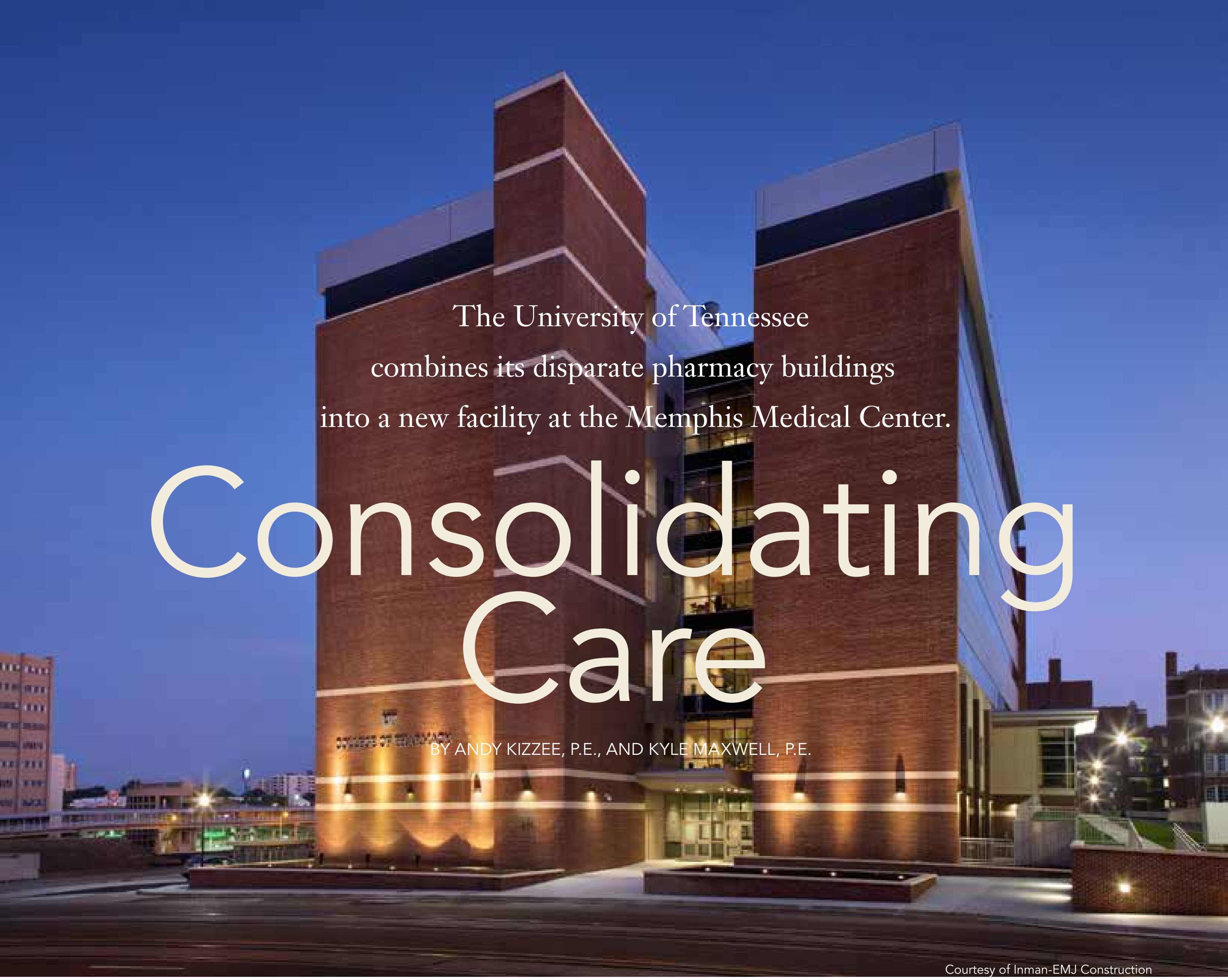
The University of Tennessee combines its disparate pharmacy buildings into a new facility at the Memphis Medical Center.

Consolidating Care

BY ANDY KIZZEE, P.E., AND KYLE MAXWELL, P.E.



Courtesy of Inman-EMJ Construction

THERE'S A LOT going on at the Memphis Medical Center. The complex, home to the University of Tennessee Health Science Center (UTHSC) campus, also includes the Regional Medical Center, Methodist Teaching Hospital, Le Bonheur Children's Hospital, VA Medical Center, Memphis Bioworks Foundation and around 35 other world-class health facilities.

UTHSC's new $65 million, 185,000-sq.-ft, seven-story College of Pharmacy building is one of the newest additions to this ever-growing healthcare epicenter. The facility consolidates the university's College of Pharmacy from six separate buildings spread over the campus into one research, learning and applied pharmaceutical technology center and is part of 1.4 million sq. ft of new laboratory, research, education and business space planned for the Memphis Medical Center. The building is separated into two distinct uses: office and education/research, which are physically separated into a single-bay-wide six-story office complex and a two-bay-wide seven-story laboratory, research and education tower. The two building components are joined together with a full-height atrium and linked at each floor with three full-bay "bridge" components.

