

A Tale of Two Masonry Facade Rehabilitations: When Preservation Standards, Codes, and Client Expectations Are at Odds

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Facade rehabilitation and restoration projects require design professionals to manage and balance varied and sometimes opposing factors, including historic preservation philosophical issues and considerations, code requirements, client expectations, and available funds. This article will focus on the terms *preservation*, *restoration*, and *rehabilitation*, and discuss the differences between each process as they relate to historic building facades and how they are interpreted relative to the two case studies presented. Successful historic preservation balances developing an appropriate scope of repairs, based on the treatment, which may require justification of additional removals and replacement of original fabric, and an understanding of when no intervention is deemed appropriate. These factors must always be considered in combination with managing the client's expectations and budget constraints. These conversations become even more challenging when incentives include tax benefits and other financial influences. This article reviews the four Secretary of the Interior's Standards for the Treatment of Historic Properties (Standards) and compares and contrasts their implementation and the

balance of many factors for two large-scale historic masonry facade repair projects.

THE SECRETARY OF THE INTERIOR'S STANDARDS FOR THE TREATMENT OF HISTORIC PROPERTIES

The Secretary of the Interior's Standards for the Treatment of Historic Properties are practical historic preservation principles that use nontechnical language. They promote historic preservation best practices. The Standards offer four distinct approaches to the treatment of historic properties—preservation, rehabilitation, restoration, and reconstruction—with accompanying guidelines for each. Inevitably, more than one of these standards will apply to a property undergoing repairs, depending on the property's significance, existing physical condition, the extent of documentation available, and interpretive goals. Most facade projects combine aspects of more than one of these approaches, depending on the condition and significance of specific elements.

The Standards are a series of concepts about maintaining, repairing, and replacing historic materials, as well as designing new additions or making alterations. The associated Guidelines

offer general design and technical recommendations to assist in applying the Standards to a specific property. Together, the Standards and Guidelines provide a framework and guidance for decision-making about work or changes to a historic property. The Standards and Guidelines can be applied to historic properties of all types, materials, constructions, sizes, and uses. They include both the exterior and interior and could also extend to a property's landscape features, site, and environment, as well as related new construction. The Guidelines are advisory, not regulatory, but are often used to guide and influence decisions regarding tax credit evaluation. For the purposes of this article, the Standards will be referenced according to how they are applied for historic masonry facades.

As part of any historic facade preservation project, selecting an appropriate treatment among the four outlined in the Standards is critical to help guide the decision-making process for the suitable scope of repairs. The following list summarizes the four philosophical approaches of the Standards:

- *Preservation* focuses on the maintenance and repair of existing historic materials and retention of a property's form as it has evolved over time.



Figure 1. Photo of original construction of Old Cook County Hospital in Chicago, Illinois, circa 1913. Source: Photograph taken on December 24, 1913, before the building's completion (from *The Man on Five* website: <http://themanonfive.com/page/59>).

- *Rehabilitation* acknowledges the need to alter or add to a historic property to meet continuing or changing uses while retaining the property's historic character.
- *Restoration* depicts a property at a particular period of time in its history, while removing evidence of other periods.
- *Reconstruction* re-creates nonsurviving portions of a property for interpretive purposes.

Choosing the most appropriate approach for a component of a building, or the entire building, requires careful review of the building's historical significance, as well as a number of other considerations, including relative importance in history, physical condition, proposed use, and mandated code requirements.

As outlined in the exemplars below, many historic preservation projects fit into more than one of the categories of treatment but use the principles set forth in the Standards. Certain federal and other high-profile historic preservation projects, where a specific period of significance is established, will require a stricter interpretation of the Standards. National Historic Landmarks, designated for their "exceptional significance in American history," or many buildings individually listed in the National Register, often warrant preservation or restoration. Buildings that contribute to the significance of a historic district but are not individually listed in the National Register more frequently undergo rehabilitation for a compatible new use.

Preservation may be appropriate if distinctive materials, features, and spaces are essentially intact and convey the building's historical significance. If the building requires more extensive repair and replacement, or if alterations or additions are necessary for a new use, then rehabilitation is probably the most appropriate treatment. These key questions play major roles in determining what treatment is selected. Regardless of the intervention, applicable code requirements will need to be taken into consideration.

