Xerox Square Tower Façade Restoration

Rochester, New York

Submitted by Structural Preservation Systems, Inc.

As the tallest building in Rochester, NY, Xerox Corporation's 33-story, 437-ft (133 m) Xerox Square Tower stands high amid the downtown skyline. The building features an elegant façade constructed of cast-in-place exposed garnet aggregate concrete that gives this landmark building a dramatically decorative finish (Fig. 1).

On September 25, 1998, a mild earthquake created vibrations reaching downtown Rochester. The tremors caused delaminated concrete to fall from the building's third floor façade, revealing an undetermined quantity of deterioration as well as other defects associated with original construction.

In 1999, a façade inspection employing hammer soundings and minor destructive testing along with a detailed mapping survey was conducted. The investigation revealed corrosion-induced delaminations and cracks in the concrete as well as extensive interior honeycombs. These honeycombs were presumed to be contributing factors to moisture transfer to the steel reinforcement that caused the subsequent corrosion. Water was also penetrating the building through sealant joints at various locations—including along failures in the gasket system at the window perimeters. Subsequently, recommendations were made for the repair of the building's concrete structure, sealants, curtain wall system, and other remedial repairs.

Fig. 1: Repairs took place high above the downtown Rochester, NY, area

Details of the Concrete Repair and Waterproofing

It was important to phase the project so that only one building elevation would be affected at a time, leaving the rest of the building accessible to the large flow of Xerox employees. The safest way to accomplish this task was to work over four construction seasons—from spring through fall of 4 consecutive years.

The project began in June 2002 and was completed in October 2005. Due to the project's magnitude, coordination requirements and curing times, the project operated 24 hours per day, 5 days per week, with Saturdays as rain make-up days. Each year, the project was mobilized in the spring and completely demobilized in the fall. In total, the crews worked over 100,000 man-hours.

Concrete repairs were necessary from the second floor entablature to the roof level, replacing portions of deteriorated cast-in-place columns and precast sections on all four elevations. Each repair site was sounded—the concrete with compressive strengths ranging from 12,000 to 15,000 psi (88 to 103 MPa)—and chipped with 15-lb pneumatic chipping guns (in many locations up to 6 in. [15 cm] of material was removed) and sounded again. The edges were sawcut and detailed before the exposed steel was sandblasted and coated with a protective coating (Fig. 2). The engineer then inspected and sounded each site to ensure that no loose or delaminated areas remained before each patch was formed and the concrete mixture hand-poured (Fig. 3). In total, 1638 ft^3 (46.4 m^3)

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Fig. 2: Typical location of deteriorated concrete after demolition

Fig. 3: Placing concrete into formed repair location

Fig. 4: The entire plaza area was fenced and covered with a flooring system to protect the paver system

of deteriorated/distressed concrete were replaced at 1912 repair locations.

Sealants were replaced at horizontal construction joints in the columns from the third floor to the roof level. Vertical control joints were replaced between precast concrete sections at the second-floor level entablature. The contractor also installed a silicone sealant system between the glass/metal panels and concrete columns from the second floor to the roof level. A total of 138,000 linear ft (42,060 m) of sealants was replaced on the building from the second floor to the roof level.

Deteriorated, misaligned, or damaged aluminum window washing rig channel sections, originally cast onto the sides of the building columns to hold a window washing stage, were replaced with stainless steel channel sections from the second floor to the roof level. Quantities of 2445 linear ft (745 m) (516 locations) of existing aluminum channel sections were replaced.

The contractor also inspected and repaired the curtain wall system from the third to the 13th floor. In the process, 100% of the lockstrip T-gasket system was inspected and 36,000 linear ft (10,973 m) were replaced. The area between the concrete column and glass of the curtain wall was sealed with a new sealant system. Finally, new flashing was installed at the seventh and 22nd floor louvers and at metal panels at the 13th floor mechanical rooms.

A Very Challenging Repair

Protection from, and containment of, falling debris and dust was a constant challenge in this downtown area. Along with large nets placed where required, the contractor installed tight rubber gaskets at the access equipment interface to contain the debris. Additionally, the entire plaza area was fenced and covered with a flooring system to protect the pavers system (Fig. 4).

