New Era in NEW YORK

BY JEFFREY SMILOW, P.E., AND ALLEN THOMPSON, P.E.

Photo: Bruce K...z/New York Mets

Photo: Mark S. Levine/New York Mets

Jeffrey Smilow is an executive vice president with WSP Cantor Seinuk.

Allen Thompson is a senior associate with WSP Cantor Seinuk.

The New York Mets' new home pays homage to historic Ebbets Field, while also bringing a 21st-century baseball facility to Queens.

IT'S ALWAYS A BIG DEAL when a new Major League Baseball park opens. It's an even bigger deal when two open at the same time in the same city, which is why 2009 has been a particularly special year for both the New York Mets and New York Yankees; both teams have been playing in their respective new ballparks since April.

The Spirit of Ebbets

In Queens, Mets fans have been enjoying better sight lines, wide concourses with panoramic views of the playing field, and improved culinary experiences at the new 41,800-seat, 1.2 million-sq.-ft. Citi Field, which replaced Shea Stadium. The architecture is based on Ebbets Field, home of the Brooklyn Dodgers until the 1950s, and features plenty of exposed steel in order to achieve a retro appearance, as well as brick cladding resembling masonry used at the famous old ballpark.

Design

Populous, the architect of record, began designing the ballpark in late 2005. In order to achieve the design and construction schedule, the construction manager and the design team agreed to break the steel construction of the ballpark into phases. The steel contract was awarded before the construction documents were completed, and the design team completed the construction documents following the phases set forth by the construction manager. This allowed the design to stay ahead of the steel fabricator and erector, since the design team could focus on coordinating one section at a time. In all, the project used 12,700 tons of structural steel.