EXEMPLARS

The following facade repair projects highlight the combination of many varied and sometimes opposing factors. Each case study illustrates the process used for evaluating and determining an appropriate scope of repairs using the appropriate Standards while managing the client's expectations. The Old Cook County Hospital facade is considered a combination preservation and rehabilitation project, while the 30th Street Station facade project would be considered a combination of preservation and restoration.

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OLD COOK COUNTY HOSPITAL (CHICAGO, ILLINOIS)

The Cook County Hospital Administration Building, designed by Paul Gerhardt (county architect) in the Classical Revival style, exemplifies the influence of the École des Beaux-Arts in its design traditions on American architecture of the 19th and early 20th centuries. The Old Cook County Hospital is regarded as one of Chicago's grandest public buildings and illustrates the importance of local Cook County government in the care and welfare of its citizens through its high-style architecture.

The eight-story Old Cook County Hospital Administration building and penthouses commenced construction in 1912 and were completed in 1916 (Fig. 1). The Cook County Hospital Administration Building as it exists today has a long, rectangular footprint that is relatively narrow given its block-long length. Its main-street facades, facing north, east, and west, are clad with tan clay brick and ornamented with white glazed terra-cotta. The building's base has a granite water table and a granite-look course of terra-cotta. The primary north facade of the building fronts Harrison Street. The east facade fronts Wood Street, and the west facade once abutted the Fantus Clinic (since demolished), which was also vacant. The south (secondary) facade fronts a surface parking lot. The main portion of the building is approximately 110 ft tall and penthouses extend to 146 ft. The building, as it currently exists, is generally rectangular in plan, as the four projecting rectangular wings with hexagonal bays extending from the south

facade were previously demolished (the demolition reportedly occurred circa 2010). The overall plan dimensions are approximately 555 ft (east-west direction) by 75 ft (north-south direction).

The great scale of the building is softened on the street facades through a tripartite division of a two-story base, five-story shaft, and one-story top. It is symmetrical and balanced, and has a visually rhythmic appearance, with the building's central and end sections set back slightly. Separated by midsections extended forward also help reduce the scale of the imposing masses. The south facade is much simpler and is clad with tan clay brick, except for the returns and the east and west ends, which mimic the detailing of the other three facades. A three-story projecting porch exists at the center of the south facade and is clad with tan clay brick and terra-cotta. Two light wells, also clad with tan brick masonry and terra-cotta, flank the central projecting porch.

The front facade has classical-style ornament of various sorts, including pairs of "giant-order" terra-cotta-clad columns that are three stories in height, cartouches, swags, decorative sills with brackets, window grilles, and moldings. Although the facade has an overall decorativeness, ornament is most concentrated around the building's main entrance, set in the center of the facade, within recesses that define floors 4 through 6, above and around many windows and other building openings, and at the building's roofline, especially where the facade projects forward. Most of the windows are aluminum-framed replacement windows to match the configuration of the original wood frame, double hung and single glazed. Large multi-lite monumental arched windows exist at the second, third, and fourth floors on the north facade. Additional unique features include the eight operating room skylights at the eighth floor centered on the north facade, as well as the two large, sloped skylights (since roofed over with sheet-metal roofing) of terra-cotta over the original operating theaters at the east and west ends of the north facade.

The building structure is a steel frame clad with structural clay-tile fireproofing with a combination of clay-tile arched floors and reinforced concrete floor slabs. The exterior walls are multiwythe header bonded brick masonry with architectural terra-cotta ornament with interior extruded clay-tile backup. Vertical chases existed between the exterior masonry cladding and the backup clay tile for ventilation and mechanical chases, with multiple voids between the clay-tile backup and floor slabs as well as between floors. Various combinations of steel beams, plates, angles, bars, rods, and J-hooks support the masonry cladding. Brick masonry is supported



Figure 2. *Old Cook County Hospital north facade before redevelopment (circa 2012).*

at each floor by continuous steel shelf angles, typically riveted to the main building structure. Terra-cotta units are either supported by shelf angles similar to the brick or independently supported by a system of steel components that are also riveted to the main structural system.

The Old Cook County Hospital was closed in 2002, and maintenance of the exterior enclosure before that was limited. Additionally, the building stood vacant and unconditioned until 2018, with little effort made to limit air and water infiltration. Temporarily stabilization of portions of the exterior facade had been installed throughout the period of vacancy to minimize hazards to public safety. Unfortunately, the previous stabilization interventions did not provide weather protection for the interior or substrate portions for the structural support and anchorages (Fig. 2).

