Reinvigorating a Historic Giant

ROW DTLA Building 2

By Samuel Mengelkoch, S.E.

Envisioned by developer Atlas Capital Group and design architect Rios Clementi Hale Studios, ROW DTLA reinvigorates the vast and historic Alameda Square warehouse and industrial building complex. The project updated the area into a vibrant district of offices, retail, and restaurants, and provides a network of public spaces for live music, entertainment, and festivals in Downtown Los Angeles. Renovated in 2017 under the provisions of the *California Historical Building Code* (CHBC), ROW DTLA Building 2 is among the first buildings that could be shown to meet the City of Los Angeles' earthquake hazard reduction requirements for non-ductile concrete buildings per Ordinance No. 183893. The project sets a precedent of how a historic, non-ductile concrete building can be retrofitted without losing its historical nature and visual appeal.

Building 2 was designed in 1918 by renowned English architect John Parkinson and originally built for the Los Angeles Union Terminal Company. The 400,000 square-foot reinforced concrete building is a significant component of the ROW DTLA development, one of the newest and largest additions to the burgeoning Arts District redevelopment in Downtown LA. Building 2 is approximately 100 feet by 600 feet in plan and consists of six stories with a basement and several rooftop penthouses as well as a rooftop water tower – originally for fire suppression, now maintained as a familiar beacon in the Arts District. New work added a rooftop deck with sweeping, north-west facing views of Downtown Los Angeles, a rare and stunning view of the heart of the city.

An ownership change in the middle of the project's design phase was one of the project's more formidable challenges. The initial owner had directed the Structural Focus team to mimic the retrofit design of a similar building on the campus, a strategy with prominent new moment frames on the exterior, significantly altering the rhythm and proportions of the façade. The new owner had a much different vision for the project, part of which was to maintain the "New York City" feel of narrow streets and formidable building façades – a style incompatible with highly visible retrofit elements. A series of shear wall cores down the center of the long, narrow building was the ideal solution for the new owner's design vision. The architecture of the rehabilitation fits well with the new design – the building behavior was simplified, and the performance was significantly improved (*Figure 1*).

With no dedicated lateral force-resisting system, the building presented challenges and opportunities requiring the structural team to think quickly, adapt to existing conditions, and make the best use of the building's characteristics. Utilizing ASCE 41, *Seismic Evaluation and Retrofit of Existing Buildings*, as specified by the Los Angeles ordinance, an ETABS model with existing structural elements was built for understanding the behavior of the historic building and strategically locating the new shear wall additions. With four full-height,

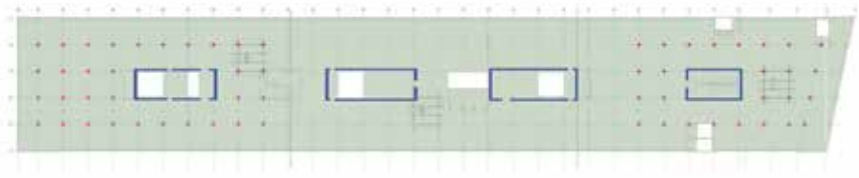

Figure 1. Typical floor plan, showing four new reinforced concrete shear wall cores (blue). Columns highlighted in red received FRP wrapping; typically the outer thirds of the building experienced greater interstory drift due to torsion.

specially reinforced concrete shear wall cores, the collection of forces was critical. The team employed the robust and generously reinforced existing beams and slabs, designed to support a historic warehouse live load of 250 pounds per square foot, for double duty in collecting forces in compression, tension, and shear and delivering the load to the new shear walls (*Figure 2*).

Because shear wall cores were employed inside the building, the contractor was able to utilize the existing structure for construction staging as they went up the building, largely eliminating the need for extensive scaffolding. Existing beams were attached to new shear walls with thru-bolts, providing easy access and a visible link to the existing structure (*Figure 3*). Suspecting they would exhibit good behavior, the team performed nonlinear finite element analysis on the existing round, spirally-reinforced concrete columns, and compared their inherent ductility to anticipated building drifts. The goal was to achieve a maximum 2% inter-story drift without inducing a column shear failure. The drift behavior of each column was analyzed by inputting linear and nonlinear properties and axial loads into the MATLAB program CUMBIA, used for force-displacement response of reinforced concrete members under moment. Only columns that could not sustain the imposed drift at the damage control limit were strengthened with Fiber Reinforced Polymer (FRP). This strategy allowed the team to eliminate the need for FRP wrapping on hundreds of sufficiently reinforced concrete columns throughout the building.

