Parametric Modelling

The new PwC Tower, in the Waterfall City development, Midrand, is set to become a structure of iconic proportion due to its distinctive twisted form designed by LYT Architecture for Attacq Waterfall Investment Company through close collaboration with Arup.

To achieve the building’s twist, each floor of the 28-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.

Arup 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.

“The biggest structural challenge was that the twist causes the gravity loads to naturally create a clockwise torsional load on the building,” explains Rudolph. “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 stresses 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.

“We also utilised parametric modelling for the design of the façade. 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.

“At the time of design no software existed for the purpose of calculating the intensities of solar reflections,” he adds. “Since the exact geometry of the façade had already been created in the parametric software, we used it to calculate and add up reflections from the façade. We could then test the effect of different proposed counter measures by including additional parameters such as glass reflectance and installation tolerances. With this knowledge, we were able to provide feasible and practical solutions to mitigate the impact of the solar reflections.”

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