Mitigating Risk: 40 Stories of Egress Stair Collapse

Retrofitting two existing 40-story staircases required care in design and sequencing to keep the occupied building safe during construction. Holmes Structures’ non-structural retrofit kept the egress staircases fully operational inside the 945,000 square-foot building throughout construction.

The existing stairs consisted of top and bottom stringers rigidly attached at the floor levels and an intermediate landing suspended from the existing floor framing. The retrofit solution left the top and bottom connections undisturbed to avoid shoring the stringer runs and interrupting the path of egress. This eliminated the typical solution used to account for earthquake movement through slip connections at each floor level.

Instead, earthquake-induced movement at the intermediate landing was accommodated by cutting the landing in half and re-supporting it on low friction pads and support framing. The support framing attached to extensions of the existing suspended rods, eliminating the need for shoring entirely (the support framing doubled as a self-shoring system once attached to the suspended rods). The built-in shoring was designed so that saw cutting of the landing could be halted in the middle of construction if emergency egress was necessary.

This project sets a precedent for mitigating existing stair vulnerabilities in a vast portfolio of buildings.

Achieving a Comprehensive Solution

Holmes Structures’ non-structural seismic solution successfully met the following requirements:

1. Accommodated inter-story drifts as expected from the Non-Linear Response History Analysis (NLRHA), without damage or collapse of stairs.
2. Minimized disturbance to tenants of the fully occupied building.
3. Coordinated with the San Francisco Fire Department (SFFD) to keep egress undisturbed.
4. Kept stairwell operational 24/7 during construction.

Prototype Testing Yields Efficient Implementation

On site mock-up of the solution was conducted for a single landing in each stairwell, which:

- Exposed unforeseen conditions not documented in existing drawings.
- Enabled testing of micro-containment area.
- Highlighted the extent and locations of abatement including asbestos-containing sheetrock, fireproofing, and lead paint.

Lessons learned from the mock-up saved $500,000 and delivered the project ahead of schedule.

425 MARKET STREET STAIRCASES
San Francisco, California

Holmes

Contractor: Plant Construction
Owner: 425 Market REIT
Client: Cushman & Wakefield
Architect: Berreton Architects

SEAONC/SEAOC 2018 Excellence In Structural Engineering Awards - Special-Use Structures