

# Win, Set and Match at Wimbledon

ANSYS software verifies the design of the innovative retractable roof at Wimbledon by simulating the opening and closing mechanisms.

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The All England Lawn Tennis and Croquet Club's annual Championships has a reputation as the world's premier tennis event. As part of a long-term plan for continuous improvement of the facility, a new retractable roof over Centre Court at Wimbledon was introduced in 2009 to allow players and spectators to enjoy the English summer weather while permitting play to continue in the event of rain.

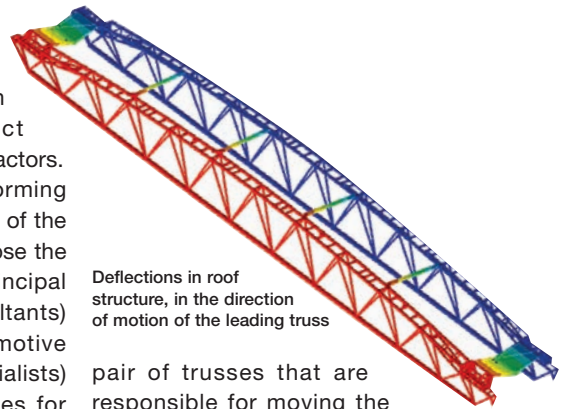
The United Kingdom-based engineering firm Advanced Computational Analysis (ACA) used software from ANSYS to verify parts of the design of the new retractable roof by conducting both static and dynamic analyses to ensure that the roof would perform properly under real-world loads and stresses.

Five years in development, the 17,000-square-foot retractable roof is an electromechanically operated structure that includes 10 movable steel trusses that support a translucent, weather-resistant fabric canopy. When open, the roof sections are parked at opposite sides of the court. To close the roof, the coordinated electromechanical system moves the trusses apart and, at the same time, unfolds and stretches out the fabric between the trusses, until the two sections meet in an overlapping seam above the middle of the structure.

While construction company Galliford Try was responsible for the

overall build of the 3,000-ton roof, the ambitious project involved many expert subcontractors. ACA was charged with performing static and dynamic verification of the mechanisms that open and close the trusses. Capita Symonds (principal structural engineering consultants) and Street Crane Express (motive control and automation specialists) constructed three roof trusses for physical testing, but it would have been extremely time- and cost-intensive to build a prototype of the entire roof. To perform a virtual analysis that would provide accurate predictive results, ACA turned to ANSYS Mechanical software. The verification process was designed to ensure that the mechanisms on each truss would perform as expected.

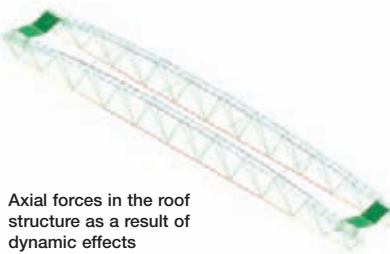
ACA conducted both static and dynamic 3-D analyses of the roof trusses in a virtual environment, confirming that they could withstand real-world physical loads and mechanical stresses in both moving and at-rest positions. ACA focused special attention on the electromechanical actuators between each



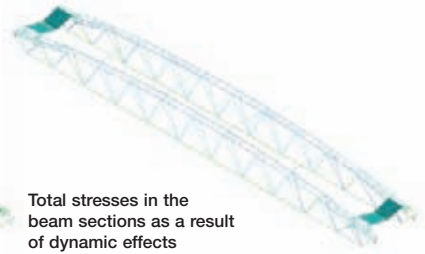
Deflections in roof structure, in the direction of motion of the leading truss

pair of trusses that are responsible for moving the roof. These actuators are subject to obvious physical forces, such as the weight of the trusses, as well as more subtle forces, such as the changing tension of the fabric canopy. ANSYS Mechanical technology supported the full range of simulation and analyses needed to verify the design of the roof system. ACA performed verification of the roof's design in a timely and cost-effective manner so that construction could proceed.

The retractable roof made its Championships debut in mid-2009, when rain would have otherwise interrupted a match. As the two roof sections came together, the capacity crowd rose in a standing ovation. ■



Axial forces in the roof structure as a result of dynamic effects



Total stresses in the beam sections as a result of dynamic effects