The evaluation of the Old Cook County Hospital exterior facade consisted of three phases. The initial phase was a code-mandated City of Chicago Facade Examination. This limited visual assessment was performed to prepare a Critical Examination report and to familiarize ourselves with the general construction and design of the building, particularly the exterior facades. The second phase was a due-diligence investigation to gain a general sense of the condition of the facades and the causes of distress, as well as gain a general sense of the order of magnitude of costs for the recommended repairs. The third phase included testing and trials to gain more knowledge of the physical characteristics of representative facade materials, as well as cleaning trials, and review of existing conditions of the monumental windows for restoration and the existing

roofing to provide information for the design of appropriate repair scope.

During Phase 1, which commenced in 2011, a limited on-site assessment of the exterior masonry walls and windows was performed, as required by the City of Chicago facade ordinance and requested by the owner, Cook County. The assessment included a close-up inspection at representative areas using industrial rope access and a review of the limited inspection of openings to observe and document concealed conditions from a personnel lift. During the inspection, temporary stabilization and additional site restrictions were recommended to address the hazardous conditions that were observed.

During Phase 2, which was conducted in 2016, a due-diligence investigation of the exterior masonry walls and windows, as requested by the redevelopment team, was performed. The investigation included a close-up inspection at representative areas of the north, east, and west facades using suspended scaffolding, and limited inspection of openings at significantly distressed areas to review and document concealed conditions. At that time, it was thought that the south facade would be removed and replaced in its entirety with a new wall system.

During Phase 3, which commenced in 2018 as the initial phase of the redevelopment, a review of cleaning systems for the brick and terra-cotta was performed and trials were implemented from grade. A cursory visual assessment was performed of the south facade to determine the extent of masonry repairs; this assessment was done because the design had been modified and there was a subsequent need to retain and restore the existing cladding on the south facade. Additionally, as part of Phase 3, a review of the



Figure 3. *Distressed terra-cotta window head unit caused by corrosion of steel anchorages and support at Old Cook County Hospital as viewed during the 2011 Phase 1 assessment.*



Figure 4. *Distressed terra-cotta window on seventh-floor head units below a previously replaced cornice at Old Cook County Hospital, as viewed during the 2016 Phase 2 assessment. The distress was attributed to corrosion of steel anchorages associated with the poor detailing of the retrofit.*



existing monumental windows was performed to determine the scope of repairs for restoration of the windows. Phase 3 also included review of the existing roofing and various roof conditions to determine appropriate roofing repairs for the main roof, skylights, and balcony areas, as well as the integral terra-cotta gutter.

Investigation Findings

Terra-Cotta and Brick

Generally, the investigation revealed that the majority of terra-cotta and brick exhibited deterioration consistent with a cladding material that has been in service for more than 100 years and minimally maintained due to vacancy of the building for the last 15 years and lack of appropriate funding. As expected, distress and deterioration were most pronounced at high-exposure area locations, with unrestricted water infiltration resulting in corrosion of supporting steel. These areas included the third-floor terra-cotta gutter, projecting balconies, hung terra-cotta elements, and parapets (Fig. 3).

Some of the cracking in the masonry cladding was not exclusively related to corroding steel anchors or shelf angles, but more related to original moisture expansion of the existing masonry and a lack of expansion provisions. Related distress included vertical cracking near the southeast and southwest corners of the south facade, as well as vertical cracking of the terra-cotta-clad monumental columns on the north facade.

In addition, distress was occurring at locations of previous incompatible or poorly designed repairs and stabilization efforts, such as the terra-cotta cornice at the seventh floor. The cornice had been previously removed and replaced with a terra-cotta flat spandrel and poor

Figure 5. View of distress at the terra-cotta masonry exacerbated by previous stabilization efforts, with corroding fasteners causing cracking and spalling of the terra-cotta units.

detailing relative to historic sensitivity and water management. The removal process included cutting steel elements flush with the plane of the wall and installing brick and poor-quality replacement terra-cotta around the existing steel. Water management considerations were not taken into account with the detail, thus allowing excessive water infiltration and subsequent corrosion of the supporting steel of the facade components below the repair area (Fig. 4). This approach provided a short-term solution to falling material, but poor detailing resulted in additional water infiltration into the “repaired” wall areas and subsequent development of distress and deterioration.

