Glass and Stainless Façade Renovation

By Janis B. Vacca, P.E. and Todd R. Campbell, P.E.

This article is dedicated to the memory of Peta Raabe, a master in her art of Landscape Architecture.

1500 Centre Square Complex in Philadelphia, Pennsylvania is a cast-in-place concrete frame building constructed in 1969. The complex consists of a four-story central atrium connecting two 44-story office towers. The atrium also contains retail shops and access to the underground subway system. In an effort to revitalize the building and attract new tenants, a $10 million renovation project to the central atrium was conducted by the building's owner, REIT Management. The Architectural design was completed by Daroff Design, Philadelphia. The three entrances to this atrium, Plaza Entrance, Market Street Entrance, and 16th Street Entrance, along with new exterior planters and a new exterior stair around the city landmark sculpture, "The Clothespin," were also included with the renovation project. The project involves renovating the three entrances to 1500 Market Street Centre Square by removing the existing façade and replacing it with clear insulated point supported Pilkington glazing and stainless steel entrance canopies.

Market Street Entrance, Centre Square, Philadelphia, PA.

The main entrance facing The Clothespin met with significant aesthetic challenges in spanning between the two massive concrete towers with a distance of only 40 feet. The project team addressed this challenge by using a clear insulated Pilkington glazing and stainless steel façade. Glazing and flanking stainless steel allow natural light into the lobby, while providing a sleek reflective finish on the outside. Standing at the right position reflects the grandeur of the recently renovated City Hall with its "Second Empire" intricate stone façade.

The other entries mirror the Pilkington glazing and stainless steel with different methods of support. After review of different systems to support glass up to 45 feet in height, a single stainless cable was selected for its purity of design and limited structural infringement. Sleek stainless steel spider fittings continued to maximize the effect of the glass façade. The 45-foot height required pre-tensioning of the 1⅛-inch stainless steel cables, providing challenges in support onto the existing structure.

Exterior entry glass with stainless steel was carried through to the interior finish around existing core elevators for the atrium. Stainless steel point-supported glazing was anchored to the existing concrete core and backlit with changing color patterns for a dramatic effect within the four story atrium. Stainless steel spider fittings minimized the impact on the glazing and helped to create a "wow" effect for all tenants and visitors.

Special Structural Design Consideration

While the stainless steel pre-tensioned cable support system for the glazing proved the best aesthetic option, challenges to the existing building were significant.

The existing building, as mentioned previously, was cast-in-place concrete with fairly tight clearances and filled with existing active systems. Four supporting cables for the front entrance, spaced 8 feet on center, were pre-tensioned to a force of up to 40,000 pounds resulting in significant loads to the existing structure.

To support these loads, new concealed structural steel was threaded below the entry vestibule. Lateral wind loads were resisted by structural steel trusses concealed within the stainless steel finish above the vestibule. All structural steel was depth restricted to fit within available space. The steel was also fabricated with a curve (called cambering) so that it's deflected shape would be flat. This necessitated cambering with a belly, as the pre-tensioning forces pull the steel up.

Heads of the stainless steel cables were supported on structural steel brackets anchored to the existing roof concrete. These brackets, due to their height above eye level, were maintained as painted structural steel rather than using stainless steel. Existing roof concrete, could not support the heavy pre-tensioning forces, but was successfully reinforced with structural steel in order to maintain the intent of the glazing support structure.

Erection tolerances to marry the structural steel support and the stainless steel were tight. Maintaining a certain tensioning level in the cables was critical for structural support of the glass. Interest-

Project Team

Owner: REIT Management
Architect of Record: Daroff Design/DDI Architects
Structural Engineer: The Harman Group
Contractor: IMC Construction
Lighting Designer: Johnson Light Studio
Lighting Manufacturer: Martin Architectural
Landscape Architect: Lager Raabe Skafte Landscape Architects
Signage Designer: DDI Graphics
Signage Manufacturer: Grid Sign Systems

ingly though, once the system was in place, allowable deflections under wind loads were large, on the order of 6½ inches. Also considered for the cables was any differential thermal loads induced.

Effect of Anchoring to Two Separate Buildings

Differential movement was an additional special design consideration of spanning between two buildings with the stainless steel supported Pilkington glazing. The buildings were designed as separate buildings with an expansion joint between them. The Pilkington system had to close off the glass but respect movement between buildings. Dissimilar movements between buildings included deflection due to wind, earthquake and thermal loads. Concealed supports that allow the glazing to move freely at one end was a significant challenge both structurally and aesthetically.

Design Methods

Wind load criteria for the performance design of the glass and backing structure was developed from current City of Philadelphia loading criteria. Advanced modeling programs were utilized to analyze and compare loading criteria and forces with the glass manufacturer's engineer, W&W Glass. Iterations were required between the base building analyses and the glass manufacturer performance engineer's analyses in order to determine final deflections and final cable forces required to support the glass. Review of existing drawings and manual calculations were performed to analyze new loads on the existing concrete structure.

Result

The end result of this entry re-cladding is an inspiring collection of glass and stainless steel. Centre Square remains an office building anchor in the heart of Philadelphia. The design team worked collaboratively with the Owner to create dramatic effects to both the interior and exterior through the use of point supported glazing, stainless steel, and structural steel. The project was a clear success for all parties. ▪

Plaza Entrance, Centre Square, Philadelphia, PA.

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