TSX Broadway – Palace Theater Redevelopment

Overall winner of the 2024 ACI Excellence in Concrete Construction Awards

Rising 48 stories, TSX Broadway brings light and entertainment to visitors in the heart of Times Square in New York, NY, USA. The 660,000 ft^2 (61,300 m^2) building is built around the historic Palace Theater, which now sits two stories above its original location. The tower's 18,000 ft^2 (1670 m^2) LED screen—one of the largest in Times Square—opens to reveal a cantilevering stage that projects 30 ft (9 m) above street level to serve as an outdoor concert venue. Equally impressive, the redevelopment project makes a significant contribution to a sustainable future as a large-scale reuse of an existing facility.

Completed in 2023, TSX Broadway was created by shifting and reassembling portions of an existing structure that included the 111-year-old theater. The original structure was combined with new elements to produce a revitalized entertainment, retail, and hotel complex. The theater was renovated to include modern amenities and lifted 31 ft (9.4 m) from its street-level location to make room for hotel and retail space below.

"My favorite aspect of the redevelopment project was the heavy reliance on concrete and the reuse of the existing structure, along with the addition of a new construction," said judge David Millar, CEO of Concrete Institute of Australia. "I love that concrete was used because it was flexible enough to be placed in such a congested area, that its strength and stiffness meant the building was able to reach great heights, and that concrete resulted in such a sustainable solution with minimal impact on the environment."

Delivered by general contractor Pavarini McGovern with concrete contractor Sorbara Construction, the project team included developer L&L Holding Company, architectural design firm Mancini Duffy, and engineering firm Severud Associates, along with foundation and theater lift engineer Urban Foundation/Engineering, LLC; preservation architect PBDW Architects; mechanical, electrical, and plumbing (MEP) consultant Cosentini Associates; and civil/geotechnical engineer Langan Engineering and Environmental Services. Tec-Crete Transit Mix Corp. supplied the concrete and Perkins Eastman provided the building envelope.

Design, Construction, Theater Lift

The project team made extensive use of reduced-carbon concrete, including a high-performance 14,000 psi (96.5 MPa) mixture. A total of 4700 yd^3 (3600 m^3) of concrete and 325 tons (295 tonnes) of reinforcing steel were used for the foundation, and the superstructure was constructed with 25,750 yd^3 (19,700 m^3) of concrete, 3540 tons (3200 tonnes) of plain steel, and 73.5 tons (66.7 tonnes) of high-strength steel strand for post-tensioning.

The hotel structure is supported by a podium built over the Palace Theater, which occupies most of the eastern portion of the 100 x 160 ft (30 x 49 m) site. Super-columns at the theater's corners support trusses to transfer the loads from the tower.

The transformation began by extending the super-columns upward and demolishing the original tower to meet them. Because the existing steel super-columns could not support the planned transfer girders, increased live loads, and new hotel structure (which required 25 million lb [111,206 kN] per column), the construction team encased them in 14,000 psi

