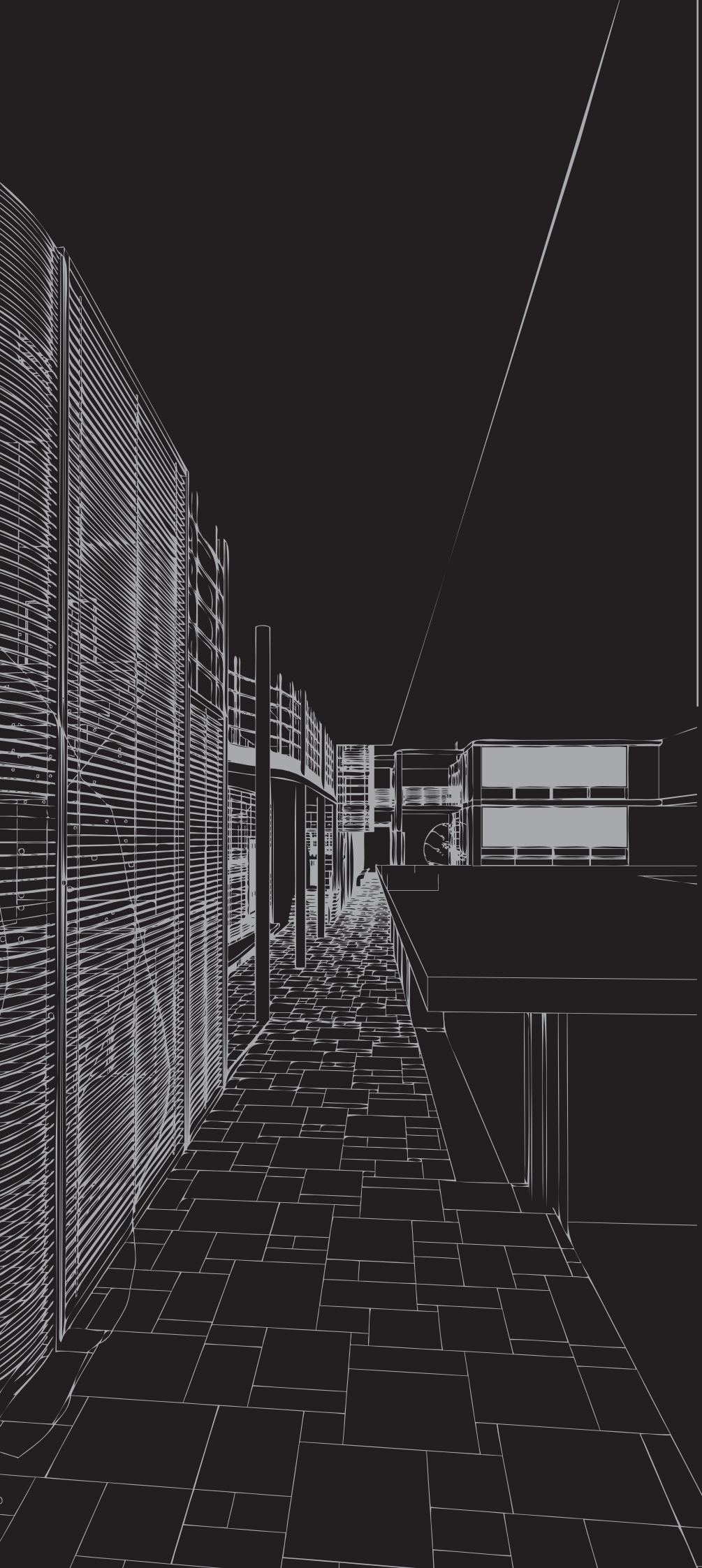

Innovate:

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New facilities promote energy-efficient design principles

In the design of the new facilities for the School of Engineering, the aim was to develop an innovative, environmentally friendly, multi-functional building that makes use of best-practice principles in terms of energy conservation and sustainability.

