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Site Logistics Spur Creative Solutions for 5 Times Square

by David S. Chartock

Tight sites for construction projects is not uncommon in New York. More often than not, project teams rise to the challenge. But when that site is landlocked by subway stations on three sides and a landmark theater on another - leaving no room for Con Edison vaults below the sidewalks - then project team members rise to the occasion, creating an uncommon solution.

And rising to the challenge is exactly what the project team for 5 Times Square did. With no room under the sidewalks to install Con Edison vaults, the team decided to put the vaults on the third floor of the new, $150 million, 38-story, 575-ft.-high, 1.1 million-sq.-ft. building.

According to Pat Muldoon, a project executive with Amec Construction Management Inc. (ACMI), formerly Morse Diesel International, the project's New York-based construction manager, the vaults will occupy 2,000 sq. ft. on the third floor.

But there is more below the sidewalks of this project's site. The project's mechanical, electrical and plumbing contractor, Jaros, Baum & Bolles (JB&B) of New York, conducted a detailed study of underground obstructions. This study, said JB&B Partner Brendan Weiden, not only included the three subway lines, but a 36-in. water main and a host of other utilities as well. Weiden said his firm used three-dimensional (3-D) mapping to detail the new services for 5 Times Square. This included bringing in service from Con Edison to the third floor where JB&B designed and built a complete Con Edison Spot Network. This network consists of six transformers.

Continuing, he said the air conditioning solution provides DX units on each floor to allow direct tenant control.

"We have stringent noise criteria to meet for the air handling units," added Robert Schubert, senior vice president of construction for Boston Properties Inc., the project's New York-based owner and developer.

As a result, Boston Properties established specific criteria in the specifications for the noise criteria for the fans with JB&B and Cerami Associates, the project's New York-based acoustical engineer, Schubert said.

After a manufacturer was selected, he explained, "we ran two tests. One was an acoustical test on the fan unit in Oklahoma City," where the manufacturer, Mammoth, is located, and the other test was a mockup built on Long Island. The mockup simulated an actual machine room with drywall partitions and doors to a machine room. A conference room and an adjacent office were also built. Actual tests were then conducted using compressors and fans.

"The test results were well within the specified criteria," Schubert said, adding that from there Mammoth made some modifications to the units that were made for and installed at 5 Times Square.

Down-In-The-Hole Hammers

The subway tunnels and passageways below the site also challenged the project team. MTA/New York City Transit (MTA/NYCT) does not permit the use of heavy construction equipment for caissons within 5 ft. of a subway structure. Since MTA/NYCT has to approve the construction equipment and methods used near its facilities, "we had to demonstrate to them that the vibration levels and the energy levels using the down-in-the-hole hammer we proposed would not harm their structures. We had to provide them with engineering calculations and manufacturer data to show we would do no harm. In addition, we provided additional seismographs and strain gauges which proved this method had minimal impact on their structures. They approved and this save as much as three months on our construction schedule," Muldoon noted.

MTA/NYCT also required that the load of the building be below the level of the subway because, Muldoon said, they believe that a load placed higher would transfer into the subway structure. This concern was particularly so with the No. 7 subway line on 41st Street. This line is 55-ft. below street level. "The original plan," Muldoon explained, "was to dig pits in the rock using jackhammers. These pits would have been approximately 30 ft. below the building's subgrade. This would have added two to three months to the project schedule. So, an alternative foundation scheme was developed. This scheme called for using 40 12-in.-dia. caissons. These caissons were placed in groups. The size of each group was based on the load. Some of the caissons are within 3 ft. of a subway structure. This is where the down-the-hole hammer proved beneficial," he added.

The project features a 50-ft. mechanical space at the roof, a 300-ft. sign on the east facade which protrudes 13-ft. from the facade, a light fin that extends from the ground floor to the roof on the north side of the building, and a crystal-like look using gray glass and aluminum curtain wall to accentuate the design's angles and setbacks.

The interior design is also critical. The combined exterior and interior design creates an image and a message. Gensler of New York is the interior architect for the project. The message Ernst & Young wants to get across as the tenant is that it is a forward-thinking company. As a result, the overall design concept is the creation of a progressive, attractive, funcitonal and flexible work environment enhanced by natural light and views.

Design Adaptation

In the process of securing a tenant, the owner had the project architect, Kohn Pedersen Fox Associates (KPF) of New York, adapt the core and shell design for the building to suit specific needs of tenants Boston Properties pursued, according to KPF Senior Associate Principal Douglas Hocking.

This constant adaptation led KPF to create a central core design that would maximize the floor plan. This meant the shape of the building, structurally, "would have to be more efficient," Hocking said.

To maximize floor layouts, Boston Properties examined several structural schemes and a decision was made to use a modified structural steel perimeter tube system. This system, explained Aine Brazil, a managing principal with Thornton-Tomasetti Engineers, the project's New York-based structural engineer, features two C-channels at the north and south faces.

