A Bridge in Building's Clothing

BY TIMOTHY COSTELLO, P.E., AND MARK RAULLI, P.E.

A community college conceives a creative crossing to connect its campus.

THERE ARE A FEW WAYS to get over a gorge.

One idea is to build a bridge. Another might be to build a building.

Onondaga Community College decided to do both—but in one structure—and is in the process of completing an $18.9 million, 45,000-sq.-ft "bridge building" across the foliage-filled Furnace Brook Gorge, a 60-ft-deep fissure that divides its campus in Syracuse, N.Y. The gorge was, in fact, previously spanned by a bridge, but one that was open to wind, rain and snow. The new building will provide a protected crossing over the gorge—particularly enticing during the area's harsh winters. In addition, the two-story structure makes use of otherwise unusable land. And by avoiding underground rerouting of elements such as sewer lines and electrical conduits, which would have been required with the original proposed building location, it was achievable within the college's original budget.

The building is actually an addition to the school's Ferrante Hall and is also attached to the Gordon Student Center, uniting the east and west campuses and connecting the campus spine on the south with public, staff and student parking to the north. Conceived as a teaching facility offering outreach to community organizations in need of performance venues, the new building encourages an integrative approach to music by providing facilities for the entire music school, including administration, production, teaching, research and support spaces. The building also shares the Gordon Student Center's loading dock and other support functions.

Inside the addition, called Ferrante Hall Academic II, are a 150-seat music recital hall, a music resource center, a 2,500-sq.-ft instrumental rehearsal room, an 1,800-sq.-ft choral rehearsal room, 20 practice rooms of various sizes, 16 faculty teaching offices and eight classrooms. The recital hall can accommodate a 110-piece orchestra with an 80-member chorus, as well as another chorus at the stage end of the lower balcony if needed.

Because limited excavation was needed to bury elements such as electrical conduits and sewer lines, and because the building taps into existing parking, loading, utility infrastructure and site work, construction costs and environmental disruption were considerably reduced, freeing up resources to attack the project's numerous engineering challenges. These included a constricted work area, uneven loading, deflection and rock fragmentation.


Cannon Design

▲ Ferrante Hall Academic II, which opens in May, adds 45,000 sq. ft of building space to the Onondaga Community College campus.

➤ Installation of two of the 200-ft-long trusses for the new building.


Tim Wilkes Photography

▲ The new "bridge building" uses 860 tons of structural steel in all.

▼ The final truss is installed.


Tim Wilkes Photography


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Over the Gorge

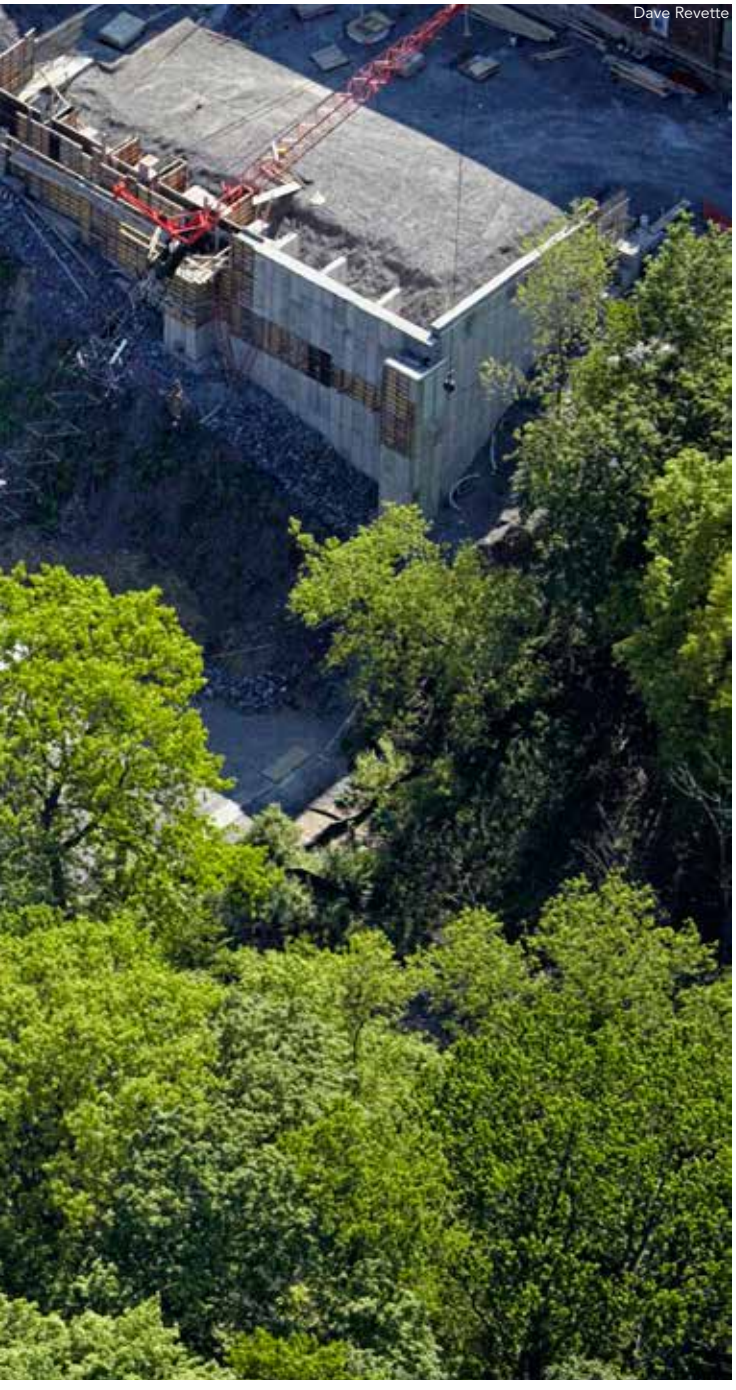
Use of bridge construction materials and techniques was essential in achieving the architectural vision, given the structure's double life as a bridge and a building. Three two-story, 200-ft trusses support the building and its range of interior room types, and bridge bearings are used to transfer loads to the building's foundations (called pot bearings, there were six total, one under each end of each truss). On either side of the truss are link buildings (60 ft to 80 ft in length) that attach the addition to the existing structures on either side of the gorge. The new building uses a total of 860 tons of structural steel.

