One Biscayne Tower Façade Restoration and Repair

Miami, FL

Submitted by STRUCTURAL

One Biscayne Tower is one of the most iconic buildings in Miami, FL. Built 40 years ago, it was the tallest building in Miami for almost a decade and was voted "Building of the Year" by BOMA Greater Miami in 2001. This 24/7 building lies along a busy intersection and sees significant pedestrian traffic on its sidewalks.

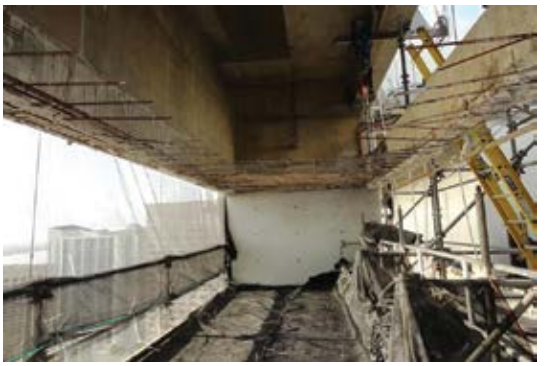
The 39-story office tower with a 12-story parking garage at its base was built with reinforced concrete and precast joists in the garage. The building's core was designed with minimal load bearing columns that maximize the tower's usable floor. There are distinctive mansards at the 39th level with partial shear wall/columns protruding toward the sidewalk.

The local environment is very aggressive, including not only frequent hurricanes but persistent deterioration from salty water and air, UV rays, high-water tides, and car pollution. Such environmental factors contributed to rapid corrosion and carbonation of the steel and concrete of the structure.

SITE INSPECTION AND EVALUATION

With the building due for a mandatory 40-year inspection for structural safety, the owner opted to focus on the façade and contracted for a survey, which determined that the existing structure had substantial deficiencies. Several tests, including corrosion mapping and radar scanning, were performed to determine the scope of restoration, with the evaluation of the overhang slabs a priority. Additional tests, such as surface-strength compression, concrete density, permeability, chlorides, carbonation, alkali-silica reaction, and concrete strength were performed throughout the rest of the structure. Test results formed the basis for a comprehensive repair plan to respond to potential life safety concerns and meet the client's expectations for extended operational life, pedestrian protection, and regulatory compliance.

The extensive restoration work included concrete repair, strengthening of structural members, corrosion protection, and the application of new sealants and coatings. Custom details using concrete, waterproofing materials, and carbon fiber-reinforced polymer (CFRP) rods and sheets were provided to replace and strengthen deteriorated concrete and reinforcing steel on the structure.



Overhang slab after demolition and "dance floor" with debris protection installed

SITE LOGISTICS PLANNING

The first step of the project was to protect the public's safety, requiring the installation of an overhead protection tunnel over the sidewalk. The tunnel was designed to withstand tropical storm-force winds and maintain unobstructed pedestrian access to the sidewalks.

Next, debris netting and suspended scaffold work platforms ("dance floors") were installed beneath the two severely deteriorated overhang slabs. These platforms were custom-designed and rated to withstand tropical storm-force winds. They served a twofold purpose: to protect against falling debris and to provide a working platform for the removal/replacement process.

Since the building is located in a hurricane zone, a Hurricane Preparedness Plan was developed to outline a procedure for securing the jobsite in the event of a hurricane or tropical storm. This plan had to be used and a partial demobilization of the jobsite was implemented on three occasions due to Hurricanes Irene, Isaac, and Sandy.

Limited roof access presented a challenge with the replacement of the overhang slabs as several pallets of concrete, equipment, and long lengths of reinforcing steel and steel shoring had to be transported to the roof via a single freight elevator. This

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required cutting and splicing shoring beams and reinforcing steel.

An additional logistical challenge on the east elevation was the presence of a balcony on the 15th level, followed by the parking structure, which protruded horizontally past the façade. Consequently, scaffold landing platforms were installed on the balcony to land swing stages for access to the façade columns and overhang slabs.

REPAIR PROCESS EXECUTION AND CHALLENGES

The first major repairs to be performed were the replacement of the two overhang slabs that were severely deteriorated. Demolition was performed using electric chipping hammers with debris falling into netting installed below the slabs. Existing reinforcing steel coverage was minimal with steel areas exposed before demolition. Upon demolition, it was discovered that the supporting soffit beams were also deteriorated and needed repair.

After demolishing the slabs, shoring was installed. Steel truss joists supported by triangular brackets were attached to the columns on either side of the overhang slabs. This required that a beam and pulley system be devised so as not to overload the "dance floor." Next, new reinforcing steel was placed and doweled into the adjacent columns and support beams. The steel was coated with corrosion inhibitor and then placed back with high-strength concrete containing corrosion inhibitor for further protection.

Cantilevered soffit slab after demolition, looking down to Bayfront Park and the bay

Repairing the south elevation using swing stages

Repairs on the façade columns and walls proceeded to the south and north elevations. When the swing stages were hung in the second phase position between the columns, the high winds made progress difficult, as there was a long, unprotected distance to travel in the swing stages between the ground and the 39th level to access the underside of the overhang slabs. To overcome this challenge, intermediate tie-off points for the stages were installed along the lengths of the columns and the swing stages were secured in place when the final position was reached.