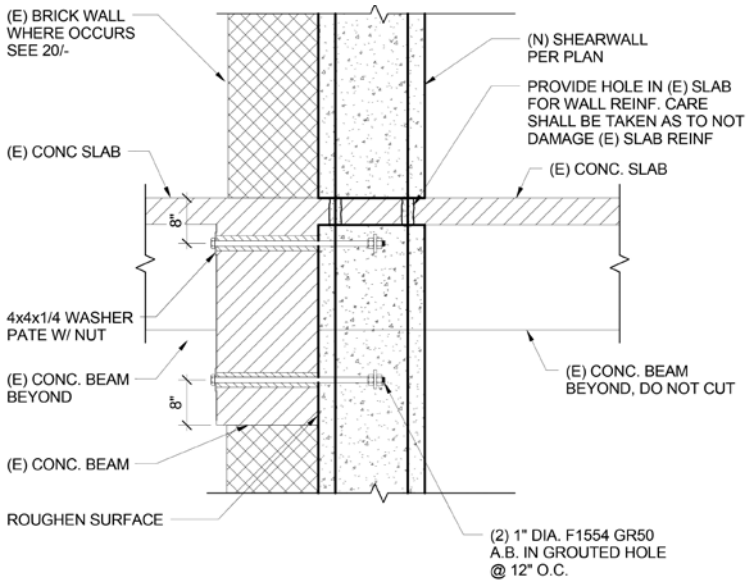

Figure 2. Detail at the thru-bolt connection between the new shear wall and existing girder. Also showing vertical wall bars passing through cores in the slab.

The four new shear wall cores required substantial mat foundations which had to be integrated with the existing spread footings. Each original column was supported by a multi-tiered, "wedding-cake" style spread footing. In the original construction, there was evidently no set footing elevation. Rather, crews likely excavated only until competent soil was reached, and that is where each footing went. Since the depth to competent soil varied across the large building footprint, footing elevations varied randomly within an approximately five-foot range. The bottom of the mat sloped to accommodate the varying elevations, always matching the bottom elevation (*Figure 4*). Since the top of the mat was level, the mat thickness varied as well, while maintaining a required minimum thickness of 60 inches. Several thousand epoxy dowels were required to integrate the existing footings with the new mat system.

Each shear wall core has a single mat foundation supporting it, with the mat resisting vertical loads, shear loads, and overturning of the core. The structural team worked with the geotechnical engineer to arrive at a rational, allowable bearing value below the mat in the most extreme seismic load cases, permitting settlement greater than typical design allows. This reflected the desired performance level of Collapse Prevention per the CHBC.

To maintain the early 20th-century charm of the building, engineers carefully surveyed and analyzed the rooftop water tower and façade fire escapes to prove that they could safely remain (*Figure 5*). With a few suggested upgrades from the team, the water tower sits proudly on top of the finished building; ultimately, however, the five 100-year old fire escapes could not be saved. Untenable strengthening requirements from the City of Los Angeles would have dramatically changed their visual character and proved cost-prohibitive.

The building's size, age, and countless functionalities presented surprises until the very last days of the project's construction. Electrical transformers from the early 20th century lined a dark room in the basement; in-floor industrial ovens capped with concrete years ago remained undisturbed, still full of ash and charred concrete; sheet metal spiral chutes used to deliver packages from upper stories down to the loading dock level were found; hidden slab overload damage that previous tenants had attempted to repair was found; and, even windows that had once been above grade were now

Figure 3. Reinforcement installation at new shear wall core. Note doweling to the existing corner column and force-transfer bolts into the existing girder at the top of the wall.

Figure 4. Crews install foundation reinforcement at the bottom of the new mat foundation. Notice "wedding-cake" style original concrete foundations at varying elevations.

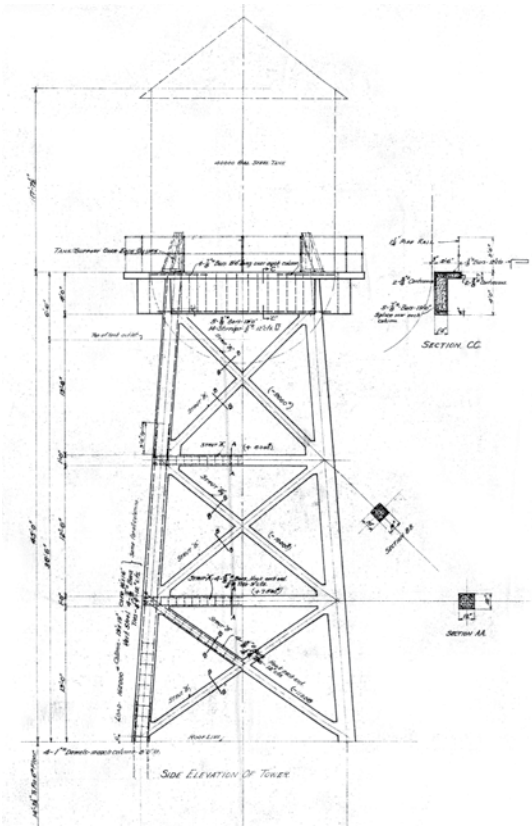

Figure 5. Rooftop water tower elevation from original 1916 Parkinson drawings. Notice support frame is of reinforced concrete.

below the street level with plywood holding back the soil behind them. Design changes and hidden conditions required many unanticipated drawing submittals, bulletins, and addendums.

The $25 million retrofit and adaptive reuse of ROW DTLA Building 2 presented unusual and complex challenges for the design team. However, positive collaboration, flexibility, and adaptability proved key to the project's successful completion while setting a precedent for the application of the Los Angeles Ordinance No. 183893. ROW DTLA is a considerable part of the revitalization of the Arts District in Los Angeles (*Figure 6*). Standing as an eclectic and elegant example of adaptive reuse without displacement, ROW demonstrates how maintaining a physical connection to our past is not at odds with a promising economic and cultural future.▪

Figure 6. Aerial view.

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