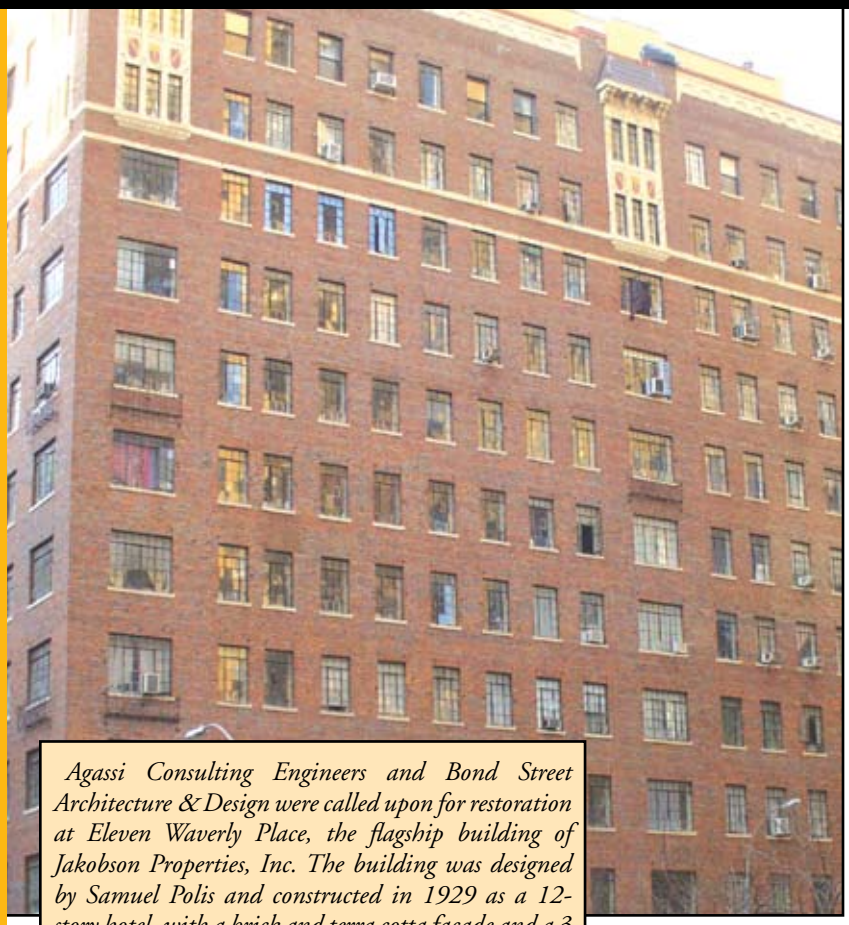
11 Waverly Place, New York City

The Versatility of Structural Steel Allows for an Innovative Restoration Alternative

By Nissim Agassi, P.E., Scott Kamen, AIA, and Denise Keaveney
Co-authored by Ophir Agassi



Agassi Consulting Engineers and Bond Street Architecture & Design were called upon for restoration at Eleven Waverly Place, the flagship building of Jakobson Properties, Inc. The building was designed by Samuel Polis and constructed in 1929 as a 12-story hotel, with a brick and terra cotta façade and a 3 story penthouse. Presently, the first floor is commercial and the remaining floors are residential units.

At first, the project was to include only restoration of the building façade; however, when inspection and probing revealed unsafe structural conditions, the owner expanded the scope of work to encompass design, inspection, and program management of a comprehensive restoration project.

A partial view of the principal façade with original windows. The existing set back 3-story penthouse was to remain intact through the entire roof rehabilitation. New steel was brought in through the top floor windows.

The space between the existing cinder concrete slab and a new metal deck is being grouted. The new deck with injection ports was installed on new sister beams, custom fitted and sealed.

Temporary shoring of the near collapsing cinder concrete slab.

Existing Condition

Initial probing revealed that the deterioration visible on the outside of the building was not confined to the façade, but extended further inside the structure. Severe corrosion of the spandrel steel at the main roof level, and spalling of the roof cinder concrete slab, which was supported by a corroded structural steel frame, was discovered. The slab reinforcing bars were severely corroded and some were completely severed. Large chunks of concrete had already fallen and were lying precariously 30 inches below on the stucco ceiling, which had never been meant for load bearing and which itself was hanging from the same deteriorated roof slab.