TSX Broadway is located in New York City's Times Square

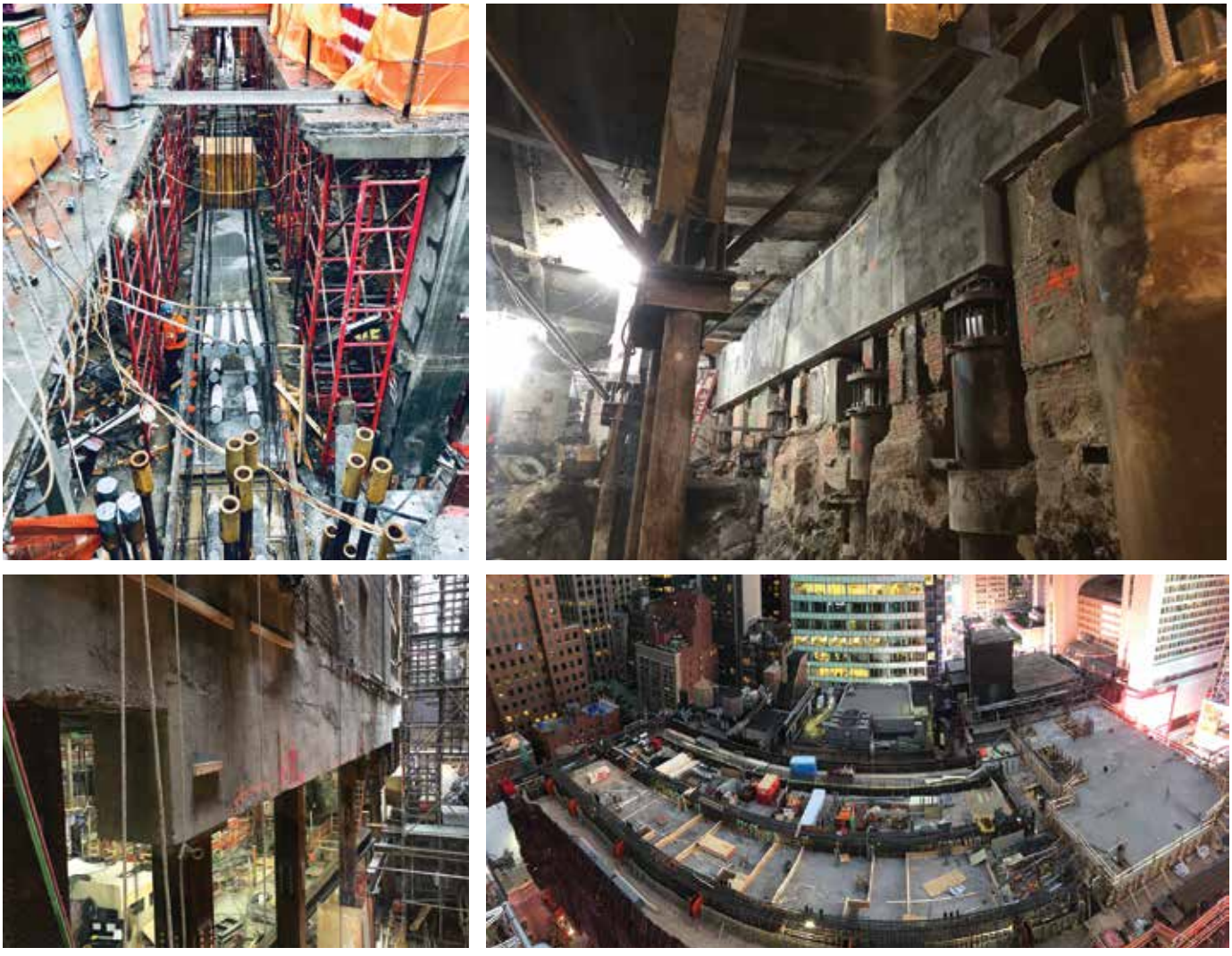
concrete reinforced with Grade 80 reinforcing bars. Above the eighth level, the new columns were constructed with high-strength reinforced concrete. The team also drilled below-grade caissons.

The structure's central and most critical feature is a system comprising three post-tensioned (PT) concrete girders linked by two transverse girders and a cast-in-place mat slab that serves as a horizontal diaphragm. The PT girders were installed between 12 to 16 stories above street level to resupport the intervening floors and allow existing trusses to be removed. Due to their massive size (44 ft [13 m] deep and spanning 140 ft [43 m]), the team placed them in four lifts. The first lift was supported on existing trusses and then post-tensioned using a specialized 1700 ton (1540 tonnes) jack to carry itself and the weight of the next lift. The girders were incrementally post-tensioned after placement of each remaining lift.

