conference preview

# RISE UP

BY ERLEEN HATFIELD, SE, PE, MOHAMMED HAQUE, PE, AND YASMIN REHMANJEE, SE, PE

Atlanta's soon-to-be-open, steel-framed Mercedes-Benz Stadium, home to the city's NFL and MLS teams, features an operable roof with a twist.

**MERCEDES-BENZ STADIUM** in Atlanta has reinvented the retractable roof.

The new venue is topped with a retractable roof design that has never been done before. It will house the largest LED video board in all of sports and is on target to become the first LEED Platinum stadium in the U.S. The 71,000-seat facility is expandable to 75,000 seats for larger (playoff) football and soccer events and 83,000 for concerts.

## A Roof Innovation

BuroHappold Engineering worked closely with architect HOK to develop a retractable roof concept that was not only unique, but also provides views of the mammoth 360° "halo" scoreboard from every seat in the house.

"From the beginning, [Falcons owner] Arthur Blank set out to redefine the stadium experience," says Scott Jenkins, general manager of Mercedes-Benz Stadium. "The stunning architecture and complex structure creates an iconic stadium that features a unique eight-petal operable roof and striking façade that provides dramatic views of Atlanta. The stadium is a remarkable example of what can be accomplished through creativity, teamwork and collaboration across all disciplines of the project team."

The stadium's retractable roof can open in 10 minutes or less by moving eight "petals" that create an eye-catching pinwheel effect while opening. While the petals appear to spin open, this is an optical illusion: in reality, they move in straight lines to the open position. The eight moving steel-framed petals cantilever from the primary trusses, which are 196 ft to 232 ft long with 40-ft back spans. To keep weight down and provide natural daylight, the petals are clad in more than 120,000 sq. ft of double-skin ETFE (ethylene tetrafluoroethylene) cushions; ETFE is a transparent, inflated lightweight material that exerts minimal weight on the long cantilever spans. When the petals slide open, the resulting oval-shaped hole spans lengthwise beyond each end zone.

Due to the cantilever of the petals, the roof trusses must support both a downward force and an uplift force. The trusses are typically 70 ft deep and are framed with a 12-ft square top chord truss box comprised of four chord members, with the tension chord 58 ft below. The roof structure is framed with four primary trusses that span 723 ft and provide support to the downward force from the cantilevered petals. In addition, secondary trusses support the uplift rails for the moving petals. Both 65-ksi and 50-ksi steel were used, including the newest jumbo shapes (W14×873).

The moving components, known as "bogies," were designed by Uni-Systems Engineering, and each petal is supported on six uplift bogies and eight gravity bogies that move the petals between 185 ft and 230 ft across the roof. The bogies are powered by eight 7.5-hp traction drive wheels per petal that move on the gravity rails. Over 700 tons of rails and rail girders are supported on the roof.

**Erleen Hatfield** (erleen.hatfield@burohappold.com) is a partner and the leader of structural engineering in the U.S., **Mohammed Haque** (mohammed.haque@burohappold.com) is an associate principal and the technical director for the Mercedes-Benz Stadium project and **Yasmin Rehmanjee** (yasmin.rehmanjee@burohappold.com) is an associate principal and the project manager for the stadium, all with BuroHappold's New York office.