To withstand structural forces, the 30-ft-high trusses incorporate some of the largest rolled steel elements available (up to W14x665). With limited working room on either side, the construction team built a temporary single-support steel tower in the middle of the gorge, allowing the trusses to be erected in two halves and spliced in the middle; the largest half-truss was 70 tons. This piecewise approach facilitated field assembly of the trusses to occur in a smaller area and enabled the use of a smaller crane. When unexpected rock fragmentation was discovered on one side of the gorge during excavation, drilled mini-piles and rock anchors were installed by a specialty contractor to supplement the foundation's original 7-ft-diameter caissons.

A Balanced Recital

The recital hall posed a major structural challenge, due to its configuration in comparison to the rest of the building. Because it was a two-story space on one side of the building and the other side of the building was composed of two one-story layers, the load on the structure was unbalanced. While the north truss supported the weight of the roof and two lower levels, the south truss only supported a roof and one lower level, and the center truss supported a two-story space on one side and two one-story spaces on the other.

If trusses were loaded after placement of curtainwall or exposed concrete floors, the deflection of the trusses could cause windows to pop out and the concrete to crack excessively. Construction was sequenced to take as much deflection out of the trusses as possible prior to placing deflection-sensitive materials. The team considered two options: preloading the trusses to neutralize deflections and sequentially unloading them as the building was completed, or installing non-deflection-critical items first to help deflect the trusses. A combination of the two was eventually chosen. As many materials as possible were installed prior to the curtain wall; once it was determined that enough deflection had occurred in the truss, the curtain wall was installed.