Design aspects that have been introduced include passive cooling systems, rainwater harvesting and air conditioning by a chilled water, variable air volume system. Various forms of sun screening are incorporated in the design, including natural vegetation racking that will enhance the conversion of carbon dioxide to exert the minimum impact on the environment. The building has deepset facades that promote shading and eliminate direct sun and heat penetration.

In its design briefing, the University of Pretoria challenged the architects to come up with a design that is in line with the international trend towards sustainable building practices. The University made it clear that it would be seeking a Green Star rating for the building. As a formal rating tool for mixed-use buildings does not currently exist, the architects had to develop innovative practice applications in all aspects of the design.

A Green Star rating is awarded to a building that complies with specific environmentally friendly requirements. It is awarded by the Green Building Council of South Africa and recognises and rewards environmental leadership. Ratings are based on the innovative use of design, construction and operational practices that significantly reduce or eliminate the impact of human activity on the environment, as well as on the users of the building. In addition, the design, material and technology used should contribute to reduced energy and resource consumption and create improved human and natural environments.

According to the architectural and engineering specialists involved in the project, Anton de Jongh of ARC Architects and Anton Frylinck of Spoormaker & Partners, the design meets all these requirements.
A major contributor to energy

consumption is the indoor environmental quality, as it drives electricity consumption, particularly in terms of air conditioning, equipment and lighting components. Internal heat gain is not only generated through direct sunlight, but also through the external structure of the building and internally by people and equipment. Conversely, energy is lost in winter via the same elements. To counter these phenomena, a premium has been paid by insulating the building fabric and specifying performance glass.

The site orientation presented a further challenge. Its long western and eastern aspects are not ideal for an energy-efficient design, as the largest section of the building receives direct sun at a particularly low azimuth. A comprehensive sun angle analysis was conducted and appropriate shading measures applied in the form of horizontal louvres, metallic vertical mesh screens, framed concrete deepset facades or planted green screens. These measures, in combination with the performance glass, will result in a 95% induced energy reduction to the facades.

The site orientation also presented an opportunity to make use of passive air extraction systems. Chimneys, operating on the Trombe system, will be introduced and fitted with metal cowls (to assist with convection) and controlled louvres. The same principle was introduced to assist with the natural ventilation of the central atrium. This approach allows the building management system (BMS) to control the ventilation systems, balance the heating or cooling loads of the air conditioning, and ultimately save energy. This will result in the building's energy efficiency being 25% below the requirements of the national standard (SANS 204).

The automatic chilled water variable air volume system that will be installed will also greatly reduce energy consumption. This system makes use of a chiller to cool the water, which is then distributed throughout the building. The system automatically measures the temperature inside and outside the building and adapts the interior temperature to a comfortable level. By reducing the need for gas-operated air conditioning systems to regulate the temperature, the spread of diseases and the incidence of 'sick building syndrome' will be reduced.

The BMS that will be installed will automatically control all the systems in the building, including the use of electricity and water, fire prevention systems, security and carbon dioxide emissions. In addition, all sanitary fittings will be provided with economy cycle water closets and taps will be fitted with control valves to minimise water flow periods.

Energy-saving lighting will be used throughout the building, with automatic control switches that need to be physically reactivated. Natural light will be introduced at every opportunity via full-height fenestration, clear-storey windows to the atria and laboratories and protected, large-scale curtainwalling to focal points.

Innovative use will be made of natural vegetation to cool the building and shade it from the sun. The interface between the parking onramp and the concourse level allows for deep tree planters to the atrium and western facades.

A number of 'green walls' will be created to screen the external facades of the building. These comprise steel frames with interchangeable containers for plants and irrigation systems partially fed with harvested rainwater. Incorporating plant material as a design element is a popular trend internationally. It not only provides an environmentally friendly dimension to the design, but improves the micro-climate, and introduces a human element to the internal and external social spaces.

A number of alternatives and international patents were considered in the development of this wall, but most of them proved to be too expensive, and not suited to the African climate.

