

Parkway 301

Adaptive Reuse of the Shenandoah Building

By Eric R. Ober, P.E., S.E. and Robert P. Antes

Parkway 301, formerly the Shenandoah Building, is a transitional masonry structure located in the Downtown Historic District in Roanoke, Virginia. The seven-story building, originally constructed in 1910 and vertically expanded in the early 1920s, had office occupancy over ground floor retail since its opening. Recently, the building was adapted to house ninety residential apartments on the upper floors over renovated ground floor retail space. Insufficient documentation of the existing construction in adaptive reuse projects challenges designers and contractors. In the case of the Parkway 301, hidden conditions overwhelmed all other structural challenges of the project.

Project Background

Roanoke is located in the southwest portion of Virginia and is the state's eighth largest city. Its population grew substantially in the first half of the twentieth century. A number of the buildings of this time period in the Downtown Historic District remain standing and have undergone renovation in recent years. Parkway 301 is among the most recent (*Figure 1*). The building was initially constructed in 1910 as a rectangular three-story reinforced concrete office building over a one-story basement. The footprint is approximately 120 by 95 feet. In the early 1920s, the Shenandoah Life Insurance Company



Figure 1. Parkway 301 after renovation. Courtesy of Peter Aaslestad, Copyright 2014.

purchased the building and commissioned a four-story steel-framed vertical expansion with a U-shaped plan opening to the south (*Figure 2*). The west, north, and east wings surround a central light well which occupies a footprint of 40 by 40 feet. Exterior masonry walls are primarily composed of brick and terra cotta, and infilled tight to the concrete and structural steel frame. This type of wall construction was common in buildings of the early 1900s, where designers intended to maximize the usable interior space and relied on the erroneous assumption that masonry construction was effective waterproofing for the embedded structural framing.

Project Description

The building remained largely unaltered until purchased by Chapman Enterprises Inc. in 2012. Chapman retained the project architect, Baskervill, to design an adaptive reuse of the building to include ninety residential apartments on the upper six floors over ground floor retail space. Baskervill engaged Simpson Gumpertz & Heger Inc. to provide structural engineering services for the project.

The major structural components of the renovation initially included a new full height interior egress stair (basement to seventh floor), reconstruction of the interior lobby slab inside the building to meet ADA requirements, lowering portions of the basement slab to create adequate headroom for tenant amenity use, and demolition of portions of the third and fourth floors to extend the light well into the original 1910 construction to accommodate additional apartment units.

Field Investigation

Drawings for the building were non-existent. The existing building construction was extensively investigated while still partially occupied.



Figure 2. Parkway 301 (then The Shenandoah Building) during 1920s vertical expansion.



Figure 3. Draped mesh slabs and steel-lumber joists at upper levels.

Readily-visible components were measured and hidden structural members were probed at representative locations. Due to the age of the existing structural steel, weldability could not be presumed by default. Samples were retrieved from columns and beams and tested with the finding that the steel is consistent with ASTM A36 in terms of metallurgy and thus easily weldable.

The 1910 construction is framed with one-way composition slabs (reinforced concrete ribs between clay tile fills) spanning between reinforced concrete beams and columns. The 1920s vertical addition has steel columns stacked over the existing concrete columns below, with the exception of three columns. Three upturned east-west-spanning transfer girders at the fourth floor carried the loads of the three offset columns above to the existing concrete columns below. The girders, encased in brick, penetrated the building envelope into the light well such that each girder was located on the interior and partially on the exterior.

The presence of some unusual structural assemblies complicated structural analysis of the existing framing. Concrete slabs and beams at the 1910 construction are reinforced with Kahn bars, developed by Julius Khan and patented in 1892. These bars were rolled in various sizes with a diamond-shaped center and horizontal projecting flat plate wings. The projecting plates were cut free from the core in a regular pattern and bent upwards at 45 degrees so that the bars served as both flexural and shear reinforcement. At the 1920s construction, draped mesh concrete slabs are supported by steel-lumber joists at close spacing, which span between structural steel girders. The name is a misnomer as there is no “lumber” in these joists. They are composed of back-to-back cold-bent C-shaped steel sections (similar to modern cold-formed steel studs) and were introduced to be a component of light framed floor systems economical in situations where wood joists were traditionally employed (Figure 3).

Asbestos-laden materials hindered completion of all of the desired probes (including those at the existing upturned transfer girders). With no visually apparent signs of structural damage or excessive deflection, further probing was deferred to the construction phase.

