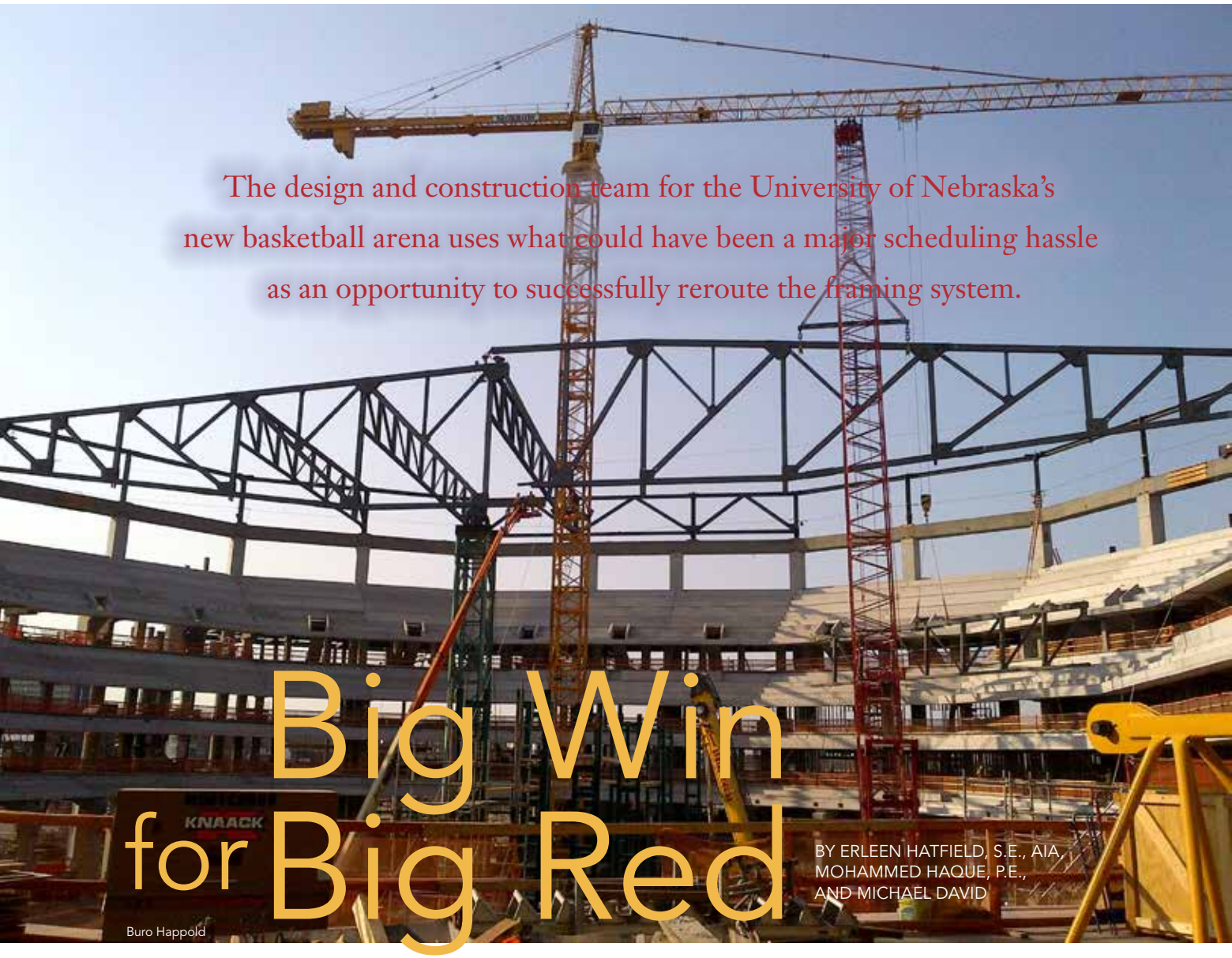

The design and construction team for the University of Nebraska's new basketball arena uses what could have been a major scheduling hassle as an opportunity to successfully reroute the framing system.

Big Win for Big Red

BY ERLEEN HATFIELD, S.E., AIA, MOHAMMED HAQUE, P.E., AND MICHAEL DAVID

Buro Happold

THIS PAST DECEMBER 12, the last steel beam was raised into place for the new Pinnacle Bank Arena in downtown Lincoln, Neb. Hundreds, clad in red hard hats (Nebraska Cornhusker fans are often seen wearing red) joined the design and construction team to witness the topping out of the arena, which will be the new home of the University of Nebraska's basketball teams.

It was no easy feat to reach this milestone. The project site was crossed by a series of active railroad tracks to the east and west, and a large part of the construction—including the installation of major portions of the concourses and stair towers—could not begin until a year after the groundbreaking, after the tracks could be relocated.

"Because of the railroad tracks on both sides of the arena, it was a major challenge to design a project of this complexity in phases, working around the difficulties of the site," explained Paula Yancey, president of PC Sports, the owner's representative. To meet the challenging schedule, the team leveraged digital tools, including Autodesk Revit and Tekla software, which helped expedite the design and construction as well as steel fabrication.