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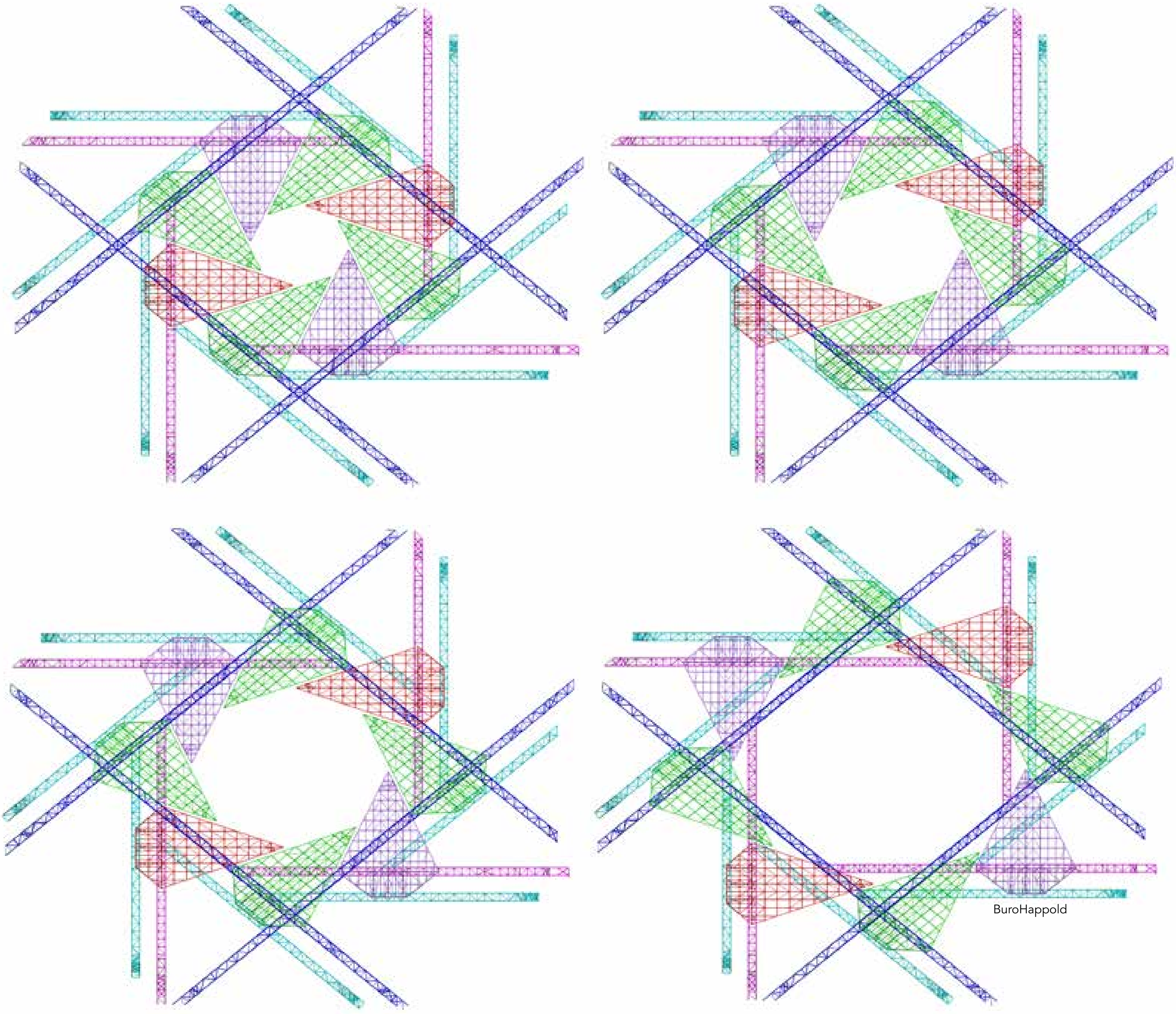
### Alternate Delivery Method

The structural design team provided two steel mill orders, based on Tekla 3D models, to the general contractor—Holder-Hunt-Russell-Moody, a joint venture—the first of which included 65-ksi members and occurred approximately eight months before the architectural construction documents were issued. The second order included 50-ksi steel members and was issued approximately five months before the documents were issued. The mill order models allowed the design team to communicate the complex geometry of the roof at almost the push of a button. It also saved time because the steel fabricator, Canam, was able to rely on the model for member properties and geometry, thus eliminating the need for creating a model from scratch.

Steel shop drawings were submitted to the design team in a 3D Tekla model as the official medium for review, as stated in the structural steel specifications. This shop drawing process provided a 3D visual that facilitated the model review process—which was not only essential to understanding and reviewing the complexities of the structure, but also simplified the review of repetitive components.

The 3D model was used extensively throughout the design process, though PDFs derived from the model were used to mark comments, at Canam's request. Tekla software was leveraged to create customizable reports so the reviewers could easily extract large quantities of information and export it into spreadsheets for clearer and faster interpretation of the steel assemblies within a given submittal. This 3D in-model-review approach saved time and yielded greater accuracy in the review of steel shop drawings. The architects were involved in the 3D review process as well, opening models and commenting on architectural interfaces with the structure during steel submittal review.