As work commenced, access equipment used to reach the height of the repairs became a challenge. To perform concrete repairs to the building's façade, the contractor needed access all around the column perimeters protruding 4 ft (1.2 m) from the face of the windows. Initial plans used the existing window washing swing stages.

From the start, the existing window washer rigs presented challenges. The second floor entablature stuck out about 4 ft (1.2 m) from the face of the columns, but did not allow enough room to land the access equipment. When landing and riding up on the swing stage, two ground men had to pull out each rig to avoid the entablature—an act that could have caused the rig to come out of the track. Additionally, the bulk and weight of the swing stages left little weight capacity for crews, equipment, and materials.

Maintaining enough electrical supply to the swing stage motors was another challenge. The height of the building caused a large voltage drop due to the length of power cable and the variable demands of building operations. Maintaining the proper air pressure and flow to the pneumatic 15-lb chipping guns used for demolition on each work platform was a daily struggle in the early stages.

Because of these challenges, the team decided to purchase mast climbing platforms to complete the project. By using mast climbers, the contractor could better control the power requirements and issues with the wind. By dedicating a step-down transformer to go from 440 V to 208 V, three-phase power, the power source was much more reliable; and the platforms provided a much more stable and larger work area for crews.

The mast climbing platforms used large motorized work decks attached to steel frames anchored to the building at 20-ft (6 m) intervals. Overall loading was a major consideration because the existing construction consisted of a supported concrete slab over the plaza deck and could not be used for bearing the load of the equipment. The equipment had to be anchored to the building's exposed columns with designed steel platforms attached to the columns using all-thread steel and epoxy anchors. Access to the platform and the mast climbers above the second floor entablature required construction of 40 ft (12.2 m) high stair towers from the plaza level (Fig. 5).

Fig. 5: Mast climbers shown with the 40 ft (12.2 m) high stair access towers from the plaza level

Aesthetic Details

A great deal of effort was also put into matching the aesthetics, with exposed garnet tailing aggregate finish, of the original concrete surface. After securing a supply of the hard-to-find aggregate (garnet tailing is a by-product of garnet mining), the contractor worked through numerous trials, tests, batches, and field tests to establish a color and concrete mixture consistent with the original construction. At the end of the testing, the final result was a field-placed concrete mixture design that included a prepackaged repair mortar, precisely measured water, and the garnet aggregate.

A crucial step in ensuring the integrity of the mixture was the process of prewashing and drying the garnet tailing. Because garnet has a specific gravity of 3.01 and can absorb 3 to 4% of its own weight in water, it had to be prewashed and soaked for 24 hours and dried so it was moist on the surface. Failure to do so would cause the garnet to absorb water from the concrete mixture. Such absorption would lead to a low slump and, ultimately, difficulty in placing the concrete.

Another critical step in ensuring a consistent finish was coating each mixture with a cementitious retarder. The retarder, along with favorable weather, temperature, and humidity, allowed the concrete at the surface of the patch to strengthen at a slower pace. When the form was removed, the surface layer of the concrete could be removed with a combination of mechanical means and power washing. The result—a beautifully exposed garnet aggregate finish (Fig. 6).

Fig. 6: Completed repair profile—a beautifully exposed garnet aggregate finish

Success in Safety

Safety is always a primary concern on any project. After the switch to the mast climbing equipment, workers attended a 3-day training course where both classroom and hands-on building techniques specifically geared toward erection, use, care, and maintenance of the platforms were taught. A job safety analysis (JSA) meeting was also conducted prior to the start of each shift to develop specific safety strategies for the day's work.

The location of the repairs—high above a very busy downtown area (Fig. 6)—required additional meticulous safety measures. The platforms were wrapped with fine mesh netting, and foam was placed between the platforms as measures to prevent materials from falling.

Unique projects such as the Xerox Square Tower Façade Restoration project require a great team effort. By effectively teaming with the consulting engineer and the repair contractor, Xerox Corporation ensured the continued beauty and structural integrity of a landmark building.

Xerox Square Tower

Owner
Xerox Corporation
Webster, New York

Project Engineer/Designer
STS Consultants
Vernon Hills, Illinois

Repair Contractor
Structural Preservation Systems, Inc.
Trenton, Michigan

Material Suppliers/Manufacturers
King Materials
Burlington, Ontario, Canada

Dow Corning Corporation
Louiston, New York