Some of the additional distress to the brick and terra-cotta was caused by the previous installation of temporary stabilization without sensitivity for eventual restoration of the building. The stainless-steel straps and mesh were installed with ferrous anchors and through the face of the terra-cotta units and brick elements, rather than through mortar joints or other means to limit distress to the masonry units. Corrosion of the ferrous anchors for the stabilization resulted in excessive cracking and spalling of many of the terra-cotta units and brick masonry that could otherwise have been salvaged (Fig. 5).

Mortar

Significant deterioration, including bond line separations, cracking, significant erosion, and missing mortar, was observed at the majority of mortar joints between terra-cotta units and

the brick masonry. Visual evidence of previous repointing at limited areas existed, but no consistent pattern was observed. Most of the horizontal and sloped mortar joints had been previously covered with sealant that had been applied directly over the mortar without proper preparation of the joint.

Rehabilitation Program

The building sits in a prominent visual location along the expressway that provides access to Chicago from the west. In its earlier days, it had provided the backdrop for notable films such as *The Fugitive* and *The Dark Knight*, but during its lengthy vacancy, the building had become an eyesore. Significant atmospheric soiling and organic growth exacerbated by the expressway traffic as well as previous stabilization efforts created a “Frankenstein’s monster” appearance and provided a canvas for local graffiti artists. These factors contributed to the need to repair and clean the exterior facade to restore its original grandeur. Restoration cleaning was limited to the street-facing facades (north, east, and west) while the south facade was “cleaned up” by washing the wall after the numerous masonry repairs were completed and replacing the corrugated metal paneling at the old wings with an insulated metal panel curtainwall.

Based on the findings of our investigation and the intent of the adaptive reuse of the building to become a hotel and offices, an exterior repair program was developed. Some of the major challenges with the facade rehabilitation included the significant deterioration and

numerous concealed conditions at the brick and terra-cotta cladding due to the lack of previous maintenance and the fact that the building had been vacant for more than 15 years. Another challenge was that the entire adaptive reuse was occurring at the same time and was supposed to move in a west-to-east direction, based on different turnover dates for certain portions of the building, similar to new construction. This meant that all trades (interior and exterior) were generally trying to work in the same area of the building at the same time. Window and roofing replacement occurred at locations of ongoing masonry repairs, which was further complicated by the long lead time of procuring replacement terra-cotta. An added challenge involved coordination of multiple subcontractors for each aspect of the exterior enclosure repairs due to county hiring requirements. Subcontractors on project included one masonry restoration contractor for the repairs on the north, west, and east facades, a different masonry restoration contractor for the south facade, a window replacement contractor, a window restoration contractor, and two roofing contractors. Coordination of their work was particularly challenging because the project also faced typical construction challenges such as maintaining consistent compliance with the restoration approach and approved mock-ups, weather, material availability, and a compressed schedule. It should be noted that for the purposes of this article, the program described herein only includes the masonry portion of the project. The exterior enclosure rehabilitation also included restoration of monumental wood windows at the north facade, removal and replacement of the double-hung wood windows with new aluminum-framed windows to match the historic configuration on the main facades, as well as replacement of all roofing including balconies.

At the direction of the owner and as defined by the Secretary of the Interior's Standards for Rehabilitation, the repair approach for Old Cook County Hospital facade rehabilitation was to develop a design that would address the most significant deterioration, create a water-tight building, and restore certain historically significant elements as outlined by the City of Chicago Department of Landmarks and the National Park Service, along with the Illinois Historic Preservation Agency and the state historic preservation office to receive tax incentives. It was understood that lower-priority repairs and maintenance would be completed when the building was occupied and able to generate revenue to pay for future repair expenditures. As such, the approach taken by the rehabilitation designers was to address the visible repairs and existing distress conditions, rather than making

Figure 6. Installation of terra-cotta units at monumental columns at the north facade during rehabilitation of the Old Cook County Hospital in 2019.



comprehensive repairs to address detailing at similar locations. This approach helped limit the amount of replacement material but did not address concealed conditions at areas currently not exhibiting distress; therefore, a more rigorous regular maintenance was recommended on the building enclosure than had a more proactive comprehensive approach been undertaken.