The benefits of this delivery method extended beyond submittal review. The model facilitated management of submit-




The roof, in various stages of opening.

tal information and was also used for coordination with other trades. Furthermore, Holder-Hunt-Russell-Moody imported the 3D steel fabrication models, with connections included, into Navisworks software to assist in a rigorous BIM coordination process with architectural and MEP systems, which helped solve coordination issues in the office or trailer rather than in the field. This approach eliminated paper submittals and helped further drive the project's sustainability efforts.

## Greenest Stadium

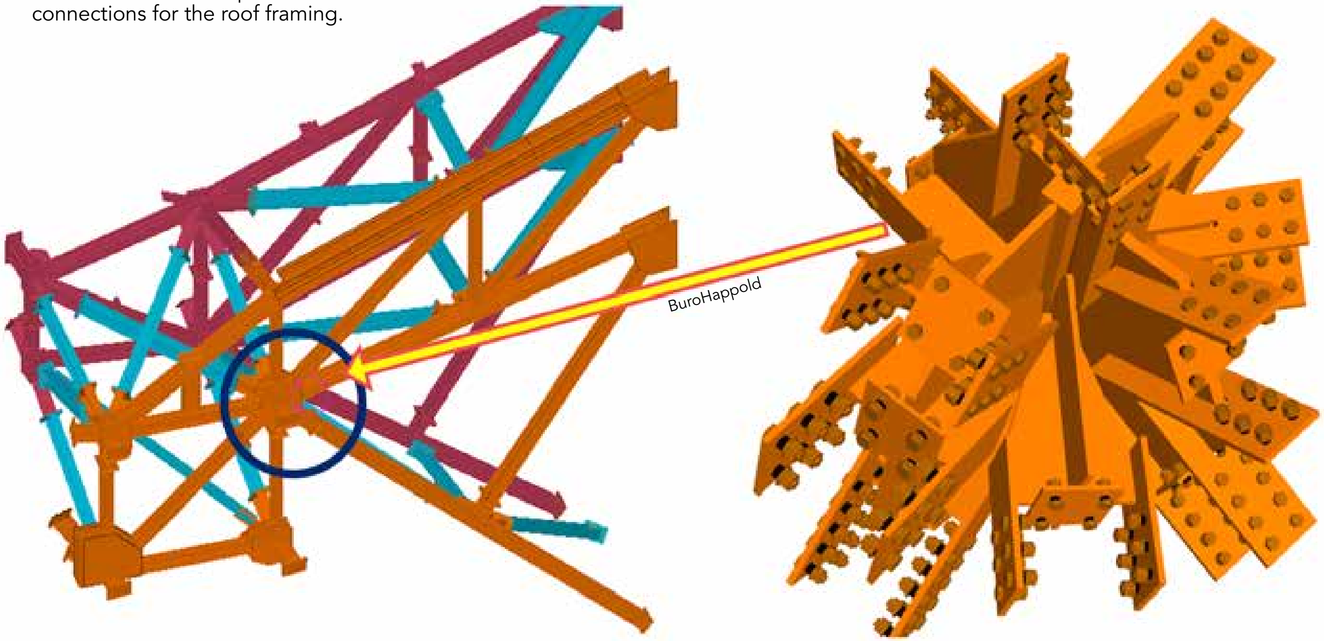
A comprehensive sustainability strategy encompassing design, construction and operations has the project on track to become the first LEED Platinum stadium in the U.S. The translucent enclosure and operable roof work to minimize energy use for lighting, heating and cooling. Storm water capture, high-efficiency plumbing, fixtures, photovoltaic arrays, electric vehicle charging stations and transit connections all contribute to the stadium's exceptional performance.

The many firsts integrated into the stadium's design advanced multiple goals concurrently, resulting in a dramatic work of architecture that uses materials, space and structure ef-


Atlanta Falcons

▲ Visit **tinyurl.com/pdgdapb** to see a video of the project, complete with visuals of the roof opening.