Site Constraints

The building is situated on the east end of the UTHSC campus on property previously occupied by the Baptist Hospital Physicians Building (circa 1920). The site was confined on three sides by an existing access drive and utility corridor, a new plaza and service dock (under construction) and an existing access drive to the plaza service dock. These limitations, as well as the grade change across the existing site, necessitated the design to incorporate a basement under the first floor to allow on-grade deliveries under the plaza level and a split-level west entrance. A 32-ft retaining wall on the west side of the building was used to frame mechanical areas. In addition to the space issue, Memphis is located near the southern end of the New Madrid Seismic Zone. On top of that, the existing soils on-site were not adequate to resist the loads from the seven-story building using conventional footings, prompting structural engineer Smith Seckman Reid (SSR) to employ auger-cast reinforced piles extending 50 ft into the soil.

When it came to the gravity framing system, SSR analyzed two different options early in the project: a one-way concrete-framed pan joist system or a composite steel beam with lightweight composite slab system. The physical separation of the two halves of the building created a unique column layout. Due to the geometry of the column spacing and building orientation, the steel-framed system offered the most economical solution, and its comparatively lower mass reduced the seismic loads on

◄ The project uses nearly 2,500 tons of structural steel in all.

► The monumental stair is framed with a continuous exposed HSS14×4×3/8 stringer.

Courtesy of Inman-EMJ Construction

the building. Typical gravity framing includes columns ranging from W12×210 on the bottom floor to W12×96 at the top level. Members on the 29-ft single-bay office portion of the tower were W24×55 girders and W12×22 infill beams, and those on the 56-ft-wide two-bay laboratory portion were W27×102 girders and W21×44 infill beams.

After the gravity framing system was determined, SSR analyzed two different lateral force resisting systems for the project: a steel special concentrically braced frame system and a special steel moment frame system. Building geometry played a major factor in this decision as well, and the latter option was deemed inappropriate for deflection issues related to it—and also because the office tower is only one bay wide. Therefore, braced frames were chosen. The bracing in the laboratory portion was all single diagonal braces, varying from HSS10×10×5/8 at the base to HSS5×5×1/2 at the top. The office portion required inverted V-bracing, most of which was HSS8×8×1/2; this inverted V orientation required W36×328 beams.

Keep 'em Separated

To execute the proposed floor plan, SSR investigated separating the two components of the facility with an expansion joint. As the original plan did not accommodate the required width of this expansion joint, particularly at the three crossover "bridge" elements, the team designed W12×72 X-braced frames in the floor framing of the "bridges" that acted as horizontal diaphragm links on each level, effectively tying the building component diaphragms together. In addition, they strategically located braced frames near the crossover bridges through the atrium space to reduce the span and stresses of the floor diaphragm.

Furthermore, the vertical special concentrically braced frames were coordinated with the architectural floor plan to accommodate corridors, doors, laboratory equipment and finishes where the braces were exposed in the laboratory. One particular design challenge with the framing system was the architectural programming requirement of a column-free auditorium located on the first floor directly below the laboratory floors. This required that a six-story column be

