BIM and BRBs bring big benefits to a hospital project in southeast Missouri.

Rapid Response

BY JASON D. PERRY, S.E., P.E.

All images this spread: Stanley D. Lindsey and Associates, Ltd.

POPLAR BLUFF is known as the "Gateway to the Ozarks."

The southeast Missouri town of roughly 17,000 is also home to a newly opened hospital that hopes to be recognized as the premiere medical facility in the region.

The area had long been served by the two campuses of Poplar Bluff Regional Medical Center, but in early 2011 the facility's owner, Health Management Associates, determined that the facilities had become outdated and no longer met the needs of the community. In May 2011 the company approached architect Thomas, Miller and Partners (TMP) about designing a replacement. The new facility, at 424,000 sq. ft and with a capacity of 250 patient beds, would not only need to meet present needs but also be required to accommodate a future expansion of an additional 50 beds.

Besides the expansion requirements, the design also needed to address a grade change on the site as well as high seismic requirements (thanks to Poplar Bluff's location near the New Madrid Seismic Zone), as well as a request from Health Management Associates that the facility be fully operational by January 2013. After receiving the Certificate of Need for the new facility from the State, that left only 20 months for the space programming, all of the various design phases, permitting and construction to occur.

Jason Perry is an associate with Stanley D. Lindsey & Associates, Ltd., in Brentwood, Tenn. You can reach him at **jperry@sdlal.com**.

Planning for Growth

One of the first challenges for the structural engineer, Stanley D. Lindsey and Associates, Ltd. (SDL) and TMP was to define the best location for the future patient rooms. The hospital was designed as a seven-story building with a partial basement that featured a "U" shaped patient room floor. It was determined that the two legs of the U would be four stories for now and that three additional stories could be added in the future.

Next, the gravity load resisting system needed to be selected. Due to the building height and column locations, two primary systems were considered. The first system was a composite lightweight concrete slab with steel wide-flange beams, and the second was a one-way concrete structure consisting of mildly reinforced concrete beams and girders. The composite structural steel system was selected because it minimized the construction time at the site when compared to a concrete system. In addition, the steel structure provided greater flexibility of the design, which overlapped with construction.

The existing soils on the site were not adequate to support the proposed facility on conventional shallow foundations. The geotechnical engineer provided two foundation systems suitable for the project. The first option was to support the building with deep foundations consisting of drilled concrete shafts. The second consisted of bearing conventional spread footings on soils strengthened with rammed aggregate piers (Geopiers). The contractor evaluated both options and the Geopier option

◄ The new Poplar Bluff Regional Medical Center replaced two outdated facilities.

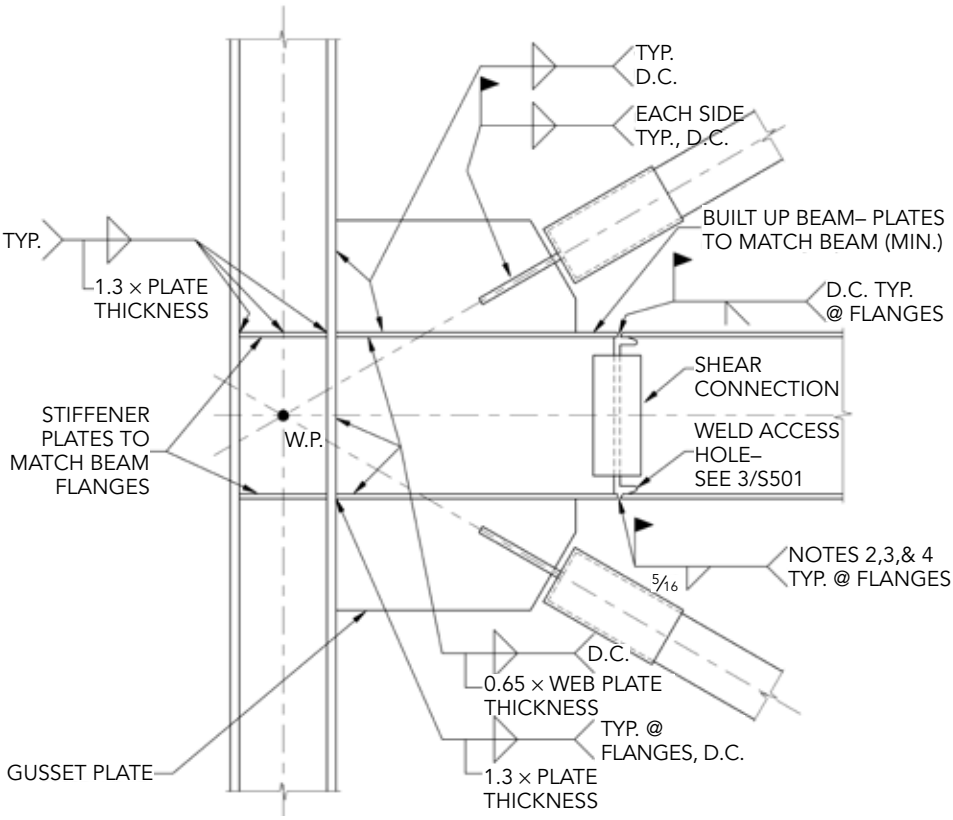
► Erection of the patient tower.

was selected because it was less expensive and, like the chosen gravity load resisting system, had a considerably shorter construction schedule when compared to the drilled shaft option.