The façade repairs were performed with electric chipping hammers on the swing stages and rigid platforms. The steel was wire-brushed clean and painted with corrosion inhibitor. Smaller repairs were placed back with hand-packed material, while larger repairs were formed and placed; both materials contained corrosion inhibitor. Crack epoxy injection was performed with pneumatic injection guns attached to a small compressor on the swing stage and used cartridges, which proved to be very efficient and effective.

UNFORESEEN CONDITIONS

This project presented numerous unforeseen conditions that significantly increased the repair quantities. The two major increases were the crack injection quantity, which increased by 1900% to a total of almost 5 miles (8 km), and the addition of three overhang slabs for removal/replacement. After completion of the initial two overhang slabs, several remaining slabs were inspected and determined to have severe deterioration. Repairs included:

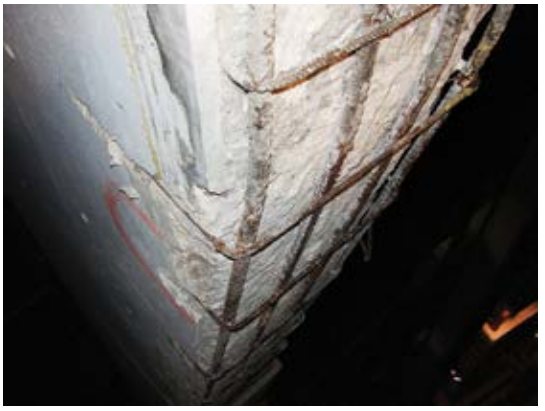
- Wrapping one slab and adjacent parapet wall in CFRP, thus negating the need for full replacement; and
- Fully replacing the three remaining slabs:
  - New shoring was designed that significantly reduced the amount of steel required and provided ease of installation; and
  - High early-strength, self-consolidating concrete (SCC) was used to allow for form removal after 7 days versus 28 days.

Other unforeseen conditions led to the creation of many custom-designed repairs, including:

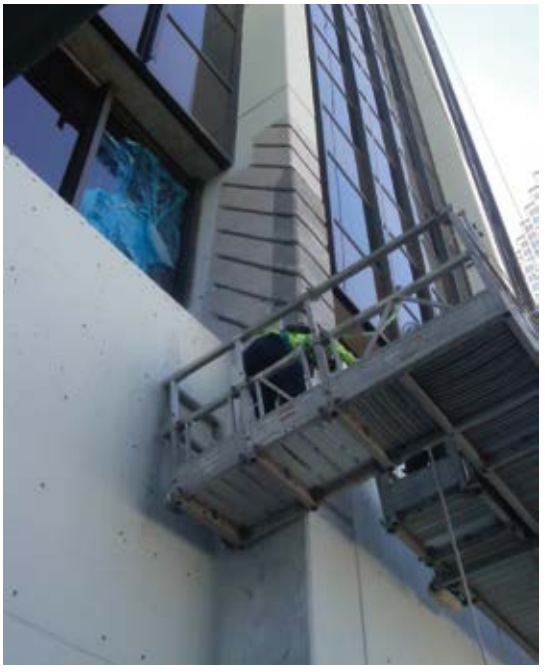
- Minimal concrete coverage was exhibited in numerous repair locations. A design was developed for the application of CFRP in all low-coverage areas;
- Large sections of columns and beams on the west and south façades exhibited significant cracking,

and exploratory demolition revealed reinforcing steel corrosion and minimal coverage. The west column was built out using SCC and wrapped with CFRP. A south column required the installation of shoring down through five floors in the garage and was built out using SCC and wrapped with CFRP;

- A large section of column on the north façade exhibited severe deterioration and unconventional reinforcing with minimal concrete coverage. A design was created to build out the column and install additional reinforcing; and
- A large section of column on the east façade at the 37th to 39th levels exhibited severe deterioration with loose concrete, posing a safety hazard to Biscayne Boulevard below. A custom repair design was created and protection measures were immediately installed to contain any falling debris. Logistics were very challenging and required the use of three independent swing stages working in tandem to access all sides of the column. The final repair included building out the column using SCC and wrapping it with CFRP.



Column repair at 39th level during demolition, looking down at night



Column build-out and additional reinforcing slots

CHALLENGES OVERCOME

What started as a 9-month project turned into a 24-month project, which used state-of-the-art and diverse repair techniques and many custom repairs. Safety was of the utmost importance throughout this project, for both the general public and the project team. Constant communication and teamwork between the contractor, engineer/inspector, and building management created a collaborative environment that met the requirements of all parties. As a result of applying diverse technologies and creative solutions, One Biscayne Tower will continue to be an iconic Miami skyline landmark for years to come.

One Biscayne Tower

OWNER
One Biscayne Tower, LLC
Miami, FL

PROJECT ENGINEER/DESIGNER
RAS Engineers
Hallandale Beach, FL

REPAIR CONTRACTOR
STRUCTURAL
Pompano Beach, FL

MATERIAL SUPPLIERS/MANUFACTURERS
Sika Corporation
Lyndhurst, NJ

STRUCTURAL TECHNOLOGIES
Hanover, MD

Completed repairs to One Biscayne Tower