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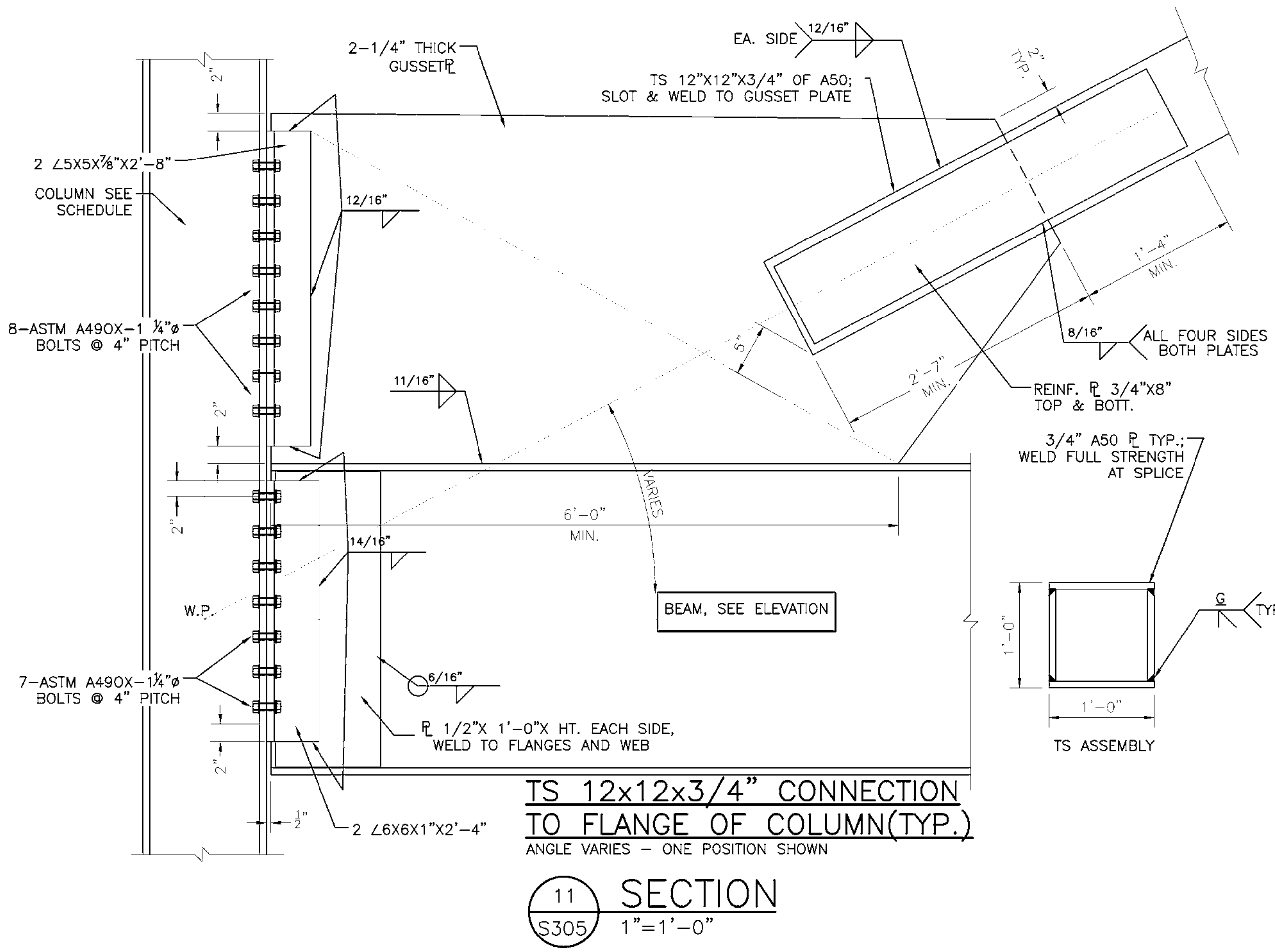


Courtesy of Evans Taylor Foster Childress

▲ A typical braced frame connection.

◀ Braced frames and a horizontal diaphragm.

terminated on the second floor with a transfer girder; however, there was not enough ceiling space in the auditorium for the transfer girder and the architectural floor plan of the second floor did not allow for the use of a full-height transfer truss. In response, SSR designed multiple transfer girders on the upper floors, the largest of which was a W40×397. These multiple girders transferred the column loads to the exterior columns and reduced the column load at the second floor to level that allowed the use of another W40 transfer beam, rather than using a plate girder or full story transfer truss. In addition, as the upper-level floor framing under the laboratories needed to resist vibrations caused by human traffic (to accommodate the sensitive equipment), the size of the girders and joists was increased and optimized under the composite slab in the laboratories.

The most visible structural element in the finished building is the multi-floor monumental stair located between each floor, spanning from the crossover bridges in the atrium to the next floor above. This element is supported by cantilever beams on the upper floors and is framed with a continuous exposed HSS14×4×3/8 stringer.

East elevation, under construction.

The exposed monumental stair, under construction.

Construction Cooperation

In an effort to minimize potential for transfer mistakes and facilitate accurate shop drawings, SSR provided the steel fabricator, Steel Service Corporation, with its RAM Structural model, which was used in the initial creation of the detailing model in SDS/2 and in coordination with the final construction documents and details. In many cases, Steel Service was able to identify conflicts within specified connections, bolt hole interferences and other miscellaneous interferences in the production of the shop drawings, and bring the issues to SSR's attention for resolution prior to fabrication and erection instead of in the field. This level of cooperation and coordination limited the in-field issues and changes during the steel erection, facilitating a smooth construction process.

Of course the project, like most, was not completely free of construction-related design changes. During construction of the temporary retaining wall, a previously unknown existing gas line was discovered, and its proximity to the basement walls and associated steel stair framing necessitated a revision in the foundation walls supporting the west entrance. SSR's solution was to relocate the foundation walls below grade and support a 2-ft, 8-in. square grade from a cantilevered portion of the retaining wall. This grade beam provided a foundation for the above-grade steel framed entry, thereby not affecting overall exterior appearance and functionality of the architectural design.

The structural steel for the entire projected amounted to 2,468 tons and helped address the design challenges related to seismic concerns, building geometry and site constraints. The completed College of Pharmacy adds a new research, education and economic engine to the UTHSC and the Memphis Medical Center, helping Memphis epitomize the city's vision to be "the city of choice in which to live, learn, work and play." MSC

Owner

University of Tennessee Health Science Center

Architect

Joint venture: TRO Jung Brannen (currently brg3s architects) and Evans Taylor Foster Childress, Memphis

Structural Engineer

Smith Seckman Reid, Memphis

General Contractor

Inman Construction (currently Inman-EMJ Construction) Memphis

Steel Fabricator, Erector and Detailer

Steel Service Corporation, Jackson, Miss. (AISC Member/ AISC Certified Fabricator)