FRENCH Connection

BY BRIAN MCELHATTEN S.E., P.E., AND CHELSEA ZDAWCZYK, P.E.

The new home for an international school in Chicago integrates structural value with architectural vision while keeping future expansion in mind.

LAST FALL MARKED the start of Lycée Français de Chicago's 20th academic year—and its first in its new home.

Founded in 1995, the school has seen significant growth over years, expanding from an initial student population of less than 150 students to its current enrollment of more than 700. In addition to growing in size, the organization has matured over the years, developing a strong connection to the city and solidifying its mission of providing a multicultural, bilingual education with an emphasis on civic-mindedness and cultural engagement.

Having outgrown its space in Chicago's Uptown neighborhood near the lakefront, the school established an ambitious vision for the development of a new urban campus. Its top priorities included satisfying an immediate need for additional student capacity, creating an environment that reflects its mission in a unified and modern architectural language and developing a master plan for future expansion of the campus. These ambitious goals were met by an equally ambitious budget: $28 million for total construction costs (including site work but not land purchase).

With the completion of its new 3.8 acre campus in the city's Ravenswood neighborhood, roughly two miles from its original location, the school now has a state-of-the art facility that solidifies its position in the academic and cultural fabric of Chicago and empowers the organization to achieve its vision for educating future generations. The new 85,000-sq.-ft building, spread over two wings, incorporates space for as many as 800 pre-K through 12th-grade students. The four-story west wing houses classrooms, labs, a library and central atrium, and the two-story east wing includes a cafeteria, additional administrative offices and a full-size gym. Future growth is accommodated with plans for a 40,000-sq.-ft two-story expansion to the east wing.

Adding Value

With a tight construction budget of $28 million, it was clear from the start that all aspects of structural design would be weighed against the value they added to the overall project and that no decision could be taken for granted, especially the choice of the primary structural system. Early in the schematic design phase, several structural options were examined, including a precast solution. However, based on initial calculations and discussions with the architect and contractor, a steel gravity system had clear advantages given the desired architectural expression of the façade, the tight budget, the presence of numerous cantilevers, shallow floor-to-floor heights and the need to be able to add on to the structure at a future time.

The overall gravity system in the west wing typically consists of steel columns supporting composite metal deck on steel beams and girders. The structural bay dimensions of approximately 25 ft by 30 ft are easily spanned by W16 beams and W24 girders. In the east wing, a similar system is used; however, larger spans required the use of W18 beams and W30 girders. At the gym, 36-in.-deep steel open-web joists are used for the 70-ft roof span. For the lateral system, the west wing uses exposed concrete core walls in the three stair cores, while the east wing uses steel braced frames.

All photos: © STL Architects

As with many projects, the aim of the overall structural scheme was simplicity and general uniformity, allowing for economy through repetitive use of details. However, specific architectural design elements in various parts of the building necessitated specific and unique structural solutions. In response to the Lycee's community-centric ideology, a modified double-loaded corridor scheme was used for the west wing layout. Classrooms are pushed to the north and south edges of the plan, taking in direct natural light and engaging the external environment. At the center of the plan, a light-filled atrium between Level 1 and the roof, surrounded by open corridors, strengthens the sense of internal community by creating a visual connection between all academic levels (pre-K at the bottom, high school at the top). Gathering spaces at each end provide further opportunities for planned and ad-hoc interaction within the building. To keep these spaces as open as possible, the column lines are held back approximately 7 ft from the edge of the atrium opening (aligned with and hidden in the classroom walls), and steel cantilevered beams (typically W16 sections) support the corridors surrounding the atrium.

At the east end of the atrium, a feature stair between the first and second floor creates a focal point and provides a visual screen between the busy main entrance and the academic areas. The stair is a hybrid structure, an exposed concrete slab suspended from the third floor by eight slender steel rods. Architecturally detailed clevis connections transfer the weight of the slab into the rods, and the lightness of the steel suspension structure provides a visually striking contrast to the heavy solid form of the concrete stair slab.

▲▼ The new 85,000-sq.-ft Lycée Français de Chicago, spread over two wings, incorporates space for as many as 800 pre-K through 12th-grade students.

Brian McElhatten is an associate principal and **Chelsea Zdawczyk** is a senior structural engineer, both with Arup's Chicago office.

Future growth is accommodated with plans for a 40,000-sq.-ft two-story expansion to the east wing.

The setback at the main entry in the east wing required transferring braced frame forces.

In contrast to the sense of openness and verticality in the west wing, the east wing presented significant challenges due to the constraints of the relatively short floor-to-floor heights coupled with the need for deeper beams due to larger spans at the cafeteria. W30 beams were required for the spans, but these did not allow sufficient space for routing MEP services from the rooftop mechanical equipment. As a result, large beam penetrations were incorporated using guidance provided by AISC Design Guide 2: *Design of Steel and Composite Beams with Web Openings*. In addition, the existence of a large setback at the northeast corner, which creates a recessed and column-free exterior entry area, required that the second floor be cantilevered approximately 13 ft beyond the first floor perimeter column line. Combined deflections at the tip of the cantilevered floor framing were an initial concern, but the heavy W30 beams were able to satisfy the requirements.