Discovery

While non-structural demolition was underway, the general contractor uncovered significant hidden structural damage around the perimeter of the light well at the fourth floor. At the north side, two concrete beams, carrying heavy masonry walls and spanning the width of the light well, were found to have wide full width diagonal cracks at their supports (Figure 4). Along the west side, the upturned transfer girders were uncovered and found to be riveted built-up steel sections

comprised of angles and plates. Where the girders penetrated the building envelope near mid-span, long-term water infiltration substantially corroded the steel resulting in areas of full section loss of the web and partial section loss of flanges (Figure 5). Along the south side, the soffit of each of the concrete spandrel beams across the width of the light well and into the adjacent bays had severe spalling and moderate reinforcement corrosion. Steel lintel angles over the punched window openings in the south wall were severely corroded.



Figure 4. Severely cracked concrete beam at north side light well.

Response

The contractor halted construction while the newly exposed existing conditions were evaluated by the structural engineer. Each of the conditions was determined to require repair intervention. The need for temporary shoring was unclear since there was no visually apparent deflection of the structure; however, the steel girders were believed to be marginally stable based on the extent of corrosion damage.

The structural engineer undertook a series of structural analyses to evaluate the effects of measured steel girder corrosion on building temporary stability, including consideration of potential alternative load paths (such as Vierendeel frame behavior of the supported structure above). No structurally adequate load path was identified.

Temporary shoring of the structure supported by the transfer girders was installed to maintain building stability while permanent repair options were contemplated. After the building was shored, the contractor resumed construction in unaffected areas.

Repairs

The concentration of structural deterioration challenged the designers and contractors to work together to develop the most efficient approaches to resolving and repairing the damage. At the north side of the light well, there was adequate headroom to enable



Figure 5. Severe deterioration of steel transfer girder.

installation of new steel beams below both of the damaged concrete beams. The south spandrel beam damage was the result of poor construction quality (inadequate reinforcement cover) but had not resulted in significant steel section loss for the Kahn bars. Conventional concrete repairs were implemented. The most serious structural concerns were with the three steel transfer girders.

The range of steel girder repair options considered included repair in place, elimination of the transfer by adding new columns to new foundations, and replacement of the transfer girders inside the enclosed portions of the building. Repair in place was eliminated from consideration early. The original ill-conceived design concept of penetrating the building envelope could not be easily made more reliable. Extending new columns to new foundations was technically feasible but architecturally unacceptable in the first floor retail space. Thus the last option, new transfer girders inside the building, was implemented. At Parkway 301, substantial clear headroom was available below the second floor to accommodate the new girders. The final repair design consists of new structural steel transfer girders spanning directly below and parallel to the original transfer girders above, maintaining the original gravity load path to the foundations. Work included the following:

- Erecting a pair of parallel wide flange girders below each transfer girder above.
- Adding steel sections and post-installed anchors around the existing columns to receive the new girders.
- Adding new columns to extend the transferred columns down to the new transfer girders.
- Modifying the existing transfer girders to retain the interior portions (intimately anchored with the existing steel columns above) and eliminate those portions outside the building envelope.

- Partially pre-loading the new girders by hydraulically jacking prior to releasing the shores.

Construction schedule was a significant consideration in the overall approach to the repairs. These repairs had to be completed before other schedule-intensive work, such as structural demolition at the light well, could be implemented. Project funding hinged on meeting occupancy goals established at the conceptualization of the project. The contractor worked with the design team to develop expedient details and, ultimately, the repairs were completed in a timely fashion to allow the overall project to meet critical deadlines.

Lessons Learned

Hidden structural deterioration is commonly uncovered in renovation or adaptive reuse projects. In the case of Parkway 301, visual observations alone would have misled the design team into the erroneous assumption that "all is well". Diligent investigation of existing conditions, regardless of the availability of drawings and often including destructive probing of representative hidden conditions, is always recommended.

The success of the Parkway 301 project is a testament to the hard work of all parties involved and a team approach to achieving the Owner's vision. ■



Eric R. Ober, P.E., S.E., is a Senior Project Manager at Simpson Gumpertz & Heger's Washington DC office. Eric can be reached at erober@sgh.com.

Robert P. Antes is a Staff II-Structures at Simpson Gumpertz & Heger's Washington DC office and serves as the Project Engineer on all types of repair and rehabilitation projects. Robert can be reached at rpantes@sgh.com.

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