Repair recommendations presented to the owner typically corresponded to the scope of work (described later) and were based on the conditions observed during our investigations, the expected rate of continued deterioration, and the appropriate repair and restoration approaches according to the Secretary of the Interior's Standards for Rehabilitation, given the historical significance of the building. The high-priority repairs were considered critical repair issues to address the significant deterioration observed. The lower-priority repairs were conditions that were addressed to not only minimize the potential of future distress to develop into conditions that would endanger public safety but also to improve the overall appearance of the building when required for historic preservation incentives.

Based on the multiphased investigation, the defined rehabilitation intent, and the historic preservation incentives, as well as the need to address applicable concealed conditions where distress was observed, the following scope of work was completed as part of the exterior facade rehabilitation. The repair scope was divided based on different priorities, including addressing hazardous conditions, reducing water infiltration, addressing fire and life safety code requirements, and improving aesthetics.



Figure 7. Reconstruction of the third-floor gutter and installation of terra-cotta units at the north, east, and west facades during rehabilitation of the Old Cook County Hospital in 2018–2019.



Figure 8. Overall view of the main entrance on the north facade following completion of the Old Cook County Hospital rehabilitation. Note the restored monumental windows and the salvaged and reinstalled the terra-cotta lanterns.

Hazardous Conditions

- Brick, stone, and terra-cotta masonry were repaired or replaced on all facades. The brick, stone, and terra-cotta units that were deteriorated beyond repair were replaced in kind. This part of the project also included the removal and rebuilding of select areas with salvaged units. Approximately 10,000 ft² of brick were removed and replaced or reinstalled. Granite units were replaced at the base of the building as necessary. Approximately 4000 terra-cotta units were removed and replaced. Approximately 10,000 additional units were removed and reinstalled as part of the repairs to address the underlying steel (Fig. 6).
- The terra-cotta gutter at the third floor of the building was reconstructed on the north, east, west, and south return facades. This included replacing steel shelf angle and all anchorages, replacing deteriorated terra-cotta with new replacement terra-cotta, reinstallation of salvaged terra-cotta, and installation of a new gutter liner (Fig. 7).
- Deteriorated brick masonry on the south facade was rebuilt with salvaged or replacement brick.

Reduction of Water Infiltration

- The north, east, and west facades were fully repointed.
- Zones of the south facade were also repointed. The zones included approximately 40% of the area (the portions with the most significant deterioration).
- New roofing was installed at all roof and balcony areas.

Code Requirements

- Entrances on the north, east, and west facades were repaired or replaced to closely match the configuration and profiles of the original doors and sidelights, and any missing doors at those entrances were replicated based on historic drawings and photographs.
- Two new entrances that closely match the historical configuration and profiles were introduced within existing openings on the north facade to accommodate new retail and commercial uses.
- New entrances were introduced as needed on the south facade to accommodate new retail and commercial uses.
- Wood windows that were either missing (that is, previously infilled or with significant

- alterations to the sash) or deteriorated beyond repair were replaced with new aluminum windows that match the historic windows in configurations, sizes, and profiles.
- Masonry infills from window openings were removed to restore the historic fenestration pattern, and new aluminum windows were installed in the original openings.
- Monumental wood windows were restored on the north facade at the second and third floors (Fig. 8).
- Interior clay-tile backup at exterior walls was removed to address mechanical, electrical, and plumbing code issues, which required adjustments to provide code-required anchorages for the replacement window installation.

Improvement of Aesthetics

- The existing brick, terra-cotta, and stone masonry were cleaned with a two-part chemical cleaning system on the north, south, and west facades (Fig. 8).
- Nonhistoric metal paneling at the former pavilion locations and nonhistoric 1959 infill on the south facade were removed, and new metal panels and windows were installed in these areas.



Figure 9. Photo of original construction of 30th Street Station in Philadelphia, Pennsylvania.

- New architectural accent illumination was added and existing historic fixtures were reused as appropriate.

30TH STREET STATION (PHILADELPHIA, PENNSYLVANIA)

Built during the Great Depression, 30th Street Station once housed the headquarters of the Pennsylvania Railroad and has served as Philadelphia's principal rail passenger station since its completion in 1934 (Fig. 9). The neoclassical design of the building's exterior reflects a "modern" interpretation of the classical style. This structure is one of the last surviving American "gateway" transit buildings.

