A New Link to Learning

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An expanded bridge on Georgia State University's campus brings two library buildings together as one.

WHEN I FIRST WALKED INTO THE GEORGIA STATE UNIVERSITY LIBRARY at the start of this project, I was transported back to my college days at nearby Georgia Tech. The smell of musty old books, the long rows of shelves, and the dim lighting evoked "knowledge" to me.

For today's students, however, natural lighting, the hum of a hard drive, and the smell of lattes are what opens their minds for learning. Georgia State, in downtown Atlanta, understood this and had a vision to make its library more inviting and up-to-date, with goals to:

- Update finishes, furniture, and building systems
- Increase reader seats and collaboration spaces
- Expand collection space by adding compact shelving
- Expand the narrow three-story steel pedestrian bridge spanning Decatur Street and link the library's north and south buildings (from the 1960s and 1980s, respectively), making them act and feel like a single building

BIM from the Start

Both the architectural and structural teams were committed to using the Revit platform on the $17.5 million project, both for collaboration and production of documents. Walter P Moore was still in the early stages of implementing the new software when this project started. Despite the steep learning curve, we quickly saw the benefits of three-dimensional collaboration and coordination.

Modeling the existing concrete buildings and steel pedestrian bridge helped us to visualize and coordinate between old and new. Multiple schemes for the new link were explored for aesthetics, constructability, and cost. Three-dimensional views of the design helped the owner more easily understand the options. The construction manager and subcontractors used these same views to better comprehend and more accurately price the options, providing a clear direction at the end of schematic design that proved itself throughout the remainder of design and construction.

The chosen scheme for the new link was a downward vertical expansion of one floor, resulting in a four-story bridge, plus a horizontal expansion of 35 ft at the two lower bridge levels and 19 ft at the two upper levels. This resulted in the addition of about 11,000 sq. ft. The second level was supported at each side by trusses, while the middle portion of the floor was supported by a truss at the level above. A truss at the third level was already in place, so a similar truss was set alongside the existing to limit the impact on usable space. The new floors at levels five and six were supported by transfer girders at level four, which were in turn supported by the new trusses. This scheme maximized the usable open space between library levels two and four and optimized the structural load path to provide an efficient overall design.

Link Analysis

The original 15-ft-wide pedestrian bridge consisted of one-story trusses on each side, spanning about 75 ft and topped with two more stories of steel beam and column framing. The south end was attached to the south library structure, while the north was supported to the ground with a braced frame system on auger-cast pile foundations separate from the library's original north structure.

Our goal from the start was to avoid costly modifications to the existing walkway members and connections. We studied various structural

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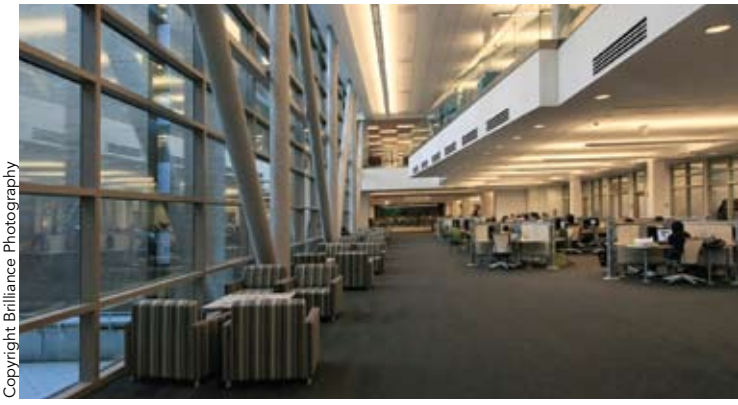
Above: Bridge erection was performed over a street, without shoring.

Center: The updated bridge included a vertical expansion of one floor, plus a horizontal expansion of 35 ft at the two lower bridge levels and 19 ft at the two upper levels.



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Above: A new mid-truss "sistered" alongside an existing truss.

design concepts that minimized the impact on the existing trusses. The final design entailed three trusses:

- The west truss is two stories high and spans between two new steel columns that aren't attached to the existing structure.
- The new east truss sat directly below the existing east truss to pick up a portion of the new second floor. This new east truss was designed to have stiffness compatible with that of the existing east truss so that new floor live loads would cause no net increase in loading on the existing truss.
- Similarly, the new "mid-truss," adjacent to the existing west truss, was designed for deflection compatibility with the existing west truss.

A staged analysis of the system was performed to ensure that the different phases of construction and various loading combinations did not overload the existing trusses and supporting structure. The mid-truss was set alongside the existing west truss and stitched together to ensure that there were no vertical stresses in the floors at the construction joint between the old and new slabs. The trusses were not stitched until after all the other framing and concrete slabs had been cast, in order that the only load to be shared between trusses would be the live load.

The original geotechnical report classified the downtown site as Site Class E. The team requested a site specific hazard study as well as shear wave velocity testing in order to more accurately assess the site class, which paid off by reducing the Site Class to D and the Seismic Design Category to B. The decreased detailing requirements and seismic forces helped reduce the required upgrades to the existing lateral system. The link expansion had very little impact on the eight-story concrete frame to the south, but the combination moment frame and braced frame at the north end was upgraded for the link expansion loads.

Constructability Challenges

Key to the project's constructability was the planning of the sequence of steel erection and the need to avoid shoring. The sequencing plan on the structural drawings specified that the trusses should be erected first, and the second and fourth floors should be erected next, which provided a working platform for the rest of the work over Decatur Street. While it would have been possible to keep the street open during construction, the contractor closed it for much-needed layout and staging space. Only after the remaining steel framing and concrete deck was placed could the connections between the new and existing structures be made. After all the structures were tied together, the cladding and finishes were attached.

Another constructability challenge was the deep foundations that were to be installed in the basement of the existing north library. The north end of the new link required new columns and foundations. The basement working clearance was only about 8 ft and required low-headroom equipment to install foundations. Auger-cast piles were chosen for this application since most of the foundations on the project were a standard installation. The steel framing at the lowest level was configured to take advantage of some significant overstrength in existing foundations and reduce the number of low-overhead foundations by about two-thirds.

Exposing the Structure

The design team initially leaned toward minimizing visibility of the structural systems, but the trusses were eventually turned into a signature element of the building. While the link's two-story open space over the road is dramatic in itself, the exposed pipe truss accentuates the height of the space. Once we had determined the diameter of the two-story truss web members, the architect did not want to wrap them in cementitious fireproofing and drywall, because they would become too bulky and obscure the views from both inside and outside. Also, because the truss web members connected right at the floor levels, pipe-to-pipe connections were made to eliminate gussets, which further enhanced the overall appeal of the system and minimized visual obstructions through the glass curtain wall.

Due to a very efficient design of the steel structure—resulting in a steel weight of 120 tons—the budget was able to accommodate the use of intumescent fireproofing on the web members of the exposed two-story truss. The wall thicknesses of some pipe member sizes were increased to reduce the required thickness of coating for the fire rating. The main shafts came to the site primed and painted with only the ends primed. The final coating was kept from the joints to keep the welding heat from damaging the intumescent paint.

Successful Transformation

Even with the exposed trusses, sleek connections, intumescent paint, difficult foundations, and other challenging existing conditions, the bridge project came in on time and under budget. The project team received an AIA award for collaboration using BIM technology. Both the owner and university community are thrilled with the "brand new" library. But most importantly, following the "scent of knowledge," students flock to the library every day and fill all the reader seats by early morning. MSC

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