Moving In

BY NAT OPPENHEIMER, YEGAL SHAMASH, AND BEN ROSENBERG

Polshek Partnership Architects/ Crystal Computer Graphics Ltd.

Dickinson School of Law, formerly an independent entity, will soon have its own building on the Penn State campus.

A DECADE AGO, TWO PROMINENT PENNSYLVANIA INSTITUTIONS OF HIGHER LEARNING— the Dickinson School of Law (DSL) in Carlisle and Penn State University in State College—joined forces in a mutually beneficial relationship. Penn State got a law school (it didn't have one before), and DSL was able to take advantage of Penn State's resources as a preeminent research institution.

But there was one problem: The two schools were almost two hours apart. From the beginning, the two schools shared a vision to create a flagship building for DSL on Penn State's main campus. Almost 10 years after the initial merger, this vision will become reality, as DSL's new Lewis Katz Building will open in State College this December. (A new sister building, also named for Lewis Katz, is scheduled to open next year on the Carlisle campus).

Structurally, the sinewy new building in State College is essentially two long halves fit and joined together along the length. The north half is brick-clad with a flat roof and connects to the campus' mechanical and transportation core. The south half is clad with a curtain wall and stone and has a sloping roof that soars over 60 ft into the air at its eastern end. Containing the library, auditorium, courtroom, and café, the south half is the visual centerpiece of the building.

Staying Light

During schematic design, we decided to use steel framing with composite concrete on metal deck. Initially, the foundation system was designed as piles, due to State College's typical ground conditions, and the structure needed to be as light as possible in order to minimize the number of piles. In addition, the client wanted an efficient system that could meet the demands of the plan irregularities that made the design so unique. After looking at alternate systems, we chose a 4½-in. light concrete slab on composite metal deck system. This system provided the appropriate fire rating and was the lightest system that was flexible enough to address the challenge of the proposed layout. In this case, repetitive or prefabricated systems did not gain the advantage due to the non-repetitive layout.

During the design development phase we discovered that the local building soil conditions were suitable for spread footings; indeed, rock was found not far below the surface. We continued to use steel framing, as spans as long as 50 ft were necessary and, as noted above, the normal cost-effectiveness of repetitive lightweight systems did not have an advantage here.

While very lightweight, the slab and deck system challenged us in two ways: vibration and noise. After sizing members for stress, deflection, and architectural constraints, we conducted a comprehensive vibration analysis on the structure and determined that several beams and girders needed to be increased in size due to vibration limitations. There was also concern about noise from mechanical rooms in the basement; three large classrooms with auditorium-style seating sit above the mechanical rooms. On the advice of the acoustical consultant, we chose a 7½-in. normal weight composite deck system at all bays above the mechanical room in order to minimize noise.

Keeping Up with the Architecture

As the building is visually striking, the exposed steel needed to be designed to meet this aesthetic. Round hollow structural sections (HSS) comprise a series of full-height columns along the south side of the building. Because all of these round HSS columns needed to be the same nominal diameter, we used ASTM A500 Grade C with a yield stress of 46 ksi instead of the more conventional Grade B, 42 ksi steel.

The most intriguing design challenge of the building was the 30-ft-high, two-story sloping ramp that carried a curtain wall and ran along the south face of the building. The view from the south side of the building, which faces the rest of the campus, is dominated by this curtain wall, and it was important to minimize the structure so as not to impede the view either from outside or from within. The ramp, which connects the two floors of the building's library, is cantilevered over the south entrances to the building. We designed a system to hang the ramp from the roof framing using a series of outrigger plates and hanger rods with clevises. Because the ramp support framing was exposed, plates allowed us to maintain the desired visual appearance. The 1-in.-diameter hanger rods, spaced at 10 ft on center, are cleanly connected with stainless steel pins to steel plates at the ramp floor structure and with clevises at the top. To carry the wind loads on the exterior curtain wall, a series of strong-back plates, also spaced at 10 ft on center, march up the ramp at a consistent offset from the hanger rods. Each strong-back consists of two vertical plates spanning the height of the curtain wall, separated by a small gap with spacer plates. The hanger rods carry gravity loads, the strong-backs carry lateral wind loads, and both work together to provide a clean visual system.

Laterally Speaking

The building's lateral system is a combination of moment frame and braced bays. A multi-story interior skylight that runs along the boundary between the north and south halves of the building creates an open corridor with a desire for little visible structure within it. We used a series of connector HSS16x8 tubes to carry lateral loads between the two halves of the building to meet both structural and aesthetic requirements.

Framing Crisis Averted

Due to a necessary architectural design change during construction, we needed to develop a solution quickly when we found that one of our double-angle braces was blocking a relocated door to a café support room. Relocating this primary lateral frame was not an option. We looked at various solutions and eventually designed a combination moment frame and braced bay that essentially framed the door. The moment frame between the head of the door and the floor above is a series of W12x72s. There is also a miniature brace bay to the side of the door, safely enclosed within a wall. We were able to safely carry the required lateral loads without disturbing the architectural design and carry out the redesign within a few days during standard shop drawing review.

Curbing Problems Early On

All invloved parties agree that for a project of this size, the steel went up in a relatively uninterrupted pattern and with very few issues arising during erection. The detailer was able to build a very accurate BIM model of the entire frame at the beginning of the shop drawing phase. Although the creation of this model generated a significant number of RFIs, all parties understood that these early RFIs would largely eliminate more urgent ones later on in construction, and communication flowed smoothly between all parties.

The fabrication shop was methodical in forwarding erection drawings and shop standards. Once these were approved, a rapid but reasonable schedule was established and held by all parties throughout significant completion of shop drawings, whereby the detailer forwarded a standard number of sheets to the general contractor once a week, on Thursdays, and these were forwarded to RSA by Monday morning. Knowing that we would be receiving a package each Monday morning allowed us to turn the package around by the Thursday of the same week, back to the architect, with little disruption to the schedule.

By establishing and maintaining a constant flow of information, all parties were able to collaborate successfully and help each other get an otherwise complex steel project erected within schedule and budget. MSC

Nat Oppenheimer is a principal, Yegal Shamash is an associate, and Ben Rosenberg is a project engineer, all with Robert Silman Associates.

Owner
The Penn State Dickinson School of Law, University Park, Pa.

Architect
Polshek Partnership Architects, New York

Structural Engineer
Robert Silman Associates, New York

Steel Fabricator
Buffalo Structural Steel Construction Corporation, Titusville, Pa.
(AISC Member)

Construction Manager/General Contractor
Gilbane Building Company, Providence, R.I.