Situated on the west bank of the Schuylkill River, the station was planned during the mid-1920s by the Pennsylvania Railroad Company in partnership with the City of Philadelphia. As constructed, the building is cruciform in plan, with the long axis running north to south, parallel with the Schuylkill River for 640 ft. The rectangular volume of the main passenger concourse—which is 135 ft wide, nearly 330 ft in length, and over 100 ft high—bisects the north-south axis in line with John F. Kennedy Boulevard, and presents an imposing facade to downtown Philadelphia. The structure is a steel and concrete frame with brick masonry infill walls, faced with coursed, buff-colored Alabama limestone that sits on a continuous horizontal base of pink granite. The station is built entirely on an elevated deck, which allows the Amtrak rail lines

and the adjacent Schuylkill Expressway to pass freely underneath. Caissons support the entire structure, transferring the loads of the station and parking deck through isolation pads down to bedrock, some 80 ft below.

The original main pedestrian entrances are located at either end of the concourse, screened behind the six composite order columns of each portico. The entrances consist of paired copper alloy and glass doors framed by decorative granite surrounds. The verticality and scale of the limestone-clad portico columns are complemented by the repetition of glass, steel window, and cast-iron curtainwall bays that punctuate the limestone walls at regular intervals. The facades are further unified architecturally by an entablature composed of a classically proportioned architrave, frieze, dentil band, and block

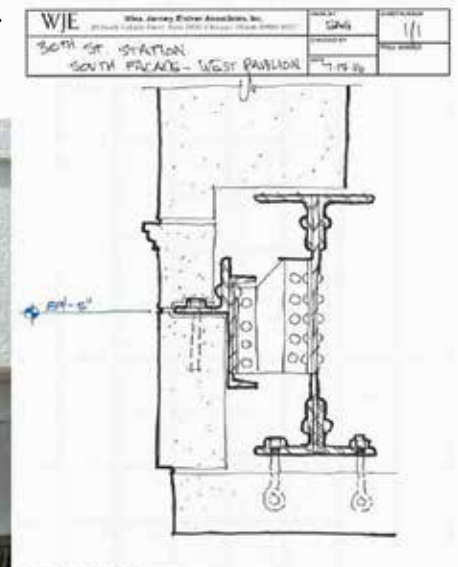
cornice, and crowned by substantial attic walls. A coffered terra-cotta soffit defines the ceiling space of the east and west porticos.

The cross-axis volume of the concourse rises above the height of the main north-south section of the building and is further defined by a second, more decorative modillion cornice and deeper attic walls, which rise to form the parapet for the roof above. The north and south faces of the upper attic have a series of false terra-cotta screens just above the cornice. The four long-axis corners of the building are emphasized by slight articulations of the facade, wider window bays, and the integration of secondary pedestrian entrances.

The north and south facades duplicate the design and rhythm established on the primary facades, including the repetitive curtainwall bays and classical entablature. The outer face of the viaduct walls at the north end of the building is treated in much the same manner as the rest of the building, punctuated in a regular pattern with sections of cast-iron, steel, and glass curtainwall and crowned with a classical entablature; however, it rises only two stories in height and lacks the attic walls above.

Two internal light courts exist immediately adjacent to the north and south walls of the main passenger concourse. The light courts extend from the second to the fifth floor and are clad with beige header-bonded brickwork, hung limestone lintels, and limestone sills, with solid steel double-hung windows in punched

Figure 10. Typical cracked condition at the limestone soffit units at 30th Street Station, including field sketch of the existing condition.



openings. The adjacent concourse facades are characterized by clerestory bays of cast-iron curtainwall set between brick-clad piers.

The south, east, and west facades of the building are constructed of Alabama limestone that is supported at each floor line by steel shelf angles riveted to steel clips that are in turn riveted to the perimeter spandrel beams. The wall system is solid masonry and typically consists of limestone units that were laid integrally with the brick backup wall or to the concrete encasement around the steel columns and spandrel beams. There are typically several courses of limestone units between shelf angle locations. The thickness of each of these ashlar courses alternates between 4 and 8 in., with the thicker units keyed into the brick backup wall. By using 8-in.-thick units, this system provides lateral restraint for the flat portions of the limestone walls. Decorative projecting courses near the top of the building are also thicker, and intermittent lateral steel strap anchors were used to restrain the pieces from rotating during installation. Historical research suggests that the cladding stone used in the construction of the station is a domestic oolitic limestone in two color tones: "buff" and variegated, of either "standard" or "select" grade.

