# University of Pretoria recognised globally with Quanser Sustainability Award for Circular Construction Initiative

*Dr Johann van der Merwe in the Department Civil Engineering at the University of Pretoria.*

Published Nov 20, 2023

**THE 2023 Quanser Sustainability Award has been awarded to Dr Calayde Davey in the Department of Architecture and Dr Johann van der Merwe in the Department Civil Engineering for their project titled "Transdisciplinary Education for Circularity in Construction – Leveraging Building Information Modelling for Material Reuse" in the Faculty of Engineering, Built Environment and IT at the University of Pretoria.**

Within the faculty, students and academics who are involved in teaching and research that relate to the various stages of a construction project are developing a transdisciplinary mindset. This transformation of traditional practices is leading to a radical shift in higher education that is equipping graduates with the skills they need when they enter the world of work.

Members of the departments of Architecture, Civil Engineering and Construction Economics have embarked on an innovative approach to built environment education. This approach achieved

international recognition for its impact, scalability and sustainability when it received the Quanser Global Sustainability Award for 2023. It was the only shortlisted project from Africa.

This award was established in 2022 to address global challenges such as climate change, biodiversity loss, and waste and pollution. It supports the development of a circular economy, which requires effective systems and solution frameworks. It also encourages the engineering community to transform its practices in an effort to improve every element of our global technological and economic systems. In the process, it challenges engineering designers to consider how they can design products that support the principles of sustainability.

The project that was submitted for the competition entailed transforming circular construction through transdisciplinary education. It focused on leveraging Building Information Modelling for the re-use of building material in the Global South.

According to Dr Johann van der Merwe, a senior lecturer in the Department of Civil Engineering, the global construction industry contributes significantly to the emission of greenhouse gases and depletion of resources. “This is exacerbated by substantial wastage and mounting construction waste.”

Adopting a circular value chain for building materials presents a compelling opportunity to address these challenges, while reducing emissions, dependency on raw materials and wasteful practices.

Van der Merwe explains that many circularity initiatives in the built environment focus on end-of-life solutions, and target the elimination of physical waste as a starting point. “While this approach is useful in addressing immediate concerns, it falls short of fostering a fundamental paradigm shift among practitioners to tackle both the symptoms and root causes of wastage with a long-term perspective.” He believes that the notion of waste must be redefined from being valueless to being a valuable, untapped source of physical material. “This is the only way one can truly advance the circular economy.”

As a structural engineer, Van der Merwe has experienced the need in industry to collaborate more closely with architects at a much earlier stage in a construction project, as this would make a big difference to the success of the project. “Collaboration among architects, engineers, landowners, consultants and users is crucial from the start of a project’s life cycle,” he explained.

As a supervisor of structural engineering research projects at postgraduate level, he therefore noted the contribution that the Department of Architecture’s digital twinning initiative could make in supporting research into circular construction and the reuse of building material. Since so much building waste ends up in the country’s landfill sites, this has both a financial and an environmental impact.

Dr Calayde Davey of the University of Pretoria's Department of Architecture.

Dr Calayde Davey, a senior lecturer in the Department of Architecture and research lead for the Hatfield Digital Twin City Initiative, explains that digital twinning provides a collaborative, data-driven platform that allows for a multitude of research and experimentation opportunities. "It is particularly relevant when teaching design at a strategic level." The collaboration of students and researchers from the Department of Architecture and the Department of Civil Engineering on this project therefore made perfect sense.

Traditionally, built environment education takes place within disciplinary siloes. This results in fragmented perspectives on complex topics such as circularity. Van der Merwe and Davey therefore realised that a new, systemic and collaborative approach needed to be adopted that transcends individual disciplines and cultivates cooperative problem-solving behaviours. "Empowering practitioners with scalable circularity skills such as transdisciplinary teamwork and unlocking shared realities is vital to effectively address challenges related to circularity," explained Davey.

The success of the transdisciplinary training model that was co-created by Van der Merwe and Davey lies in the fact that existing resources were leveraged to overhaul traditional built environment education. Existing modules in Architecture, Civil Engineering and Construction Economics were used to instil a circularity and transdisciplinary mindset in students and researchers without disrupting the core pedagogy. The initiative furthermore focused on the students' professional development.

It entailed transcending disciplinary boundaries so that students can fully comprehend the significance of collaboration and learning by doing. "This innovative setting accentuates students' recognition of the

immediate and long-term value of collaboration," said Davey. "It fosters novel insights, shared impacts and diverse perspectives through collective learning." As students from different disciplines exchange methods, skills and diverse viewpoints, a dynamic learning environment emerges that mirrors the intricacies of real-world projects.

While formally focused on architecture and civil engineering students, the initiative attracted interest from students from other departments as well. "As the original group struggled to quantify their models for varying detail levels," said Van der Merwe, "quantity surveying students from the Department of Construction Economics voluntarily joined to help them."

The students prepared presentations on quantity surveying methodologies that had a significant impact on the team's understanding and outcomes of the core concepts of circularity. "This sensitised the entire student cohort to the quantity surveying discourse, an experience the original students would not encounter in a traditional education setting," said Davey. Furthermore, while the structural engineering students delved into their individual research on structural life-cycle assessment, the students swiftly offered their disciplinary perspective.

This significantly enriched the comprehension and intricacy of life-cycle assessment for all involved, intensifying the team's inquiry, and kindling heightened enthusiasm for broader circularity concerns.

In the process, the transdisciplinary classroom organically transitioned into a flipped classroom, in which students mutually instructed each other in core disciplinary skills using shared Building Information Modelling models. Davey said that cross-skilling within a shared digital ecosystem not only reshapes perspectives on the subject matter, but fosters collaboration, critical thinking and creative, complex problem-solving skills.

The impact of this approach is that it is scalable beyond the classroom. When they enter industry, graduate architects and structural engineers will already be aware of the benefit of collaborating with professionals

from other disciplines at an earlier stage in the construction process, with benefits to all concerned. From an academic point of view, the scalability of the approach is evident in its application across different themes, as complex problems can be better solved by working together. This transdisciplinary initiative is furthermore aligned with the United Nations' Sustainable Development Goals as it addresses multiple facets of responsible consumption and resource use, which fosters sustainable urbanisation, particularly in the Global South.

As a pilot initiative, this project served as an experiment, paving the way for further transdisciplinary collaboration at the University of Pretoria. Davey explains that the expansion of this initiative could continue as informal collaborations or evolve into structured transdisciplinary teams within the Faculty of Engineering, Built Environment and Information Technology, all the while safeguarding the development of core disciplinary competencies.

The ultimate vision of the academics involved is the creation of transdisciplinary classrooms that can serve as a catalyst for significant, far-reaching transformation within the built environment. By nurturing well-rounded professional, who are adept at navigating complexity and who can seamlessly collaborate across disciplines, this approach strives to foster substantial and enduring change.