A unique concept therefore had to be developed that was suitable to the local context, climate and craftsmanship. With this innovation, plants will be planted in individual containers, which can be removed and replaced as the need arises. Evergreen plants will be selected for their particular anticipated habitat, either on the western or eastern side. Possible options are *Chondropetalum*, *Surtera* and *Asystasia*.

The landscaping aspects of the building are being planned in consultation with Newtown Landscape Architects. In addition to the vertical green screens on the sides of the building, the large retaining walls at the entrance to the building will also be softened with strips of vegetation that will be incorporated into the walls themselves.

Plants in the atrium will also help reduce carbon dioxide emissions in the building itself.

A series of built-in plant containers, which are large enough to plant trees, will form part of the structure of the western and eastern sides of the parkade. Great care is taken in the protection of the habitat, to the extent that the existing fever tree lane, which is within two metres of the excavations, is left untouched during the entire construction process.

This new building and parkade will not only meet the need for additional facilities for the School of Engineering and provide urgently needed parking space for the University's students, staff and visitors, but it will also serve as a best-practice example of architectural excellence and innovative energy-efficient building practice.

Managing the engineering project

The smooth functioning of a project of the magnitude of the University of Pretoria's new Engineering Building Parkade Project would not be possible without an experienced project manager to coordinate the various aspects.

The professional team is headed by Anton de Jongh of ARC Architectural Consultants. This company was responsible for the architectural design of the new development. The other professional service providers are Pentad and Davis Langdon (quantity surveyors), Aurecon Group (civil and structural engineers), Delport du Preez (electronic engineers), Claasen Auret (electrical engineers), Spoormaker & Partners (mechanical engineers), Proacoustic Consortium (acoustic consultants), Chimera Fire (fire design consultants), Newtown Landscape Architects and Louwrens and Pound Land Surveyors.

Prof Schalk Claasen, former head of the University's Department of Industrial and Systems Engineering, has been seconded to the Department of Facilities Management for the duration of the project to oversee this large and complex project for the University. He will enhance the project management capacity in the Department of Facilities Management for this specific project. In addition to the facilities management team, other internal role-players include staff from Information Technology Services, Security Services and Education Innovation, who will be involved in providing the IT infrastructure, security management and audio-visual equipment and technology, as well as staff from the Department of Plant Sciences, who will advise the project team on the selection of trees and other plants to use for landscaping. Academic Administration is involved in defining the user requirements for the lecturing facilities.

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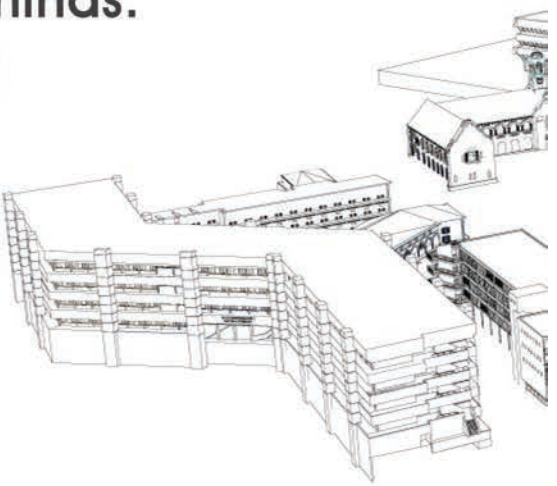
anton de jongh | beyers slabbert | pierre van driel

Urbanism as a stimulant for interactive minds: the new engineering precinct in context

by Anton de Jongh



The University of Pretoria's new Engineering building and interphases with its surrounds have certain similarities to the thriving community that was Iron Age Mapungubwe.

Seven centuries prior to the day the existence of Mapungubwe (in the Limpopo Province) was revealed to the University of Pretoria (UP), a civilisation existed and was confronted with challenges little different to those of today. Food production, sustainable water resources and the storage of these resources are fundamental to any civilisation and require innovation and engineering skills. To evolve and partake in the remote competitive trading environment of Great Zimbabwe required that the inhabitants hone their skills in mining, bead-making and jewellery-making, transport and many others. It may well have been the exposure to the convergence of these ideas and skills that further fuelled the innovative culture of these people… to the point that they were flexible enough to relocate to the north.