The owner was immediately notified of the findings, and asked to conduct an investigation of the entire cinder concrete slab and the steel framing system from inside the 12th floor apartments. This investigation confirmed that the problems observed during the façade probe were widespread. Water damage over the years had caused severe corrosion of the structural steel and reinforcing bars, and non-reversible deterioration of the cinder concrete slab over the entire roof area. When coring of the deteriorated slab was attempted, it simply crumbled, indicating little strength to support itself and other rooftop loading.

The first response to these discoveries was to address the safety of the building occupants. The flimsy 1-inch stucco ceiling that was hanging from the deteriorated roof slab was the only barrier between the falling concrete debris and the occupants of the 12th floor. This was truly a disaster waiting to happen. With the owner's complete cooperation, the entire 12th floor and the penthouse were vacated to avoid tragedy. To protect the occupants of the 11th floor, the owner, at the designers' recommendation, engaged Brisk Waterproofing Company to remove the stucco ceiling and temporarily shore the deteriorated roof slab as each 12th floor apartment became vacant.

Reviewing the situation revealed the need to repair the corroded steel and deteriorated slab, while at the same time leaving the 3-story penthouse intact. The penthouse housed the main building services, so removing the penthouse would have caused the owner to incur exorbitant losses from service interruption to other fully occupied

"Toothing" out of the exfoliated salmon (orange) face brick.

parts of the building, as well as the undesirable cost of rebuilding the penthouse. Furthermore, it was determined to do all work without swinging a crane over the building in order to avoid having to evacuate the 11th floor, which would have meant complicated logistics and significant financial losses as well. To minimize costs, designers also wished to avoid the need for tenting the entire roof during the process of removing and reconstructing the existing slab and roofing system.

A Novel Solution: Load Relief

The aforementioned conditions constrained the ability to increase the load-carrying capacity of the steel structural system through standard reinforcement, so an alternative was necessary. The solution utilized a load reduction combined with a novel relief and transfer system.

The original roof was constructed with a plenum space for ventilation and for containing the building's main mechanical piping system. The plenum space was limited, but would provide enough space for the placement of new shallow 8-inch to 10-inch deep support girders. These new girders, installed a few inches below the existing ones, would undergo relatively large deflections but function suitably as a stage against which the existing girders could be jacked and partially relieved of their load. The roof slab stiffness would be maintained by the coupled system of the existing and new girders acting in unison. Jacking and "freezing" the deformed position between the existing and new girders at specific jacking points, and locking-in a predetermined force through the insertion of calibrated bearing plates, served to permanently relieve the existing corroded girders of their excessive load and transfer this necessary load to the new support girders.

The existing concrete encased girder (top) being jacked against the new (lower) girder. Two calibrated jacks were used at each jacking location to permit the installation of a permanent bearing plate between them.

Close up of a typical exfoliated salmon face brick.

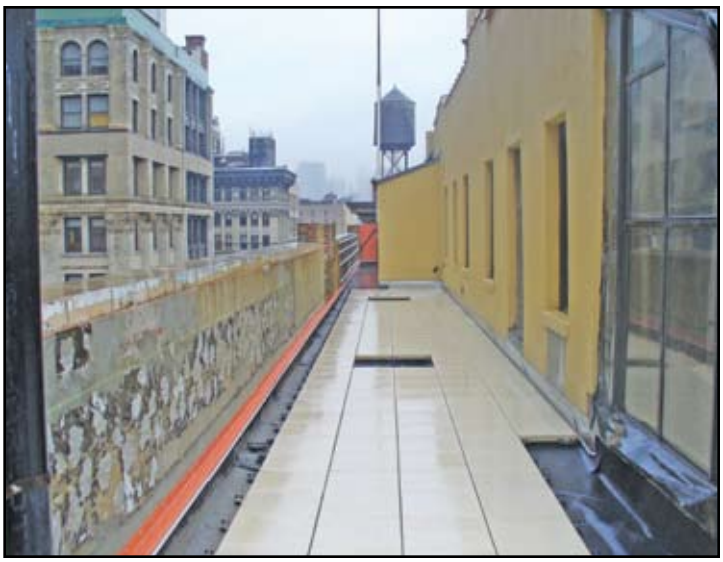
The unique jacking system had to be worked out in detail, and required careful calibration of forces and deflections at each jacking location coupled with proper sequencing. A simultaneous jacking of all interconnected girders was necessary to ensure that induced deflections did not cause permitted loads to be exceeded in any girder.