Given Poplar Bluff's proximity to the New Madrid Fault, the project was classified as high-seismic and therefore required a highly ductile system as the lateral load resisting system. SDL determined that three systems could be well-suited for the project: special concrete shear walls, eccentrically braced frames (EBF) and buckling restrained braced frames (BRBF). Because of the schedule, the contractor, M. J. Harris (MJH), was selected early in the design process and provided feedback on the systems being considered. MJH eliminated special concrete shear walls due to the adverse impact they would have on the schedule, leaving a choice between the two structural steel systems. SDL prepared a typical frame for a cost comparison between the EBF and BRBF systems. The respective costs of the two systems, including the proprietary braces, were approximately equal. However, the BRBF system would save approximately 7,000 shop hours and decrease the overall fabrication time; thus this system was selected as the lateral force resisting system. During the design process the BRB (buckling restrained brace) supplier, Star Seismic, worked closely with SDL, giving guidance on the best brace configuration to minimize beam and column sizes as well as reviewing the lateral design.

Once the final design of the structure was complete, the structural steel weight was 11.3 lbs. per sq. ft. This encompassed the main structural steel, connection material, bolts, canopies, screen walls and miscellaneous steel including the owner-furnished equipment supports. Overall, nearly 2,400 tons of structural steel were used on the project, not including the BRBs.

A building information modeling (BIM) approach, with Autodesk Revit at the center, was used to create the construction documents



► Middle: A typical BRB connection detail; D.C. stands for "demand critical."

Bottom: Welding the BRB connections.

Stanley D. Lindsey and Associates, Ltd.

Stanley D. Lindsey and Associates, Ltd.

▲ The main tower during construction.

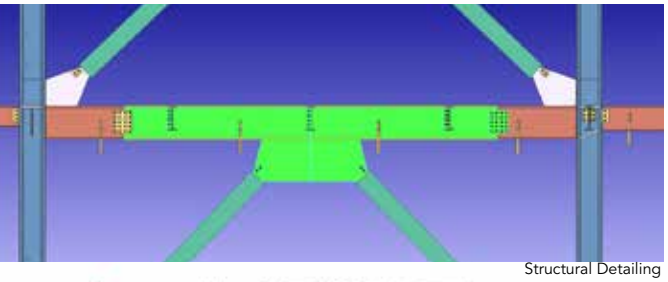
▼ A typical SDS/2 BRB connection rendering.

◀ Overall, nearly 2,400 tons of structural steel were used on the project, not including the BRBs.