Limestone soffits are located between piers throughout the building. These soffits are hung from continuous steel members that span between the piers. The configuration of the steel varies but generally consists of built-up beams, channels, and angles. The soffits are hung from a series of eyebolts in the head joints between units, with rods that span between adjacent units. The eyebolts extend through horizontal legs in the steel members above.

The north facade is constructed with a similar system, but, in general, the unit thickness is thinner than the other walls, resulting in the shelf angles and lateral straps being closer to the exterior surface of the units. A continuous shelf angle extends at approximately the midheight of the piers and above the hung soffit units on the north facade. Two lateral stability anchors were installed in the units supported by the shelf angle. The remaining courses presumably alternate thickness in a manner similar to the other areas of the facade. The interior surface of the north facade is exposed to the train platform, creating a false wall.

The evaluation of the 30th Street Station exterior facade consisted of three primary phases. The initial phase was intended to understand the construction and design of the building, particularly the exterior facades. The second phase was an on-site investigation to gain a general sense of the condition of the facades and the causes of distress. The third phase was a testing

phase to gain more knowledge of the physical characteristics of representative facade materials to provide information for the design of appropriate repairs. The following is a more detailed description of the various tasks performed during each of the three phases described above, specifically related to the stone cladding.

Phase 1 included tasks to become familiar with the general composition of the exterior cladding systems and any specific work previously performed on the exterior enclosure.

During this phase, we performed the following tasks.

- Reviewed available original drawings provided by Amtrak.
- Reviewed available previous pertinent reports and repair documents provided by Amtrak.
- Performed research at the Philadelphia Historical Commission regarding previous projects related to the exterior of the building. No significant documents were found during our research.
- Performed a limited search of historical architectural journals for published articles pertaining to the design and construction of 30th Street Station. Limited information, primarily dealing with the interior of the building and general facade information, was found.
- Performed archival research at the Chicago Historical Society, the depository of many of the drawings by Graham, Anderson, Probst & White. No additional drawings beyond those in Amtrak's archive were found.
- Performed archival research to identify historical materials and building components, including stone, brick, windows, and the curtainwall.

During Phase 2, an on-site investigation of the exterior masonry walls, steel windows, and cast-iron curtainwall system was performed. The investigation included close-up inspection at representative areas and inspections of openings at selected areas to observe and document concealed conditions.

The investigation was performed using a combination of access techniques. Suspended scaffolding was used to access the interior light courts. Personnel lifts were used to access the portico ceilings and accessible areas of the primary limestone facades. Inspection of less-accessible areas of the light courts was performed using industrial rope access.

Masonry inspection openings were made to understand the condition of the concealed materials and in the development of appropriate repairs. Material samples were extracted at this time for laboratory testing during Phase 3.

A review of potential cleaning systems was also conducted and included trial cleaning of the limestone facade from a penthouse roof on the southeast fifth-floor roof, on grade at the viaduct, and on grade at the west portico, to determine the effectiveness of various cleaning techniques.

Phase 3 consisted of limited laboratory analysis of various materials performed to identify likely causes of distress and to inform recommendations for appropriate repairs that will not damage the building's facades, alter their appearance, or reduce the potential for performing future work on them. Testing included limited petrographic analysis and physical testing of the face brick and limestone to define material characteristics. A limited petrographic and chemical analysis of mortar samples was also performed to determine the mortar's composition and character and to assist in designing an appropriate proportion for repointing and setting mortar.

Investigation Findings

Limestone and Brick

Generally, the investigation revealed that the majority of limestone and brick exhibited deterioration consistent with a cladding material that has been in service for more than 80 years. As expected, weathering of the limestone was most pronounced on horizontal surfaces such as the tops of copings and projecting cornice elements. Some cracking in the limestone was not related to corroding steel anchors or shelf angles. For example, vertical cracking was found in the limestone on the east and west pavilions. In addition, cracks in some of the other ashlar units were noted, with no discernable pattern identified throughout the rest of the facade areas. The majority of the large hung soffit panels in the light court areas are cracked near the bearing points at the piers. The typical soffit arrangement consists of three individual hung units. The center unit is supported from the structural system above, while the end units are hung from this same structure but also bear on the adjacent pier. Spalling was also identified at shelf angles and lateral anchor locations. The majority of this spalling was observed on the north facade adjacent to Arch Street and on the units directly below the projecting cornice units around the perimeter of the main portion of the building. Some spalling corresponded to wood shims that had been left in place during the original construction. Spalling at shelf angle locations corresponded to the toe of the horizontal leg of the shelf angle, where the edge of the angle ("toe") was relatively close to the face of the limestone, and the presence of some corrosion scale.