In the end, the approach of jacking and relieving the loads from the existing girders permanently increased the overall load-carrying capacity of the roof structural system, and entirely eliminated the need to reinforce the corroded steel girders.

Optimizing Efficiency, Increasing Safety and Reducing Costs

To accomplish the restoration as efficiently, safely, and cost effectively as possible, it was determined to do all roof work without protective tenting, and without using a crane or boom to haul pieces to the roof level. To make this possible, innovative strategies were employed to conduct all the structural steel repair work from beneath the roof.

continued on next page



New concrete plaza deck pavers showing location of new drains and custom metal parapet cover & flashing. The existing parapet was cored & reinforced before the replacement of the roof slab. The penthouse was recoated with Thorolastic.

Temporary loose rubber roofing & flashing were installed & new drains added.

To begin with, the forest of temporary shoring that was protecting the workers on the 12th floor and the occupants of the 11th floor had to be removed. At the same time, we still needed a shoring platform in place to support the deteriorated slab until it could be replaced. The solution combined into one system a temporary shoring scheme with a permanent support for the roof that enabled confining both the problem and solution to the roof level. The combined system eliminated the temporary shores all together, ensured the efficient and orderly implementation of the work, maximized the protection to occupants and workers, and minimized the building's exposure to the elements.

Like the existing girders, the existing steel filler beams, supporting the roof slab, were left in place and not repaired at all. Instead, new sister beams were installed in each bay and were fitted with welded steel shelf angles. The angles supported a temporary metal deck placed against the bottom of the existing roof slab. This temporary deck served two functions: as a collapse protection platform during construction and as a stage on which the existing cinder concrete slab was to be demolished. Once the deteriorated roof slab was demolished, the temporary deck was removed and a new permanent metal deck was installed on top of the sister beams, avoiding 3 inches of concrete dead load in the new roof.

The new permanent metal deck and existing steel before pumping new concrete. The existing steel was cleaned and left in place. After removal of the existing slab, the temporary deck was removed and a new permanent deck (shown) was installed on new sister beams that are below the lines of the shear studs.

Instead of using a crane or boom over the building, Helmark Steel, the structural steel fabricator and erector, was instructed to use a crane supported at street level to haul all steel members to the 12th floor and then deliver them through the 12th floor windows and roll them into place. Long steel members were cut into manageable length pieces and were spliced in place during erection.

The demolition of the deteriorated roof slab and the installation of the new concrete slab were accomplished by dividing the roof area into a carefully planned pattern of sequential demolition and reconstruction, in order to maintain the flow of work and the stability of the 3-story penthouse structure during the time the roof slab diaphragm was open.

While the process of demolition and replacement of the roof slab took place from above, the need for tenting was entirely eliminated and the building was kept watertight by a temporary loosely-laid rubber membrane that utilized new permanent drains previously installed at the main roof. The temporary rubber roofing system was rolled open in the morning and closed at the end of each workday. This membrane was installed in sections immediately following the removal of the existing roofing and cinder fill, and remained in place until the new permanent waterproofing system could be installed.

Accomplishing a project such as this requires careful planning, cooperation, and close coordination among all parties involved. All participants deserve credit for their contribution to the safe and successful completion of this project.▪

Project Team

Owner:
Jakobson Properties

Design & Construction Management Team:
Agassi Consulting Engineers
and
Bond Street Architecture & Design

General Contractor:
Brisk Waterproofing Company

Steel Fabricator & Erector:
Helmark Steel

Testing Lab:
Testwell Laboratories

Nissim Agassi, P.E., is the founding principal of Agassi Consulting Engineers, NYC. He has extensive experience in structural engineering, project management, building renovation & retrofit, façade restoration, and value engineering. For questions & feedback e-mail: ***nagassi.ace@verizon.net****.*

Scott Kamen is a Principal with Bond Street Architecture & Design, with offices in New York and Westchester County. Mr. Kamen has extensive experience in commercial and residential architecture and design and historic building restoration.

Denise Keaveney graduated from University College Dublin, Ireland, with a Bachelor of Architecture (Hons) in 2000. As an architect working in NYC since 2000, Denise has gained much experience in project management and design both from her role on this unique restoration project and on other design projects.

Ophir Agassi is an artist and writer. He graduated from Yale University and has held numerous exhibitions of his work. He can be reached at ***oagassi@gmail.com****.*