The Thornton-Tomasetti design for the project is a lateral wind-resisting system that consists of a centrally-braced core. The cost for fabricating and erecting a braced system tends to be lower than for a comparable moment-frame system. The downside for a braced system is that it reduces the amount of usable floor space, according to Marco Shmerykowsky, a former Thorton-Tomasetti project engineer for 5 Times Square, who last year, joined his father's firm, Shmerykowsky Consulting Engineers of New York.

The Lateral System

Thornton-Tomasetti team members said that since leased square footage is such a highly prized asset in the New York City office market, minimizing the area needed for the lateral system became a high priority.

By moving the lateral system to the perimeter, the design team was able to maximize the leased space. The economical system itself is a modification of a traditional tube system which uses closely-spaced columns, typically 6- to 12-ft. on center, and deep spandrel girders around the entire perimeter of the structure. The north and south faces of the lateral system are composed of W14 steel columns that are spaced at 10-ft. on center and linked using W36 wind girders. The modification to the traditional tube system exists in the east and west faces. These sides of the tower also use W14 columns and W36 girders. Since these sides of the building are longer than the north and south faces, it was possible to increase the column spacing on the center three bays to 30 ft. This allowed the architect to use a larger column-free viewing area while still retaining many of the structural benefits of a traditional tube system. The modified tube system also serves as a practical system to support the elegant lines, angles and folds created by the architect while minimizing the impact on leased space.

In addition to using a modified perimeter tube system, the building will feature a full-story-high 90-ft.-long transfer truss to pick up the load from three of the tower's bustle columns located on the west side of the building. At the eighth floor, the profile of the building face changes to extend to the property line. To effectively use office and retail space below this level, the Thornton-Tomasetti team felt it was necessary to transfer the columns and gravity and lateral loads to another part of the structure. The most direct solution was to build a large truss into the moment frame. This permitted the overall system to continue to benefit from the modified tube system while economically transferring the loads. A similar system was used between the second and third floors to transfer column loads. At this level, diagonals were added to the perimeter frame to create a belt system consisting of moment connections and a typical truss system.

At the 25th floor, 12 of the tower's perimeter moment frame columns are transferred to the southeast corner which uses a series of W40 and W36 girders which average 42-in. in depth.

Steel erection also posed a challenge. Muldoon said the building's slopes and articulation means no two floors in the building will have the same floor layout. "From a structural steel erection perspective, this presented concerns because the steel was not going to go straight up. The odds of getting into a misalignment in the field was greatly increased. The solution was to have the steel detailer spend extra time and money upfront to develop a 3-D computer model of the steel structure prior to beginning his detailing. This ensured that the geometry of the building and its design worked."

DOWCO Consultants of Vancouver, Canada was the steel detailer under a contract with Helmark Steel of Wilmington, Del.

"Our first step was to build this 3-D model," explained DOWCO Project Coordinator Don Adair. "In each individual steel piece, the beams, columns and bracing are modeled in three-dimension. It includes the size and grade of material. Then, after that is all checked to make sure it is in the right location, the next step was to get the computer to generate lists of mateirals so the fabricator can order the materials. Then, we applied the connections betwene the members in the model. These connections were supplied by another Helmark subcontractor, Computerized Structural Design of Milwaukee."

"This was a challenge," Adair continued. "We had 10 volumes, each 4-in.-thick, of connection designs. There were over 300 design packages in these volumes. In addition, there were approximately 500 individual, specialized designs. So, sorting out the multitudes of connections was a challenge. The solution was to apply them to their designed location in the model. Once that ws done, we were able to produce detailed drawings for the fabricator."

More than 7,000 draings will be produced when all is said and done. The model and comptuer simulation saved time and money, Adair noted. "Because nothing was square in the building, the computer was helpful. In addition, the computer simulation detected when connections conflicted or if there would be any erection problems so they could be fixed before the steel is fabricated and in the field."

Other Challenges

According to Schubert, other project challenges included a tight schedule and strict historic preservation requirements.

Muldoon said the solution to the tight schedule was to begin excavation of the south side of the 22,000-sq.-ft. site before the demolition was completed on the north side of the site where there was a parking lot. "This led to a congested site, but it allowed the foundations on the south side to be completed two months earlier than if demolition had been totally completed before excavation could begin."

The historic preservation requirements were the result of the site being adjacent to the New Amsterdam Theater. Since the theater's rubble foundation could not be disturbed, a monitoring program was developed with Judith Saltzman of Lee Saltzman Architects, Amec, Disney and the 42nd Street Development Project Inc. The plan allowed all team members to monitor vibrations. Shmerykowsky Consulting Engineers was hired by Boston Properties to engineer the protection procedures for the New Amsterdam Theater columns adjacent to 5 Times Square on the north side of the project site. Mueser Rutledge Consulting Engineers of New York was the geotechnical engineer.

The monitoring plan called for setting up seismographs and crack monitors and wiring them to pagers, Schubert explained. In that way, if certain threshold acceleration levels were on the seismographs were exceed, the beepers would automatically notify a number of project personnel. This allowed real-time monitoring that led to immediate solutions.

Occupancy is expected to begin in May 2001. The project is expected to be completed in the last quarter of 2002.