In relation to the lateral system, these same architectural features, as well as the location of future programmatic elements, limited potential locations for braced frames in the east wing. Additionally, due to the offset at the northeast corner, it was not possible to create a vertically continuous frame on the north side of the east wing. Forces from above must transfer through horizontal steel bracing at the Level 2 to an adjacent frame between Levels 1 and 2.

Looking up and down through the atrium.

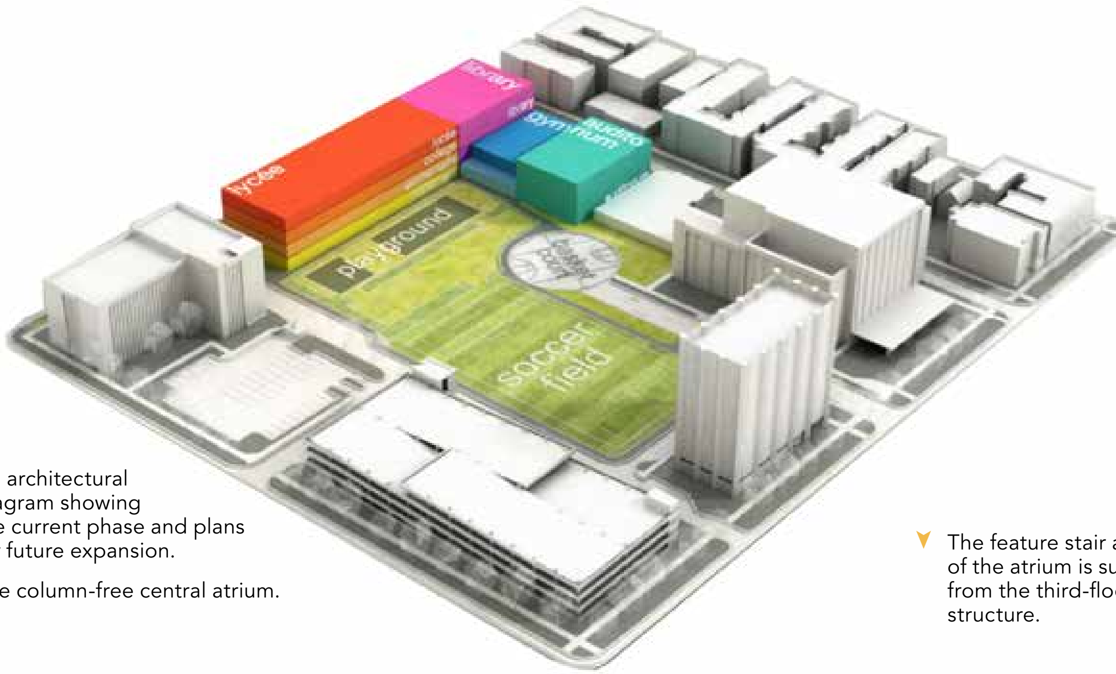
Overall 3D view of the structural Revit model.

Future Expansion

The master plan for the new facility includes provisions for future expansion, including the addition of two floors on top of the east wing. Although the budget was tight, the school had the foresight to invest in upgrading the structural design now to support the future loads as opposed to taking on costly and disruptive strengthening work later. Columns, bracing and foundations were upsized as necessary to deal with the additional forces and stiffness requirements, and future connections also needed to be thought out in order to minimize the need for future field modifications to the existing structure. The use of steel simplified the design since unobtrusive detailing could be incorporated to facilitate future column splices and beam connections. In numerous locations, end plate connections were anticipated to prevent the detailing from protruding outside the building envelope.

During the design process, the project scope grew to include the full design (through permit drawings) of a potential 300-seat multipurpose auditorium space, which would allow for expansion of the school's arts program pending additional fund raising efforts. The siting of the auditorium will be directly adjacent to the gym and connected to the gym and main academic areas by a future corridor on the west side.

The auditorium design uses a "box-in-box" design to provide acoustic separation for the performance space; an exterior steel gravity structure with steel braced frames on all four sides allows the auditorium to be fully independent from the gym and east wing. The interior box is formed by full-height concrete masonry unit walls on three sides and a concrete circulation core at the rear of the auditorium, and the balcony seating will be supported by cantilevering steel raker beams from embedded connection plates in this core wall. These beams will support precast panels to form the stepped seating. The spans over the auditorium are similar to those of the gym, but the roof structure must also resist concentrated loads from catwalks and rigging. As such, 48-in.-deep steel open-web joists and a metal



An architectural diagram showing the current phase and plans for future expansion.

The column-free central atrium.

The feature stair at the end of the atrium is suspended from the third-floor structure.

deck diaphragm were incorporated to provide a cost-effective, lightweight and structurally simple means to carry these loads to the perimeter columns.

The design for the school's new campus presented numerous design challenges. However, the adaptability of steel meant that solutions could be found that fit a tight budget and short timeline and facilitated the realization of the client's vision for the project. The result is a new and inspiring academic environment for educating the next generation of global citizens. ■

Owner
Lycée Français de Chicago

General Contractor
Bulley and Andrews

Architect
STL Architects

Structural Engineer
Arup

Steel Fabricator and Detailer
Scott Steel Services, Inc.