fresh air will then be contained for as long as possible. Once the temperature inside the building gets to high the windows at the top of the building will automatically open, allowing the hot built up air to escape.

To maintain the thermal comfort of the occupants, the building will make use of a small inverter air conditioning system which will run from the solar power. When the temperature in the office drops below or above the comfort level, the air conditioning system will automatically activate to get the temperature back to the optimum thermal comfort.

The building also features a courtyard at its southern end. Botha points out that this creates a light environment which will draw cool air into the building. This also creates an environment where people can go and enjoy some time outside. "This courtyard adds to the social sustainability of the building,

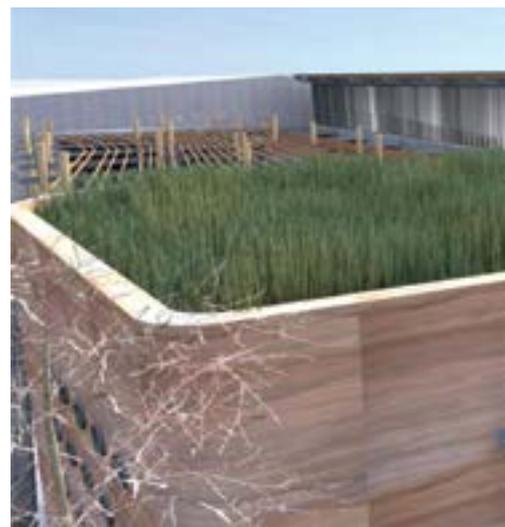
as you want happy workers, because this improves efficiency from an economic sustainability point of view."

Botha highlights that the office building and warehouse were also designed to allow I-CAT flexibility in the way in which the buildings can be utilised. Both buildings have been designed with an open plan layout that can be divided into smaller sections if needed.

"The interior of the office building is designed in such a way to allow it to be used as a large open plan office, or to divide it into smaller offices in the future. The warehouse features a column free design, with supporting columns only along the perimeter of the warehouse. This leaves the interior of the warehouse free to be adjusted and changed to suit future needs," Botha concludes.

Shading

The heating effect by solar radiation in the summer months will be controlled by





Rudie Botha, the architect (from Earthworld Architects).

external shading, north facing windows will be shaded by a roof overhang that will shade the building completely during the summer months and partially during the winter months to ensure the comfort of building occupants are optimised. East facing windows will be shaded by vertical fins that deflect early morning radiation during the summer months and afternoon sun on the south facing windows.

Thermal conduction resistivity

Roof

100 mm Rigid Expanded Polystyrene EPS suggested by SANS 204 will be used as roof insulation to restrict the thermal conduction through the roof structure.

Walls

High thermal material will be used to construct the office building walls to ensure there is a sufficient time lag so thermal heat does not reach the interior of the building in the peak working hours and natural ventila-





tion will cool down the building in off peak periods.

Windows

East and west facing glass windows were restricted and all glass windows were designed incorporating shading devices to limit exposure to solar radiation.

Colour of building envelope

Light coloured building materials were selected to reduce the absorbance of solar radiation by the building envelope.

Landscaping, trees, ground covers

According to Earthworld Architects the following considerations in terms of the thermal design was taken into account:

- Plants are provided to shade windows and walls, thus reducing the solar gain.
- Ground covers, trees and shrubs are provided to reduce the reflectivity of surfaces, thus minimizing both the solar reflectance and long-wave reflectance into windows.
- Un-shaded hard surfaces are kept to a minimum. Hard surfaces (paving, concrete, and asphalt) are alternated with plants and ground covers. Patios with hard surfaces are shaded during the summer time.
- The planting of vegetation would be seasonally beneficial to the building. In front of the equatorial facing windows only a few tall deciduous trees are planned.

Environmental efficient considerations

Energy consumption

I-CAT Environmental Solutions will incorpo-

rate a solar photovoltaic system on the roof of the new building to generate electricity. The system will not be connected to the national electricity grid so all electricity generated will be used to supply power to the building itself.

A typical solar system of this nature will supply enough power for peak working hours without feeding excess power back into the grid. Should the building require extra power at any given time, power from the national grid is available. The implementation of the system will allow I-CAT Environmental Solutions to generate 69 920 kWh per annum from solar energy which is a renewable resource. As a result of this project I-CAT will only need to import an expected 1 049 kWh per annum from the national electricity grid. The implantation of the system will result in the reduction of greenhouse gas emissions. The electricity from the national grid has an emission factor of close to 1 kg of CO₂ per kWh of electricity. Hence, the implementation of the system will result in a reduction of almost 70 tonnes of CO₂ emissions per annum.

Rainwater Harvesting System

I-CAT Environmental Solutions will be implementing a rain water harvesting system at the new building. A 50 000 litre underground water storage reservoir will be installed. The intention is to collect all the rainwater from the combined roof area which is 1 495 m². This water will be filtered and re-used to flush toilets and landscaping purposes, also, I-CAT has focused on water efficiency through the use of waterless urinals, low water usage toilets and low water usage taps to conserve water.

Solar water heating and solar powered heat pumps

The new building will incorporate the

installation of solar water heaters and solar powered heat pumps. Solar water heaters convert solar radiation into thermal energy for heating water. Solar water heating systems consist of a solar collector and a storage tank. In the solar collector, the sun's thermal energy is used to heat a liquid. This liquid transports the heat through pipes to the storage tank. Heat pumps use electricity more efficiently and hence also reduce the electricity demand of the building.

Wash bay filtration system

I-CAT Environmental Solutions will install a filtration system at the property's wash bay, which will use disc filtration technology to remove any suspended solids. The filtration system will also make use of activated carbon filters to remove hydrocarbons and dissolved impurities. UF membrane filters will be used to remove all particles up to 0,01 microns including bacteria and viruses.

Water will then be re-used in the wash bay and for irrigation purposes. With clean water becoming more scarce, I-CAT intends to re-use all of the water used for cleaning the vehicles at the wash bay. It is estimated that there will be a 93% recovery rate of the water used after filtration, which means there would only be a 7% loss. This will reduce pressure on the municipal water treat

An increase in environmental consciousness in the design, construction and operation of corporate and industrial buildings leads to a decrease in negative environmental impacts.

I-CAT Environmental Solutions has taken every aspect of the environment into consideration to optimise spatial use and minimise the impacts on the receiving environment as far as possible, while increasing the visual impact of the new I-CAT Environmental Solutions building. ◀