



Bluewater Shopping Centre



The Project

Modern out-of-town shopping centers aim to provide the ultimate consumer experience. For the engineers involved in their construction, there's often a professional challenge too. Using Graitec UK's SuperSTRESS frame analysis program, Waterman Partnership successfully completed design work on the Bluewater retail complex. SuperSTRESS provided high productivity, detailed analysis and flexible output for its roofs, atrium and facade.

Opened in March 1999, Bluewater in Kent has 1.6 million square feet of retail space and parking for 13,000 cars. Key attractions include a multiplex cinema, cafes, restaurants and covered tropical gardens. As the largest retail complex in Europe, the 240-acre site also contains lakes, wildlife habitats and thousands of trees. Interestingly, it's built in a former 50-metre deep Blue Circle quarry.



Company Profile

Turning the architect's vision for a strikingly different building design into workable construction plans was the responsibility of Waterman Partnership. Employing 700 people, Waterman provides a comprehensive engineering design service. Notable projects include Paternoster Square, the Bullring Birmingham, the National Museum of Scotland and award-winning work at Hillingdon Station.

The Problem

Senior Associate Director Alan Hunn says that the £350 million Bluewater project provided a "considerable architectural and engineering challenge". The firm was also responsible for the civil, environmental and traffic engineering work across the site which had difficult ground conditions. Key features are three mall roofs, a water garden and a curved facade, all with huge areas of glazing. The concept designer was an American, Eric Kuhne, along with Benoy as the architects.



The Solution

To verify the proposed designs, Waterman used SuperSTRESS for frame analysis. Manual designs were input and carefully modelled. The largest structure analysed was the Water Garden roof, which has a triangular base of side 38.9 metres. Three main curved rafters intersect to form a pyramid set on a sphere, requiring a totally glazed construction on an exposed steel framework.

Although smaller with 18.9 metre spans, the mall roofs each had different spatial requirements. Hunn believes

it's quite unusual to have three roof designs in a single building. For example, one mall was constructed from welded lattice girders to form a barrel vault roof. The second roof featured a triangular half-glazed design while the third used concentric circles to make a spherical segment.



"The analysis of the roof lattice girder systems under various loading conditions including thermal movements and wind speeds was easily carried out using SuperSTRESS."

The key to timely completion of the engineering analysis was "good productivity". In particular, SuperSTRESS contributed to the "quick and efficient evaluation" for each structure. The individual models were altered by different load cases or changing the members. This allowed "fine tuning" of the design by revisions to section sizes or geometry.

One major benefit of using SuperSTRESS is flexible tabular and graphical output, which Hunn describes as "very good".

Engineers may view their designs graphically and also examine the precise deflections at nominated points. For example, Waterman was able to produce relative deflections between many points on the Atrium roof. It helped ensure the jointing between glazing elements was capable of safely taking the design distortions.

"SuperSTRESS is user-friendly, flexible and powerful. From our manual designs, we were able to calculate and give the finite deflections for all the various load cases to the specialist sub-contractors."

The use of SuperSTRESS is backed by an effective technical helpline, contributing to a "close working relationship" of more than 10 years. Waterman also uses SuperSTEEL, SuperCONCRETE, Wood-Armer and H-LOAD. Hunn adds that he's confident that support queries raised by major projects like Bluewater goes into new product development and closer integration. Thanks to the vital contribution from SuperSTRESS, Bluewater has now become one of Europe's most popular shopping centres.