One Bryant Park: striking in design and in meeting its many challenges

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Construction has commenced on One Bryant Park, a 55-story office building that will be the New York headquarters for the Bank of America. With 2.1 million-square-feet of office space and a height of 945 feet—1,200 feet to its spire—it will be one of the largest buildings in Manhattan. Although simple in appearance, the structural design was anything but and presented challenges in all of its aspects, from the bottom of the foundation to the tip of its spire. The solutions to these challenges, however, ended up as elegant as its crystalline form would imply.

The columns and basement walls of One Bryant Park are founded on rock with an allowable bearing capacity of 40 tons per square foot, approximately 60 feet below street level. Columns are supported by isolated spread footings while the perimeter walls bear directly on rock. At the core, a mat underlying all of the concrete shear walls was originally considered. However, due to the high allowable bearing capacity, continuous spread footings (albeit wide, thick spread footings) were found to be sufficient. The use of continuous footings rather than a mat foundation resulted in significant savings in concrete and reinforcing steel.

One Bryant Park is essentially a steel-framed building but with reinforced concrete shear walls at the core. The floors are concrete fill on composite metal deck supported by composite steel beams with a clear-span of 40 feet. The typical office floor is basically rectangular but at the northeast and southwest corners, cantilevered projections provide an additional 15-foot width of floor space. The projections give the floor the appearance of two shallow rectangles offset in the east-west direction and, indeed, the building is treated architecturally as two separate volumes.

In addition to the three cellar levels, the building stacking includes an eight-story podium that covers the entire site (about two-thirds of the block bounded by Sixth Avenue, Broadway and 42nd and 43rd streets) and an office tower of 43 additional floors at the east end of the site (near Sixth Avenue) and set back from the podium portion. The highest occupied floor is the 51st Floor; above that are four mechanical floors and a roof, but only on the southern half of the building. On the northern half of the building, the 52nd Floor roof provides a platform for cooling towers and other mechanical equipment.

For architectural (9'-6" ceilings) and mechanical (under-floor air circulation) reasons, the typical floor-to-floor height is 14'-6", significantly higher than most office buildings. Consequently, there are fewer floors than might be expected for a building of this height.

One of the most striking architectural features of One Bryant Park is its faceted shape. Starting at about the 18th Floor and extending all the way to the top of the curtain wall, the four corners of the building begin to slope inward, towards the core, at shallow angles of about seven degrees (on average). Each corner starts its slope at a different floor and each sloping surface is skewed at a different angle (about 20 degrees, on average). The varied sloping surfaces and the curtain wall's extremely clear coloring give the building the appearance of a very large quartz crystal.

To accommodate the sloping surfaces of the facade, the exterior columns, spaced at 20 feet, are also sloped. Each column starts sloping at a different floor and at the top of the building, almost all of them are sloped (the three columns that do not slope mark points at which the sloping surfaces of adjacent corners meet). Because the angle of slope is very acute and therefore the offset at each floor small, vertical columns and transfer girders were also investigated. However, because the magnitude of the column loads is high, the necessary depth of the girders would not fit into the floor construction envelope.

Although a steel-framed building, One Bryant Park utilizes reinforced concrete shear walls that encase the steel frame of the vertical transportation core to resist lateral loads. This system, where the steel frame is erected first and followed by the concrete encasement, was developed in the late 1960s

and early 1970s but did not achieve widespread use, mainly due to problems coordinating the two trades and the lack of efficient forming systems. Recently, with the desire by building owners for hardened elevator shafts and stairways, this construction methodology is becoming more attractive. The system maintains the speed of erection of all-steel buildings but takes advantage of the stiffness of concrete shear walls.

This construction technique presents its own set of design challenges. During construction, the steel frame is erected several floors ahead of the concrete walls. As placement of the concrete walls progresses upwards, the formwork must also move up, a potentially time-consuming and expensive operation. Traditionally, this might have been done manually with hand-built forms. To streamline the process, however, a self-climbing formwork apparatus will be employed.

As each elevator bank terminates, steel columns and beams are used to frame the structural bay. For the lower two elevator banks, this transition from steel framing to concrete presented a difficult gravity load transfer. To minimize steel tonnage, the columns that are encased in concrete are designed only to support the dead weight and construction live load of the steel frame that can be erected before the concrete is placed, a maximum of 12 floors. Consequently, the columns are relatively light W12 sections. This resulted in two design challenges: transferring loads from the steel columns to the concrete walls and controlling the potential for differential elastic shortening.

Towards the top of the building, where the concrete portion of the core diminishes, moment-resisting frames at the building perimeter take a larger share of the lateral load. Above the 54th Floor, where the concrete core terminates, braced frames (not possible at office floors due to obstruction of the view) carry most of the wind and seismic loads.

The highest floor of One Bryant Park is about 900 feet above grade level and the highest point of the curtain wall is 945 feet above the street below. But a 300-foot high spire at the top of the building, whose tip will reach a height of 1200 feet, will make One Bryant Park the second highest building in Manhattan (the Empire State Building will remain the highest at 1250 feet). The spire, which consists of a cylindrical core for its full height and a four-sided frame for the lower two-thirds, will measure about 15 feet by 15 feet at its base (in the shape of a parallelogram) and will taper to about two feet in diameter at the top. A smaller spire will house a weather station on an elevated platform.

Environmentally, One Bryant Park is attempting to become the first Platinum rated building in the country. This will be achieved through many mechanical systems and architectural features but will be aided by the structure as well. Structural steel has a very high content of recycled material and most of it will be procured within the 500-mile radius considered "local" to the site. Concrete, also typically a local material (with a much smaller radius) will for One Bryant Park have a high recycled material content with the substitution of blast furnace slag for 45 percent of the cement. As an added bonus, the concrete will be stronger, denser and more durable than concrete containing only cement.

ONE BRYANT PARK

One Bryant Park Credits:
Owner/Developer: The Durst Organization in joint venture with the Bank of America
Architect: Cook+Fox Architects, LLP
Associate Architect: Adamson Associates Architects
Structural Engineer: Severud Associates Consulting Engineers, PC
MEP Engineer: Jaros Baum & Bolles Consulting Engineers
Construction Manager: Tishman Construction Company