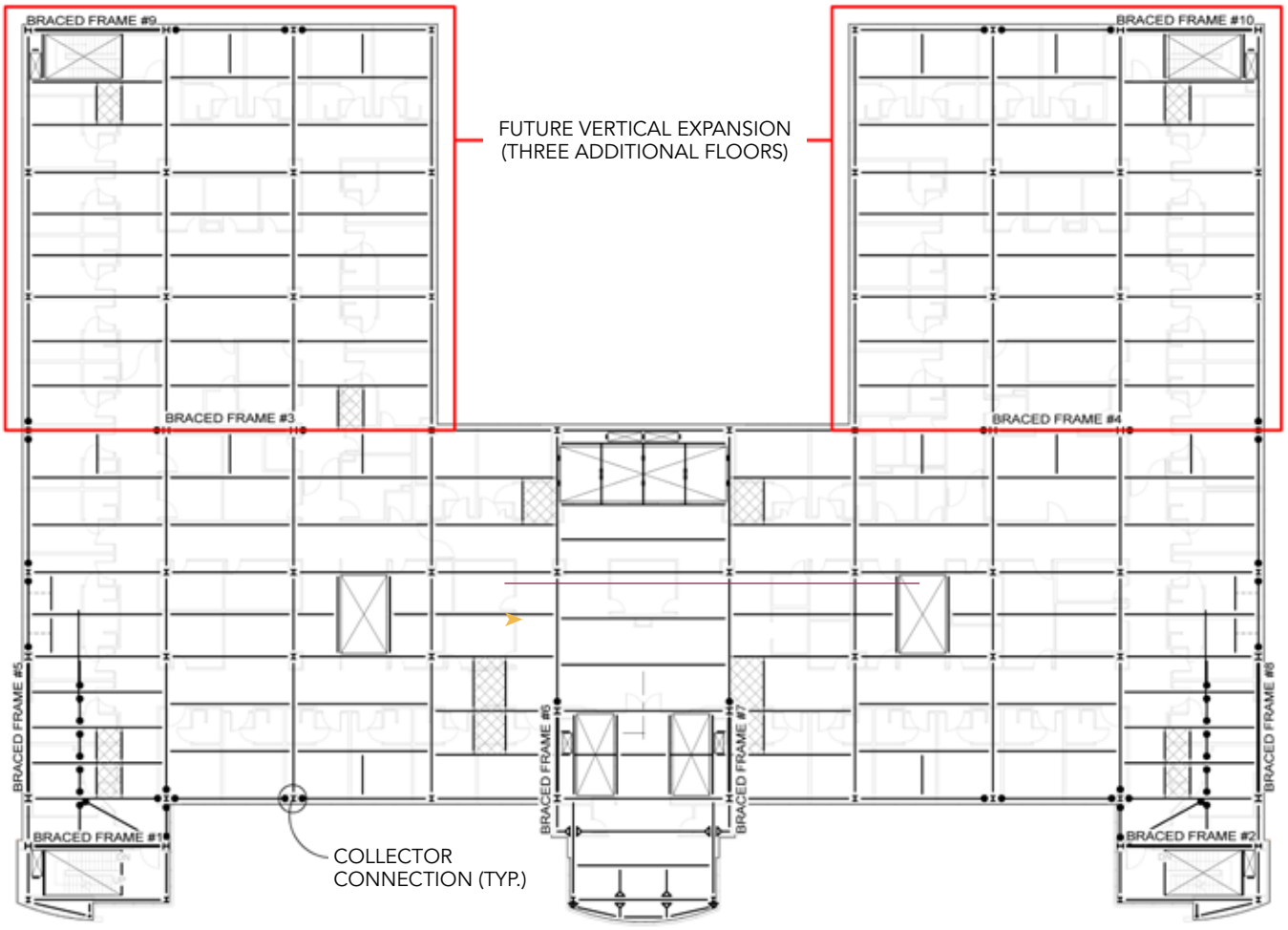
and convey the design information to the contractor. This allowed the design team to better coordinate between the different disciplines prior to the actual construction in the field, a situation that was especially important when it came to the braces and gusset plates in the patient rooms and outdoor dining areas. Star Seismic was able to provide the actual brace sizes early during the design phase as well as provide connection designs and details to the steel detailer, and SDL was able to accurately model the braces and connections in the critical areas requested by TMP. This allowed the architect to fully visualize the structural system and modify the architecture as required to minimize the impact of the braces and connections to the building design.

Fast Pace

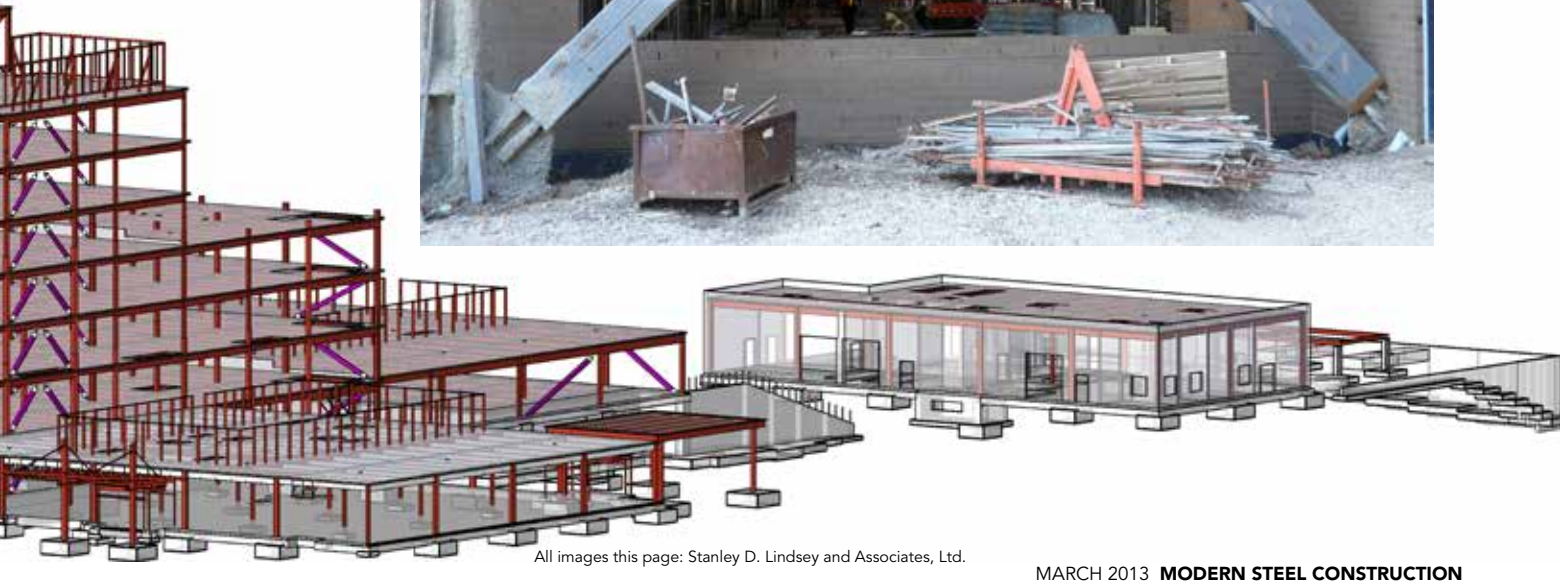
The request for the facility to open by January 2013 resulted in a reduction of a typical design and construction schedule by at least a year. The condensed design schedule had the design phase beginning in August 2011 and the final construction documents being issued in January of 2012. In order for MJH to meet its build schedule, construction of the structure itself had to begin by November 2011. The only way to accommodate this start date was to release the structure in multiple packages. The first structural package, the foundation and retaining wall package, was released on October 14, 2011 and over the next three months, 17 structural packages were provided to MJH before the final construction document package was released.