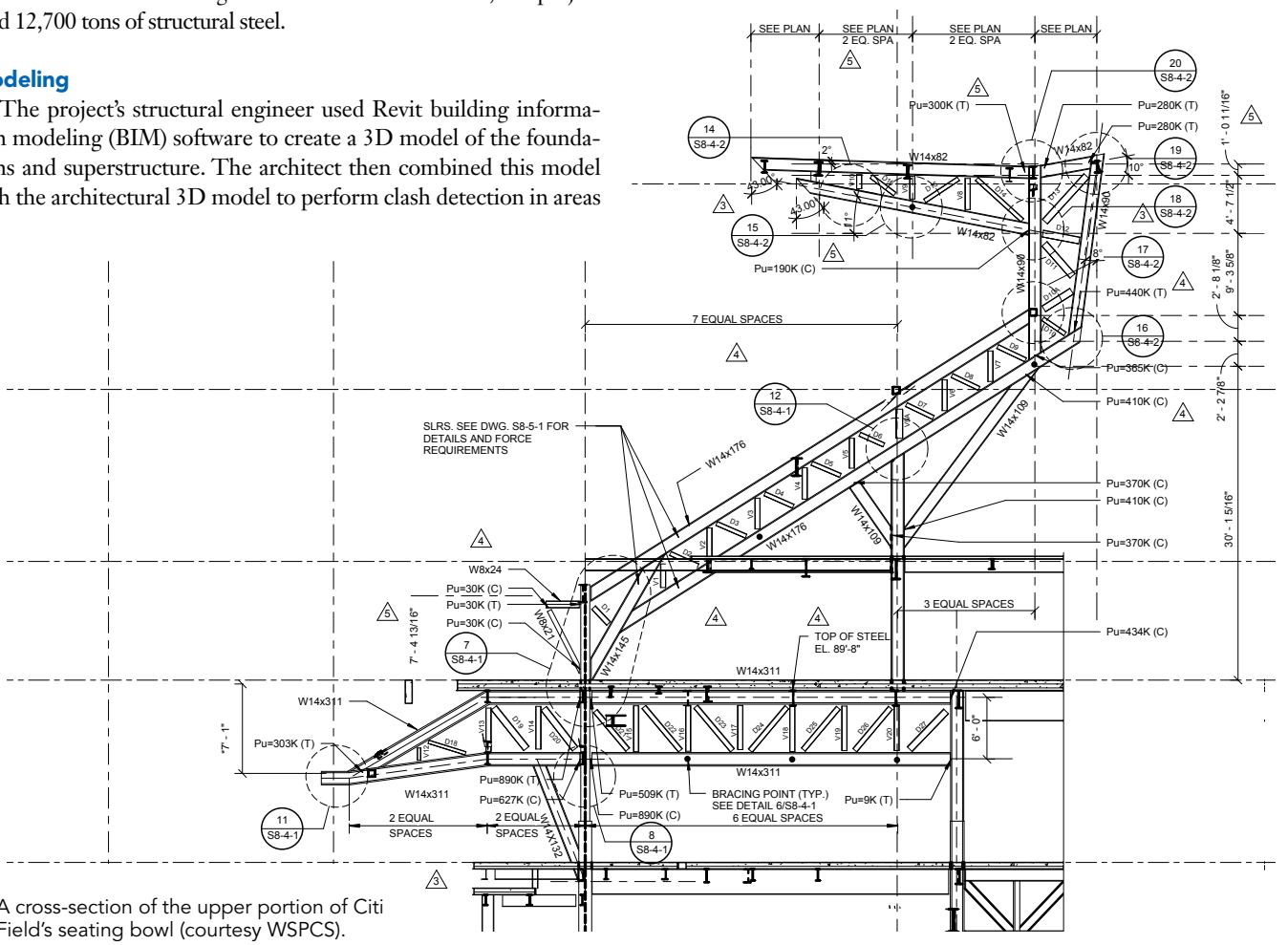
Modeling

The project's structural engineer used Revit building information modeling (BIM) software to create a 3D model of the foundations and superstructure. The architect then combined this model with the architectural 3D model to perform clash detection in areas such as door clearances next to columns, head room heights in the seating bowl under diagonal members, head room heights under the trusses, and sight line-analysis.

The owner authorized the creation of a 3D detailing model (using Tekla Sturctures) in order to get a head start on the steel shop drawing process, and steel detailers were subcontracted during the design phase in order to develop the model. Three primary benefits resulted from this effort. First, time was saved in the fabrication schedule, because a fully developed model was already available upon award of the steel contract. Second, the bid phase period was shortened, since the steel bidders were provided with the model. Third, the data that the detailer needed to create the model was incorporated into the design drawings, resulting in minimal RFIs during construction.

Lateral Systems

The soil conditions below Citi Field are extremely poor and therefore affected lateral load resisting design for the ballpark. Because of the high likelihood of liquefaction during a seismic event, the soil conditions result in high seismic forces upon the structure. The design team chose special concentrically braced frames (SCBFs) for the lateral systems, a decision that not only reduced the design seismic forces but also saved a considerable amount of structural steel, piles, foundation concrete, and rebar. In addition, the use of SCBFs also allowed the design team



A cross-section of the upper portion of Citi Field's seating bowl (courtesy WSPCS).

to reduce the amount of braced frames required, allowing for more open concourse plans.

Vibration Analysis

Jeff Wilpon, the Mets' COO, sought an intimate ballpark. In order to achieve his request, the architect stacked the seating bowl levels vertically, allowing for all the seats, including those on the Excelsior Level and Promenade Level (upper deck) levels, to be as close to the field as possible. Since the levels do not step back and the columns must be located behind the seating bowl, large cantilevers were required at these two levels. Given that this is a ballpark, the cantilevers were susceptible to fan-induced vibrations. As such, the engineers performed a thorough vibration analysis on the entire seating bowl superstructure. The analysis modeled the entire structure, including the precast seating bowl, so as to consider the interaction between it and the steel cantilevers. An optimized vibration analysis enabled the design team to tune the cantilevers by adding steel where it would be most effective in reducing vibrations. The design team added kickers—one-story diagonal members spanning from a work point at the column centerline on the level below and a work point on the cantilever—to reduce the cantilevers' lengths and thereby increase their natural frequency. It also increased the top and bottom flanges of the trusses to increase the stiffness of the cantilever and, again, increase the natural frequency of the truss.

Permanent Exposure

More than half the steel in the ballpark is permanently exposed to the environment. In order to provide the most corrosion-resistant structure possible, the design team invested considerable effort in creating details that allowed for completely shop-painted members. Most members have shop-applied primer and finish coat, and *all* members are completely shop-painted with zinc-rich primer. At the connections, specifically at the faying surfaces, the top coat was left off to allow for slip-critical connections. The zinc-rich primer allowed for a class-B faying surface, which provides 50% greater slip-critical bolt capacity compared to a class-A faying surface.

Moving inside, the Jackie Robinson Rotunda portion of the project features two crossing 183-ft-long arched steel roof trusses with bow-shaped cable tension chords. These massive trusses support considerable loads, including two levels of steel-supported concrete slabs with 100-psf live loads and a 4-in. concrete topping slab. MSC

Developer
Queens Ballpark Company, LLC, New York

Architect
Populous (formerly HOK Sport+Venue+Event), Kansas City

Structural Engineer
WSP Cantor Seinuk, New York

Steel Fabricator and Detailer
Canam Steel Corporation, Point of Rocks, Md. and Saint-Gédéon-de-Beauce, Quebec (AISC Member)

Steel Erector
Cornell and Company, Woodbury N.J. (AISC Member)

Construction Manager
Hunt/Bovis Lend Lease Alliance II (a Joint Venture), New York