ENGINEERING 4.0

Completed: November 2020
Location: University of Pretoria, Hillcrest, Gauteng
Size: 6,800m²

The University of Pretoria (UP) officially opened its state-of-the-art Engineering 4.0 facility in late 2020, which focuses its research on smart transport, cities and infrastructure.

Situated on the Hillcrest Campus, Engineering 4.0 has its home in the Faculty of Engineering, Built Environment and Information Technology (EBIT). It is an absolute first for Africa, and has been brought to fuition in collaboration with the South African National Roads Agency (SANRAL), the Council for Scientific and Industrial Research (CSIR) – an entity of the Department of Science and Innovation – and York Timbers.

The architecture of this pioneering project was realised by ARC Architects with landscape architecture by Insite Landscape Architects.

ARC Architects explain that from the onset of this project, an Engineering, Built Environment and IT (EBIT) focused precinct needed to be created, supplemented by a learning facility and developmental, research and large-scale testing laboratory. User clients include EBIT (learning, office, reception, display, largescale laboratory spaces and infrastructure) SANRAL (training and reference laboratory) and CSIR (bitumen testing laboratory).

Focus on biodiversity
The Masterplan was developed to address accessibility from a local and limited national roads and potential rail connection. The environment needed to be respected in preserving the indigenous forest and grassland and enhancing biodiversity.

Integrated with the functionality, is the facilitation of inter - departmental technological cooperation, exposure of students to biophilia, wellness and total immersion to open architecture and virtual interaction. Departing radically from a typical civil engineering surround and as the site boasts a mostly indigenous forest and significant Moot grassland, a plan to enhance the biodiversity was integrated.

Foreign vegetation was eliminated and architecture was introduced to vacated areas, allowing the environment to flow into the building through perforated shade screens and full height glass facades.

Tilt-up doors are used to open to the atrium learning space, also enhanced with planters.

'Board and chalk' principles are moving toward a more interactive exposure learning – particularly in the practical built environment. Supporting this notion, all ceilings are open to expose all services, all floors are scoured down to expose aggregates and a sun ingress diagram has been introduced to witness sun patterns.

The South African transport engineering industry currently faces numerous challenges like the shortage of civil engineers, limited training as well as no centralised reference testing facilities.

Engineering 4.0 now offers students (vocational and tertiary), researchers and academics a world class facility enabling them to be on par with other first world training facilities. Virtual reality training kits have been developed to replicate the training facilities, for students to receive introductory courses remotely for more effective training once in the actual lab.

The architecture consists of large-scale concrete tilt-up panels in combination with steel structure and full height glazed façades to enhance the interaction with the natural environment and biophilia. The laboratory building construction involved the use of a tilt-up panel system together with in-situ columns and mainly steel roof structures. The advantages of the use of a tilt-up panel was the speed of construction. The use of concrete walls assists greatly with thermal insulation and creates a comfortable large internal working space. The foyer mainly consists of glass and steel construction and, where required, structurally in-situ concrete columns and masonry walls.

Bringing the outside in

Together with the constant visual connection of the external environment and as an extension of the biophilia concept, indoor planting has been provided throughout the building. The main staircase features a vertical planter element with extensive in-situ planting including trees and indoor vegetation. Potted plants are positioned in walkways and study/seating areas. The auditorium was designed, specified and implemented by following the critical criteria of reverberation as defined by the acoustic consultant. An open plan study area has additional suspended acoustic panels to limit noise disturbance, with alternative sound cubicles and private meeting rooms.

MEET THE TEAM:

Client:
University of Pretoria

Architects:
ARC architects

Project Managers:
MDSA

Quantity Surveyor:
Gro2 Consulting

Civil Engineers:
Aurecon

Mechanical Engineers:
Spoormaker & Partners

Electrical Engineers:
Conscius Consultants

Contractors:
WBHO

Landscape Architects:
Insite Landscape Architects (and interior planting design)

Landscape Contractors:
Bidvest Top Turf

Restoration & Cultural/Industrial Heritage Advisor:
HPA heritage consultants

Acoustical consultants:
Linspace Acoustics

Other features of Engineering 4.0 include:

A concrete laboratory: This consists of preparation areas, curing and humidity rooms, and a test floor where various concrete and structural testing can be conducted for use in areas that include road construction and infrastructure. There is also a national roads reference laboratory.

Accelerated Pavement Testing (APT) Track: The 100 x 6m APT track allows for the construction of different pavement structures and their accelerated evaluation, using a mobile APT device. This enables engineers to monitor the expected behaviour of a pavement over a fraction of its life.

"For our smart cities research, we will be working with a team of academics including social and environmental scientists, economists, urban planners, architects and lawyers," Profs Maharaj and Steyn said. "We need to redesign and integrate living spaces to promote social cohesion. We need to restructure urban planning so that people can live closer to work, reduce travel expenses, take the pressure off roads and lead more affordable, environmentally conscious lives."

UP Vice-Chancellor and Principal Professor Tawana Kupe said Engineering 4.0 will share its vast resources in technology and data sciences with all faculties via the institutions' platforms for developing inter- and trans-disciplinary research networks within the University and the global research community. "We thank our partners and value their contribution to this landmark collaboration," he said. "Working together means we can achieve much more in solving Africa's grand challenges."

The York Wood Engineering Laboratory aims to expand the footprint of mass timber construction, using advanced engineered wood products on the continent, in collaboration with civil and chemical engineering, architecture, materials science, data science, genetics and other related bio-economy disciplines.

We look forward to witnessing the beforementioned professions flourish through this new node within the Hillcrest Campus.

SUPPLIERS:

Laser cut panels & steel features:
Truestyle Hard Landscaping Solutions
– 011 768 1305

Water Features:
Hard Landscape Enterprises
– 083 263 5656

Paving:
Bosun – 010 001 8398

Custom seating benches and retaining walls:
Gallo Precast – 012 546 6067

Interior planting:
Execuflora – 011 025 9933