▼ One of the more complex connections for the roof framing.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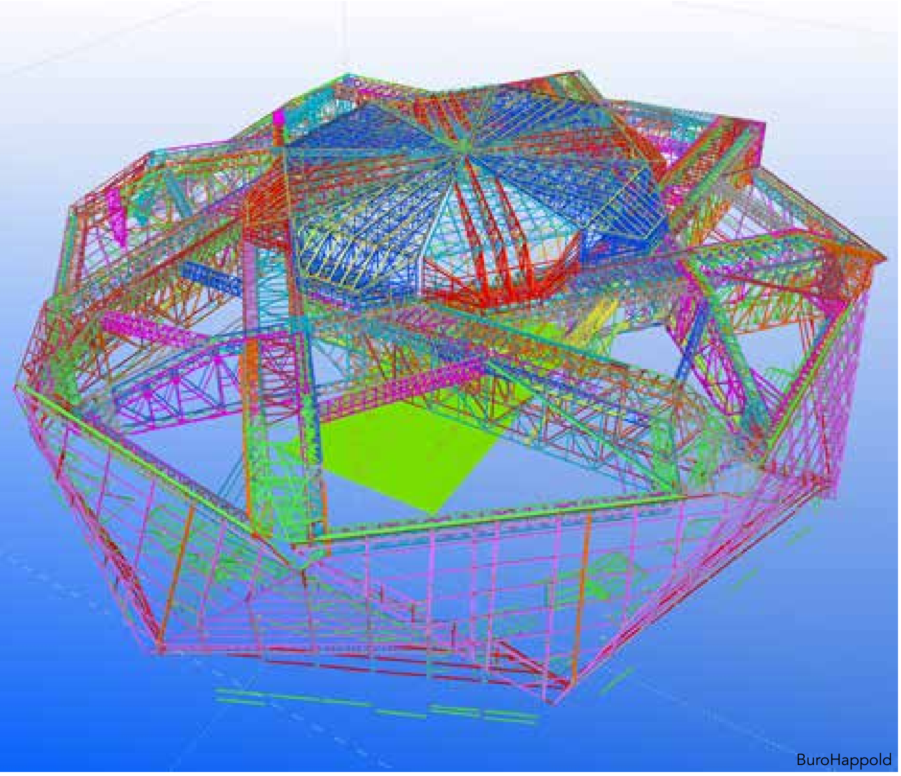
ficiently and intelligently. The stadium's bold engineering transforms the fan experience while setting a new standard for retractable roofs and sustainability in multipurpose venues. ■

*This article is a preview of Session T1 "Rise Up—Atlanta Falcons Stadium Roof" at NASCC: The Steel Conference, taking place March 22–24 in San Antonio. Learn more about the conference at* ***www.aisc.org/nascc****.*




▲ The moving roof components are known as "bogies," and each petal is supported on six uplift bogies and eight gravity bogies that move the petals between 185 ft and 230 ft across the roof.

**Owner**
Georgia World Congress Center Authority

**Architect**
HOK

**Structural Engineer**
BuroHappold Engineering
Sykes Consulting Engineers (foundations)

**General Contractor**
Holder-Hunt-Russell-Moody, a joint venture

**Steel Team**

**Fabricator and Detailer**
Canam Steel Corporation (AISC Certified Fabricator)

**Erectors**
Derr & Isbel Construction, Euless, Texas (AISC Certified Erector)
Superior Rigging & Erecting Co., Inc., Atlanta (AISC Certified Erector)

**Detailers**
Dowco Consultants, Ltd., Surrey, B.C., Canada (AISC Detailer)
Anatomic Iron and Steel Detailing, North Vancouver, B.C., Canada (AISC Detailer)

### High-Def Halo

The steel roof structure supports a high-definition halo-style video board—the largest in the world—that displays 360° imagery. Supplied by Daktronics, at nearly six stories tall and 1,100 ft in circumference, the board weighs approximately 1,000 tons—a considerable amount to support at the mid-span of the roof trusses. Additionally, 150 tons of rigging loads can be supported simultaneously. The halo will enhance the experience for every fan, whether the roof is open or closed.