"We've been told that the girders holding up the hotel tower are the longest and largest PT cast-in-place concrete girders in the Western Hemisphere," said Cawsie Jijina, Principal with Severud Associates. "Whereas we do not know if this is verifiably true, and we would be proud of that, we are even more proud that we designed a way to erect them over a 111-year-old theater and 125 ft [38 m] above grade level without significant falsework and shoring."

To raise the entire theater an astonishing 31 ft to its new home between Levels 3 to 8, the team first constructed 6 ft (2 m) deep concrete beams beneath the theater's thick masonry bearing walls. The beams were installed in segments below the ground floor framing by pocketing steel posts into the walls and then replacing the brick with concrete in lengths of 30 to 40 ft (9 to 12 m). Adjacent segments were coupled together to form a continuous ring at the perimeter of the theater. They then erected lifting posts and jacks beneath the ring beam.

Next, they built the 32-story hotel tower with reinforced



Construction of the TSX Broadway – Palace Theater Redevelopment project

concrete columns, core walls, and flat-plate floors atop the transfer system. The transfer girders were re-post-tensioned after the construction of each 10-floor tower segment to control stresses and limit deflections. A total of 36 high-strength tendons—210,000 ft (64,000 m)—were tensioned to 2000 kip (8900 kN) each. Movements were closely monitored as construction progressed. At completion, the girders exhibited deflection of only 1/4 in. (6 mm).

Concrete Was Key to Timely Construction

Each of the project's significant components—the theater lift, transfer girders, additional cellars, and hotel tower—was challenging on its own. Executing all of them in one urban location was an extremely complex operation that greatly benefited from the use of concrete.

The flexibility of concrete placement accommodated the congested location, while the material's high strength and stiffness allowed the building to reach a soaring height of 581 ft (177 m). Integrating the concrete work with other trades helped ease the project schedule. Using concrete also allowed the team to meet a crucial project requirement: retaining 25% of the original concrete slabs to maintain the structure's overall floor area.

"In the amenities space below the transfer system—floors 1 through 12—we had to remove every other floor to increase height. We simultaneously had to remove every other column to create a more open environment and yet retain all the remaining floor slabs—and we had to double the floor load-carrying capacity. This doubled the unbraced length of the columns and increased the load on each of the remaining columns by a factor of eight," Jijina explained. "This is where the versatility of concrete as a build medium is at its best. We increased the column diameters by adding a new outer ring column around the old column, and we bonded a new reinforced concrete topping slab to the old slab—artfully manipulating the reinforcement in the new slab to work in tandem with the old slab's reinforcement. We used post-installed adhesive anchors to ensure everything worked together."

Sustainability Approaches

All concrete mixtures substituted up to 40% of standard cement with supplementary cementitious materials, which reduced the project's carbon footprint by an estimated 3400 tons (3080 tonnes). The concrete reinforcement is made from nearly 100% recycled steel, and the structural steel framing contains more than 90% recycled material.

Additional components further reduced the environmental impact of the tower's construction and ongoing operation:

- The Palace Theater's landmark status protects it from demolition, but its original location and single basement limited the modifications that could be made to its mechanical systems. Raising the theater and adding a second basement level allowed greater flexibility in improving building performance;
- While the complete demolition of the remainder of the existing building would have been conceptually simpler, it also would have maximized the volume of refuse. Retaining 25% of the floor construction reduced waste and decreased the demand for new materials;
- High-performance curtain walls increase the building's energy efficiency;
- Advanced MEP systems include energy-recovery ventilation units that transfer heat from exhaust airstreams to precondition incoming outside air, a high-efficiency gas-fired condensing boiler that captures heat from the combustion exhaust, a state-of-the-art building management system, and energy-use monitoring; and
- Occupancy sensors turn off lights and adjust heating, ventilation, and air-conditioning (HVAC) levels to reduce energy use.

"The TSX Broadway – Palace Theater Redevelopment project is a great example of how innovative concrete design, construction, and use of materials can provide long-lasting solutions while meeting sustainability and environmental challenges," Millar said.