South Africa has inherited a political, social and commercial legacy of compartmentalisation and segregation. Fortunately, the phenomenal growth in access to electronic information, in conjuction with the implementation of one of the most progressive constitutions internationally, has changed the social/intellectual landscape dramatically. Computing capability is constantly increasing, and so does man's ability to aquire knowledge. Factors that affect the rate of growth include the increased availability and variety of educated people, cross-pollination of ideas between previously segregated areas of science and culture, silicon-based tools of computing and communication and an increased understanding and enhancement of the process of thinking and creative thought. These include psychopharmacology, cognitive science and the study of memes as replicators.

Due to the convergence of the human brain's growing capability and the availability of information, educators will advise that learning, as a linear process, is enhanced by the ability of the individual to randomly attach and assimilate information. This process should not be limited to cyberspace, but should be proactively promoted in the built environment. Progressive corporates have recognised this phenomenon and have planned their corporate environments, as horizontal interactive workspaces, to promote the movement and interaction of staff of all designations, in the pursuit of innovation.

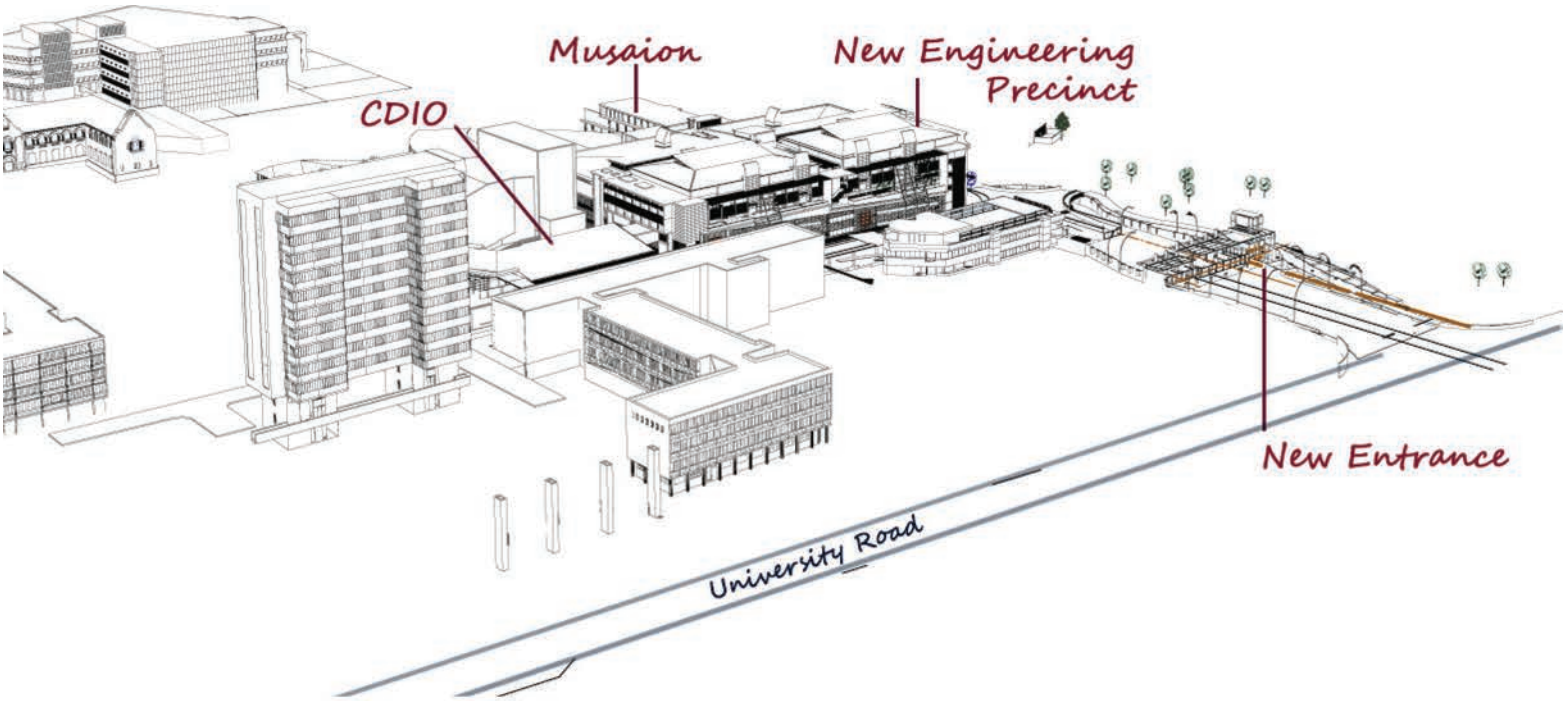
It follows logically that the built environment of the University's Engineering precinct should not only enhance the learning experience, but should also promote interaction with science, culture, the arts, social skills, sustainability, respect for the environment and heritage, as well as the expression of views.