DLR Group, known for the Century Link Center in Omaha, designed the $180 million arena, which will host the University of Nebraska Men's and Women's basketball teams, plus a host of other entertainment and sporting activities. Scheduled to open in September, the arena will initially accommodate 16,000 seats and will have the capacity to eventually expand to 18,000.

In addition to its primary role, the arena also serves as an anchor for new development in the West Haymarket neighborhood, a former warehouse district in Lincoln. The construction of the arena has catalyzed a burst of new urban growth, including lively restaurants, hotels, residential buildings and retail space. Since the West Haymarket area consists of low-rise brick structures, DLR Group made a conscious effort to scale down the façade and use contextual materials that will harmonize with the neighboring structures.

"It was important to complement the surrounding buildings and give a sense of congruency," said Stan Meradith, AIA, lead architect for DLR Group. "The design of the new arena appropriately fits into the existing development, given the context and juxtaposition of turn of the century buildings with 21st-century architecture, creating a destination that's integrated into the West Haymarket district and the Lincoln community at large."

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Staying on Track

Initially, the team planned to build the entire bowl out of concrete. In order to meet the construction schedule, DLR Group designed a seating bowl that could be built between the existing tracks. However, there remained over 100,000 sq. ft of construction that could not be started until the railroad tracks were removed, compressing the time frame to finish construction. To expedite construction, DLR Group, Buro Happold and Mortenson Construction considered different design configurations of the seating bowl and concourses. As the various iterations of steel and concrete structures were explored, it became evident that if more areas were steel-framed, they could be fabricated early and ready to erect around the perimeter of the site as soon as the tracks were extracted, thus keeping the project on schedule. The unusual lower structure consisted of a concrete bowl and portions of concourses framed with concrete but with steel framing for the four stair towers as well as for portions of the concourses in the areas of the former railroad tracks. This mixing of materials made for a complex and unique lower bowl structure.

"The team's collaborative and open-minded approach was the engine that drove a successful project," said John Hinshaw, senior project manager at Mortenson. "With a mandate to overcome nearly impossible schedule demands, Buro Happold designed a unique structural engineering approach to marry a cast-in-place structure with a steel structure."

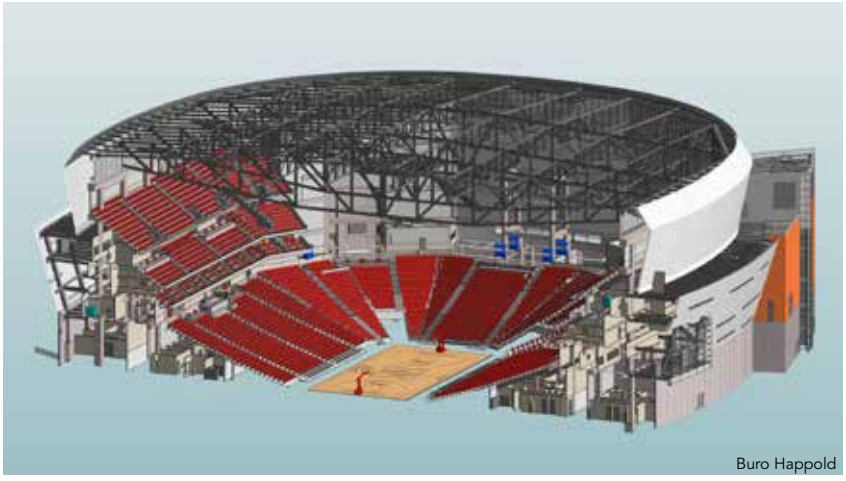
In addition to facilitating the construction schedule, steel enabled the team to create a roof that clears spans of 350 ft × 480 ft and supports a 25-ton scoreboard plus the rigging loads of 62.5 tons for center stage shows and 80 tons for end stage shows. In addition, the roof supports catwalks, speakers, lapidary panels for acoustic control, half-house curtains and 6-ft ring ducts.

The roof is framed with four main trusses that are 36 ft deep at the center and span 350 ft to a concrete ring beam at each end. The top chords of the main trusses slope at ¾ in. per 12 in. towards drains located at the perimeter of the roof.


DLR Group

The arena will initially accommodate 16,000 seats and will have the capacity to eventually expand to 18,000.