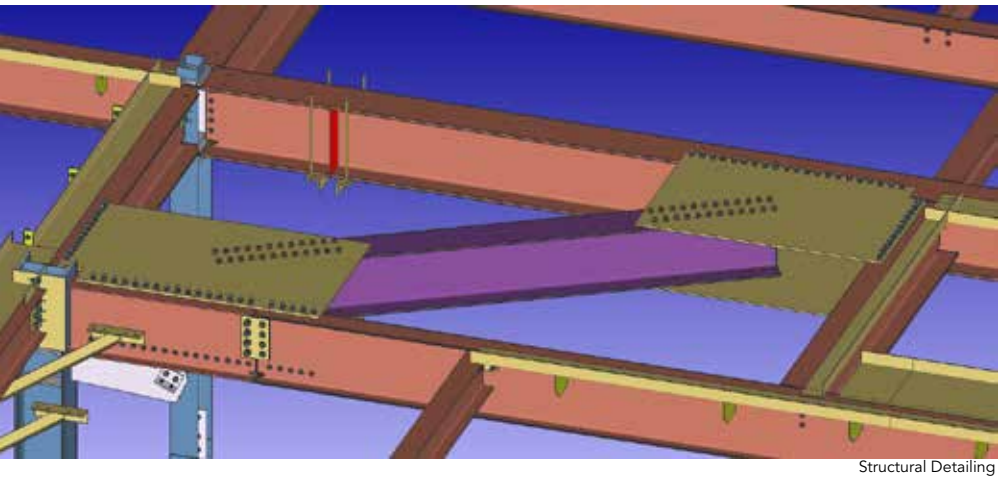
Structural Detailing



- A typical patient floor framing plan.
- Exposed BRBs at the outdoor dining area.
- An Autodesk Revit 3D model of the hospital.



All images this page: Stanley D. Lindsey and Associates, Ltd.



Structural Detailing

SDS/2 connection rendering of a 400-kip collector.

To facilitate and expedite the design process, weekly meetings were held between TMP, SDL, MJH, Wylie Steel (the fabricator) and the erector to discuss the design as well as to let the construction team give input on the initial design of the various structural elements. It also allowed the design team to ask for input on the most economical method of achieving a structure that met all design requirements. This reduced the amount of alternates proposed by the contractor during construction and freed up the design team to incorporate the preferred details into the initial design. These meetings provided an excellent opportunity for the contractors to speak with the designers about the construction schedule and to request the release of certain critical path structural elements early. The constant communication between the design and construction teams permitted the design team to prioritize the element designs to minimize delays to the project.

Throughout the construction process, the design team continued to work with the contractor toward meeting the January 2013 deadline, and SDL and the TMP expedited RFI responses and shop drawing review. The construction team was able to top out the structure on May 9, 2012—the one-year anniversary of receiving the certificate of need for the facility—and the new $112 million Poplar Bluff Regional Medical Center was turned over to the medical staff on time in January 2013, as requested. MSC

Owner
Health Management Associates, Inc.

Architect
Thomas, Miller and Partners, PLLC, Brentwood, Tenn.

Structural Engineer
Stanley D. Lindsey and Associates, Ltd., Brentwood

General Contractor
M. J. Harris, Inc., Birmingham, Ala.

Steel Team

Steel Fabricator
Wylie Steel Fabricators, Inc., Franklin, Tenn.
(AISC Member/AISC Certified Fabricator)

Steel Detailer
Structural Detailing, LLC, Brentwood (AISC Member)