Urban interaction

With the Old Arts Building as main focal point on the Hatfield Campus of UP, the urban landscape began to take shape in 1912 when the planting of the tree avenues was commissioned. This later defined the main axis and central student space of the campus. The twin converging axes were established and defined by College House and the Old Club Hall, as designed by the Department of Public Works and Gerhard Moerdyk respectively. The Aula complex followed, but extensions to the stage tower blurred the original intent of the master planners.

The new development seeks to recreate the clarity of the campus's urban landscape through the

→ *The parkade approached from the new entrance in University Road.*



introduction of a cultural spine, which defines the convergent axis and elevates points of convergence, as people spaces. As people move along the spines, they are subliminally drawn into interactive people spaces and are exposed to social events, heritage, the arts and an exchange of ideas.

Due to pressure on the availability of space and infrastructural requirements, the urban landscape is layered. This aspect creates the opportunity to link into the existing elevated pedestrian walkways via the Aula deck. The main Engineering concourse becomes the second connectivity spine, linking with the existing engineering precinct, the Conceive, Develop, Implement and Operate (CDIO) space, the Musaion music library and the Aula. This innovation puts movement-impaired people in the mainstream, as they will have direct access from their vehicles to all aspects of campus life. The CDIO space is placed in a convergent node, stimulating interaction and the cross-pollination of ideas.

Architectural response

The architecture is responsive to the urban context. It seeks to be anti-iconic and would rather provide a transparent view onto a landscape, a square or the inherited building fabric. It transcends the realm of its built fabric to create positive internal and external connectivity between spaces, thus providing the canvas to introduce interactivity and communication in a flexible environment.

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→ *Innovative use is made of natural vegetation to cool the building.*

***Anton de Jongh** is the managing director of ARC Architects (Pretoria). He graduated from the University of Pretoria in 1981 with a BArch degree and is the principal agent of the University of Pretoria's Engineering Building Parkade Project.*

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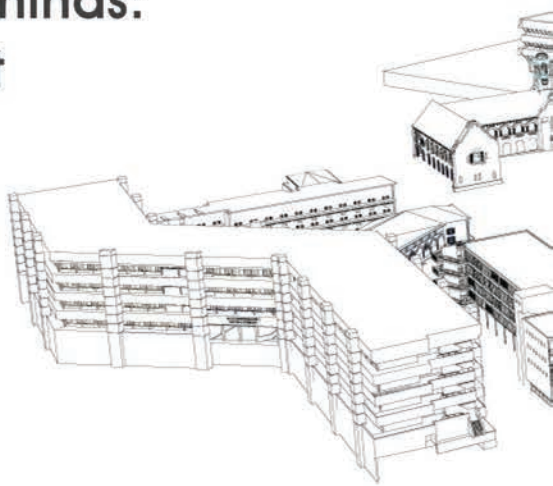

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