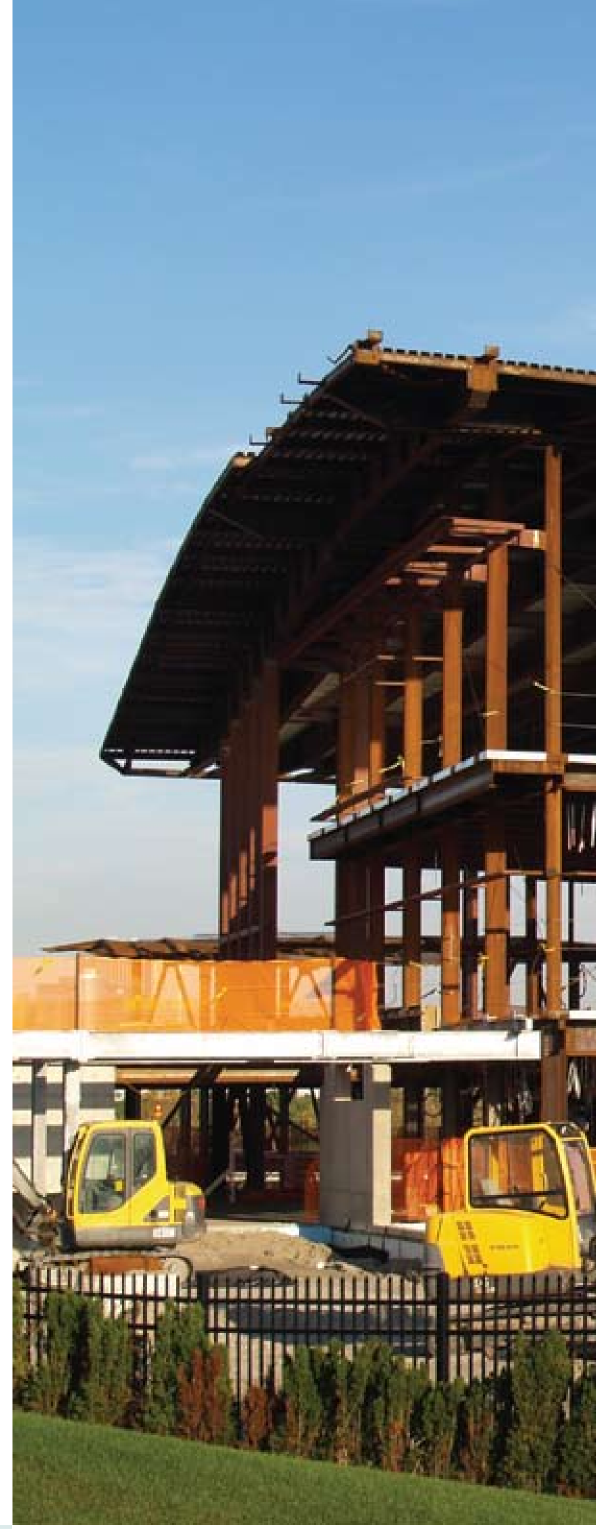
The 19th Hole

BY JEFFREY URDAN

Sweeping views of the New York skyline and complex, artistic steel framing characterize a soon-to-be-open golf course clubhouse on the Jersey shore.



Willowbend Development

LIKE GOLF? IF SO, THERE'S A NEW COURSE ON THE JERSEY CITY, N.J. WATERFRONT. Just bring your clubs and your spikes—and the $500,000 membership fee (you also have to be invited to join). Once you're in, you can arrive by land, sea, or air: by car, private yacht service with on-board concierge, or helicopter.

While it may be exclusive in terms of membership, the soon-to-be-open Liberty National Golf Club possesses architectural, environmental, and structural attributes that everyone can appreciate. From an envi-

Crystal Steel

BY THE NUMBERS

Tonnage
approx. 800 tons

Unique pieces
approx. 2,200

Pieces/ton
2.75

Average piece weight
727 lb

"Non-standard" connections
approx. 3,000

Detailing man-hours/ton
21

Pieces of steel in "clamshell" roof
approx. 100

ronmental standpoint, the course uses local grasses and employs an advanced rainwater reclamation system to irrigate the greenery, and mature trees were planted throughout. Further, it was built on a 250-acre brownfield site, and all aspects of the project were designed with sustainability in mind.

From a design perspective, the owner wished the clubhouse, framed in steel, to be evocative of a luxury yacht, given the waterfront setting. Visitors are greeted with a 24-ft-long cantilevered canopy and enter into a dramatic reception area with 30-ft ceilings, beyond which are framed views of Midtown Manhattan and the Statue of Liberty.

