The horizon of Midrand, north of Johannesburg, is set to change forever with the construction of the new PwC Tower, which will be widely visible and a focal point in the up and coming Waterfall City development. It is set to become a structure of iconic proportion due to its distinctive twisted form designed by LYT Architecture for Attaeq Waterfall Investment Company and their developer Atterbury, and realized through close collaboration with Arup - one of South Africa’s leading design engineering consultancies.

To achieve the building’s twist, each floor of the 29-storey office tower rotates 1.2 degrees relative to the floor below. This posed a variety of design challenges for both the structure and façade, many of which Arup was able to solve creatively and efficiently using parametric modelling.

"We needed to ensure our design solutions met the architect’s intent and that a creative concept could be successfully applied," Richard Lawson, buildings associate at Arup, says. "At Arup we are fortunate to be able to share cutting edge research and technology within our global network, which enables us to tap into the latest scientific knowledge and creative thought, which when combined with the utilisation of software, allows us to push the..."
boundaries of design. Our advanced parametric modelling software and systems enables us to explore many options in our search to establish the optimal solution for complex building designs such as the PwC Tower project."

Arap façade engineer Rudolf le Roux describes parametric modelling as 'modelling a structure or object in an n-dimensional space, where certain chosen parameters of the structure are adjustable'. In other words it makes it possible to explore the impact of any of the input parameters on the design and cost of a structure.

Building design
"The biggest structural challenge was that the twist causes the gravity loads to naturally create a clockwise torsional load on the building," explains Lawson. "The obvious solution to this would have been a very thick core wall, but because we were able to quickly assess a number of different structural geometries, we were able to optimise the solution. Our final scheme incorporated structural columns on the façade of the building that slope in a counter-clockwise direction around the core, balancing the gravity loads on the corner columns and reducing the torsion on the core of the tower. This meant that the struts on the core wall decreased by a factor of four: therefore we could use a 450mm thick wall which is not much thicker than a typical straight tower of that height would have needed."

Le Roux continues, "We also utilised parametric modelling for the design of the façade for the PwC building. Various solutions were on the drawing board at the conceptual stage with factors such as glass utilisation, aesthetic integration with the structure and integration of blinds with a sloping, slanting façade. Building a concave, twisted façade out of straight aluminium profiles and flat glass was a challenge made possible through parametric modelling.

"What we really enjoyed was that we could sit down with the architect and make real-time adjustments to things like the column spacing and angles that they could see instantly in 3D. It makes collaboration easy, and results in far less exchange of correspondence back and forth," explains le Roux.