A Revit model of the arena.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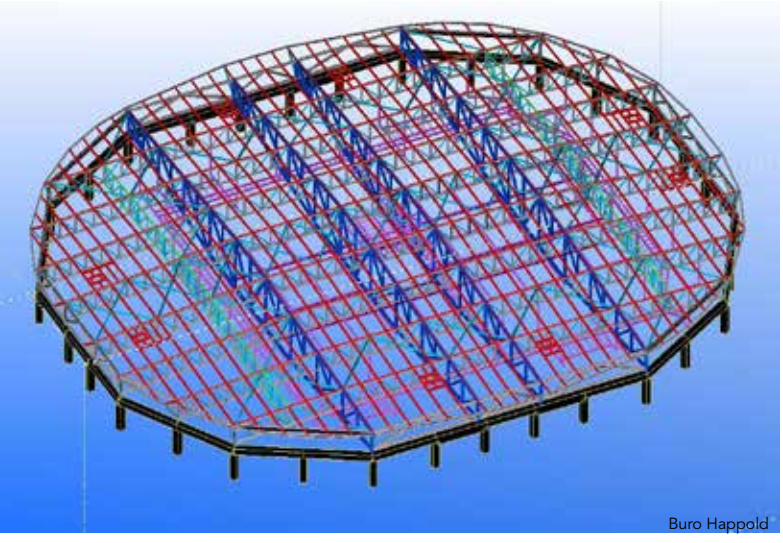
Erleen Hatfield is a partner and the U.S. structural engineering leader for Buro Happold. She is a member of the ASCE Committee on the Design of Steel Buildings and the AIANY Technology Committee. She also teaches at Yale University. You can reach her at **erleen.hatfield@burohappold.com**. **Mohammed Haque** is an associate principal in Buro Happold's New York office and is the project leader for the Pinnacle Bank Arena. He specializes in the design of complex steel and concrete structures and has designed multiple stadiums and arenas. You can reach him at **mohammed.haque@burohappold.com**. **Michael David** is structural engineer in Buro Happold's New York office and an engineer for the Pinnacle Bank Arena. With a background in high-performance structures, he specializes in using software interoperability for the design and construction of complex steel structures. You can reach him at **michael.david@burohappold.com**.



▲ A Tekla model of the roof's structural system.

➤ Topping out the facility.

➤ The roof can support a 25-ton scoreboard plus rigging loads for center stage (62.5 tons) and end stage (80 tons) shows.

To facilitate the rigging platform, the bottom chords of the main trusses are horizontal and at the same elevation. The main trusses have 52 members, allowing for quick assembly on site and erection. The entire roof was erected in less than four months.

The schedule allowed enough time to procure high-strength 65-ksi steel for truss chord and web members over W14×90 (50-ksi steel was used for the rest of the project), therefore saving on material and cost. The roof truss chord members are turned web horizontal. In between the main trusses are a series of smaller trusses, 12 ft in depth. The smaller trusses brace the main trusses and support the roof purlins, which are typically W14 members. The steel roof deck is 3-in.-deep type N, supplied by Canam Steel.

BIM Adds Value

The team used Autodesk Revit 2011 to create a building information model that facilitated coordination of the various disciplines—structural, architectural, MEP and façade. The team shared its Revit model with Mortenson at the end of the construction document phase to use for reference in the field. During

▲ The high roof uses 1,943 tons of structural steel...

▼ ...while the seating bowl uses 1,626 tons.

Photos this page: Danny's Construction

▲ The roof is framed with four main trusses that are 36 ft deep at the center and span 350 ft to a concrete ring beam at each end. The top chords of the main trusses slope at ¾ in. per 12 in. towards drains located at the perimeter of the roof.

▼

construction, the workers and design team had the ability to refer to the model in the field using BIM stations that Mortenson set up at many locations on-site. In addition to the 3D model, Buro Happold used Tekla software to create a fabrication model of the roof members, which included typical modeling preferences so it could be used immediately by the fabricators without rework.

At the completion of the construction documents, Buro Happold provided Mortenson with the Tekla fabrication model and gave the fabricator the right to rely on the model for the information contained in it. This pioneering approach gave the fabricator confidence in the model fidelity and jump-started the mill order and shop drawing phases quickly after the contract was awarded—plus the Tekla model allowed the fabricators and erectors to use the model to pull quantities and better understand the project complexity during bidding, thus promoting tighter bids and accelerating the schedule.

"The fabrication modeling not only expedited the delivery of materials for this project but also dramatically facilitated the way we built the structure," said Hinshaw.

When Pinnacle Bank Arena opens in the fall of 2013, it will be a landmark destination for more than 200,000 Lincoln residents, and Nebraska's $4 billion tourism industry. At completion, the project will contain bowl will contain more than 3,500 tons of fabricated steel: 1,626 tons for the bowl and 1,943 tons for the high roof. Though the design and construction team faced many challenges in the execution of the project, it also opened the door to explore new opportunities in design and construction approaches. A collaborative team effort and innovative design have resulted in a signature project that Huskers fans hope will spur their teams on to success. MSC

Owner
West Haymarket Joint Public Agency

Architect
DLR Group, Omaha

Structural Engineer
Buro Happold, New York

General Contractor
Mortenson Construction, Minneapolis

Steel Team

Fabricators
LeJeune Steel Company, Minneapolis (AISC Member/AISC Certified Fabricator)
Midwest Steel Works, Inc., Lincoln (AISC Member/AISC Certified Fabricator)

Erector
Danny's Construction Company, Inc., Shakopee, Minn. (AISC Member/AISC Certified Erector)

Detailer
Computer Detailing, Inc., Salt Lake City, Utah (AISC Member)