Fast and Complex

And then there's the structural steel framing itself. "The grid for this project is not the customary orthogonal grid, with rectangular bays and X and Y coordinates or dimensions that everyone is used to working with," says Chris Christoforou, the engineer of record with Thornton Tomasetti's Newark office. "Every column is located with polar coordinates based on an angle and a distance from one of four focus points. So all the beams are connecting to radial-laid girders, some of them curving; no two connections on the job are alike."

Christoforou notes that the structural design team didn't set out to work with steel specifically. However, the fast-track project schedule required very quick erection of the structural frame. The architect began the project drawings in 2006, and the project was scheduled to open in the sum-

Thornton Tomasetti

Beams are connected to radial-laid girders instead of the customary orthogonal grid.

mer of 2008, about a year ahead of what would be expected for a project of this size and complexity, says Christoforou.

Since the building geometry is so complex, a concrete contractor would have required a longer schedule—and expediting the schedule would have made the project prohibitively expensive to do in concrete. In addition, long cantilevers on the roof, with its curved profile, would have made concrete an even more impractical choice. So, the compressed time frame really made steel the only viable option.

Technology and Teamwork

Fabricator Crystal Steel's detailing team developed its initial wireframe using StruCAD. The team consisted of 13 detailers and checkers working for nearly five months on parallel portions of the StruCAD model, really pushing the software to

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its limits and beyond. "StruCAD was not designed to work in this type of multi-user environment, but StruCAD's tech support group helped us find a way to fool the system into thinking it was multiple jobs," says Bill Lo, president of Crystal Steel.

When the detailing manager met with the design team and walked them through the 3D model, there were a lot of questions about design intent and how to bring the various elements together. The architect and engineer worked openly and constructively with the fabricator in a close collaboration that would extend over the next several months as the design blossomed and the steel details were nailed down in parallel. Crystal Steel submitted connection geometry and computations directly to the design team while concurrently posting the submissions to an internal web site for project record.

Many of the connection details were complex in nature due to the geometry of the structure.

The Devil is in the Details

The geometry in plan view was difficult due to the polar grid, but that wasn't the end of the challenges; the vertical geometry of the sloping side-wall framing and the curved surface of the roof made 3D detailing a necessity. If an architectural feature was based on a certain set of dimensions and that geometry was adjusted in any direction, the change caused a ripple effect of changes throughout the steel model.

Because of the complex geometry of the framing members, few of the connection details could be considered "standard." In fact, the individual connection geometry could not be determined until the overall framing geometry for the structure was fully developed and confirmed. StruCAD's 3D modeling enabled Crystal Steel to provide precise locations for every individual piece of steel on the project without spending weeks calculating angles of rotation. Once member locations had been established, connection computations were provided by Crystal Steel's structural consultant, Columbia Engineering, Inc. In the end, more than 2,200 piece details were produced along with the corresponding computations for the connections.

Approvals, Transmittals, Comments and Stamps

Once the shop drawings were complete, they were submitted for review via the project website created by the construction manager. Rather than print drawings, pack them up and mail them, unpack and stamp them "Received," review, comment, copy comments to multiple sets, repack, re-ship, etc., the drawings were uploaded once, and all team members were notified.

In addition, the architect's and engineer's stamps had been given to the fabricator in advance so that they could be digitally incorporated into the drawing template, saving hours of manual stamping on each set of drawings. Using Adobe Acrobat, the architect and engineer could mark up the drawings online with no need to print each one. Reviewed drawings were returned via the same quick upload to the project site. According to the architect, approximately one-third of the 2,200 shop drawings were never printed out, saving paper and time.

Cutting Steel

With approved drawings in hand, Crystal Steel set to work fabricating the job. More than 75% of the job consisted of pieces with skewed cuts, and there were about 100 pieces of rolled material for the roof. With the ongoing design modifications that come with a fast-track job, loading trailers at the last minute was critical. "If we had run this like a normal job—worked the pieces and then loaded them right onto the trailers—we would have unloaded trailers twice for every time we loaded them," says Bill Gibris, vice president of operations for Crystal Steel. "We held off until the last possible second to load because we knew there would be design changes coming, and we didn't want to have to locate finished pieces in the middle of a trailer, then unload and rework them to conform to new information that had just been developed by the design team or incorporated by our detailers. Fabrication was working so closely to design that changes were flowing daily."

Putting it All Together

Despite the complexity of the project and the fast-track schedule, the steel came together just fine, thanks to the close collaboration between the design team and the fabricator. As Darley Travers, Crystal Steel's project manager, put it: "If you have 100% perfect details and 100% perfect fabrication, it doesn't matter how complex the building is—the steel fits together perfectly." MSC

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Steel Detailing Software
StruCAD