Dave Revette

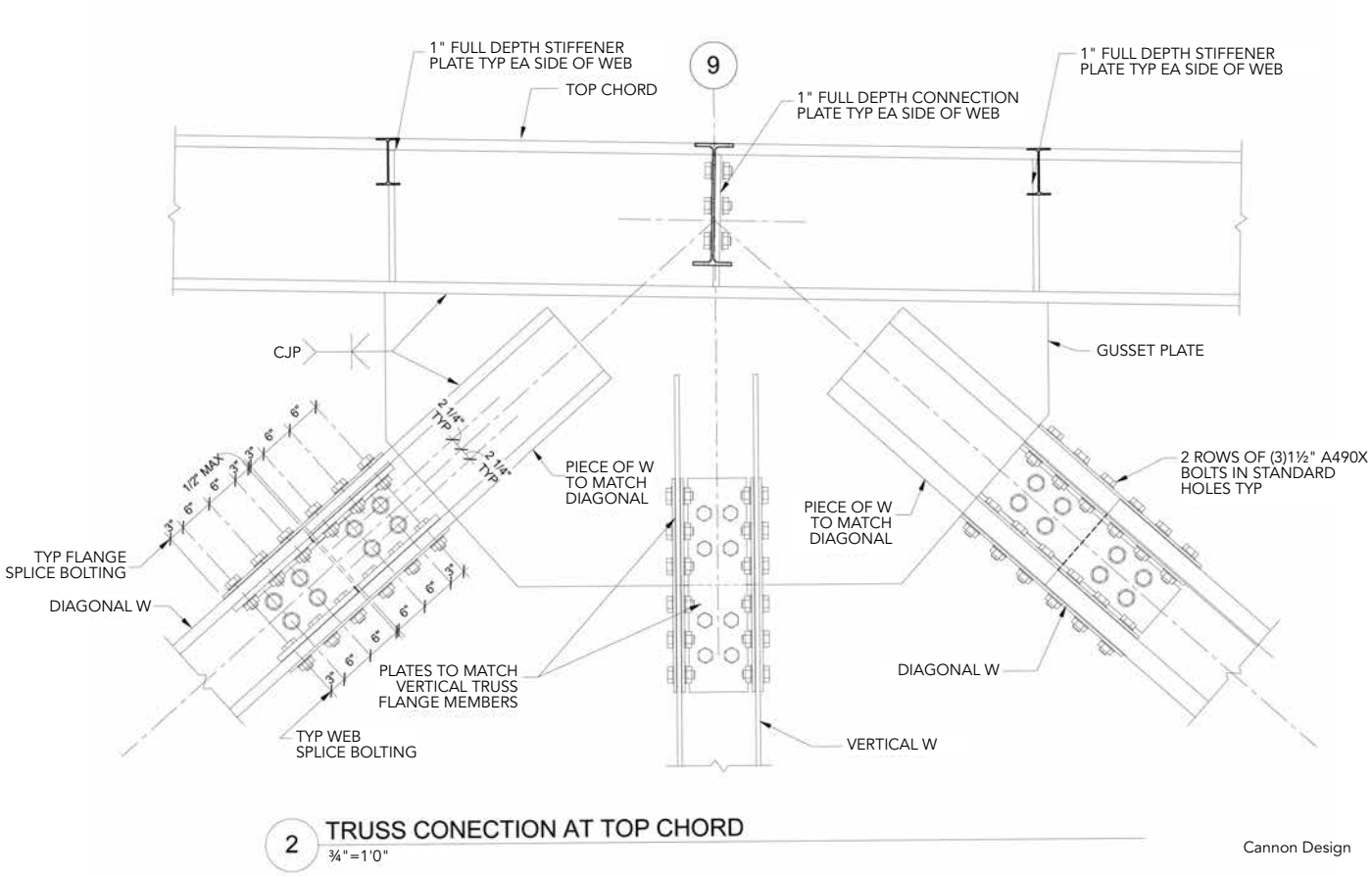
Tim Wilkes Photography

▲ Lift and installation of truss 1.

◀ The construction team built a temporary single-support steel tower in the middle of the gorge, allowing the trusses to be erected in two halves and spliced in the middle.

▼ A top truss cord gusset connection.

Tim Wilkes Photography



▲ A detail of a top truss chord connection.

Bolt Dilemma

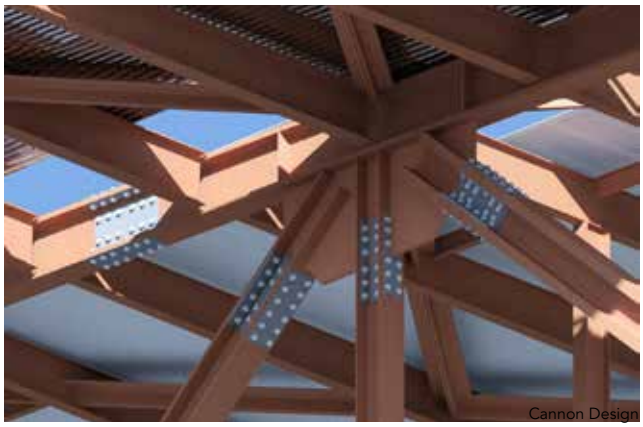
Besides the unique construction area and balance issues, bolting also posed a challenge. During steel fabrication, the team learned that the 1½-in. A490 bolts specified in the design had a tendency to fail if they were installed by turning the head end of the bolt rather than the nut end. In the building's design, however, the bolts were an architectural feature specifically designed to be installed in one direction—via rotation of the bolt head. And because the bolts were so large, they couldn't be installed any other way. (Due to manufacturing techniques used for the large bolts, a special lubricant was needed to achieve the required torque for them, as the friction would have been too great otherwise.)

When the new bridge building opens in May, Onondaga Community College students, faculty and visitors will have a new path across Furnace Creek Gorge, as well as a new music building surrounded on all sides—including below—by natural beauty. MSC

Owner

Onondaga Community College, Syracuse, N.Y.

▼ A truss connection as a Revit model...



▼ ... and as-built.

▲ The building sits above a 60-ft-deep fissure.

▼ Lift and installation of truss 2.

Architect and Structural Engineer
Cannon Design, Grand Island, N.Y.

General Contractor
Hueber-Breuer Construction Company, Inc., Syracuse

Construction Manager
C&S Companies, Syracuse

Steel Team

Fabricator and Erector
Raulli & Sons, Inc., Syracuse, N.Y. (AISC Member/AISC Certified Fabricator and Erector)

Detailer
JCM and Associates, Ltd., Frankford, Ontario, Canada (AISC Member)