Petrographic analysis of the limestone revealed that the stone is an oolitic-fossiliferous



Figure 11. Installation of replacement stone at shelf angle location at 30th Street Station.



Figure 12. Repointing effort at the limestone at 30th Street Station.

stone with calcite, minor amounts of quartz, and traces of clay. Physical testing of the limestone revealed that, based on the density of the limestone and water absorption, the limestone conforms to a category II, medium-density limestone.

Isolated areas of dark “crusts” and dirt accumulation existed on the limestone at projecting assemblies such as the cornice and other concealed areas (dentils, brackets, and column capitals). Dark microbiological algae growth was identified near the parapet walls and the horizontal portions of the limestone cornice. Several

iron inclusions and stains were observed at isolated areas throughout the limestone facades.

The brick exhibited cracking and displacement in the light courts as a result of corrosion of supporting shelf angles corresponding to the top of the windows at each floor. These conditions also extended to the light court parapets. The inside wythe of brick at the majority of parapets exhibited indications of damage from cycles of freezing and thawing.

Mortar

General deterioration, including bond line separations, cracking, and missing mortar, was observed at most mortar joints between limestone units. Visual evidence of previous repointing at limited areas was noted, but no consistent pattern was identified. Most of the horizontal and sloped mortar joints had been previously covered with sealant. The sealant was applied directly over the mortar, and typically the joints were not properly prepared. Chemical testing of the mortar revealed that the mortar consisted of a mixture of slag cement, hydrated lime, and sand, consistent with slag cement—hydrated

lime mortars of the period.

Restoration Program

Based on the findings of our investigation and the application of the Secretary of the Interior’s Standards for Restoration, a phased-priority restoration program was developed. One of the major challenges with the facade restoration at the building was that the entire building—including offices, restaurants, commercial spaces, and, most significantly, full train operations for three different rail lines that interfaced with the station—was to

remain open throughout the work. Achieving that goal was particularly challenging because the work also included typical construction challenges such as weather, noise, and dust, as well as hazardous material abatement for the masonry work (including removal of lead paint for the cast iron recoating and sealants containing polychlorinated biphenyls for the window restoration), odors from new coatings and sealants, and removing windows for restoration as well as areas of window replacement. It should be noted that for purposes of this article, the following program description includes only the masonry portion of the project. The restoration also included restoration of the cast-iron curtainwall and steel windows on the main facades and concourse, as well as window replacement in the light courts.

At the direction of Amtrak, the approach for 30th Street Station facade restoration was to develop a 50- to 75-year design. The potential for ongoing maintenance and the likelihood of additional funding in the near term for repairs were generally recognized to be improbable. As such, unlike the previous case study, the approach taken by the designers was to address the repairs based on details rather than visible and existing distress. Thus, if distress was noted at specific shelf angle elevations, the entire length of angle would be repaired, rather than only those areas exhibiting distress. This approach helped limit issues related to matching existing stone, provided a more uniform appearance, and reduced the amount of long-term maintenance that would be required.

The following prioritization of the recommendations was presented to Amtrak based on the conditions observed during our investigation, the expected rate of continued deterioration, and appropriate repair and restoration approaches given the historical significance of the building. The highest-priority repairs were those that were considered critical repair issues. The second-highest-priority repairs were conditions that were addressed to minimize the potential of future distress to develop into a condition that endangers public safety. Finally, the lowest-priority repairs were considered to be maintenance and aesthetic issues. These repairs will minimize the potential of future distress developing and improve the overall appearance of the building.

Based on the investigation, the following scope of work was considered the highest priority:

- Spalled areas of limestone adjacent to corroded steel lateral straps were repaired. For smaller units, the repair included removing the limestone unit with the spall. Following



Figure 13. Water-misting cleaning at the limestone soffits at the main facades of 30th Street Station.



Figure 14. Overall view of completed rehabilitation of the east facade of 30th Street Station in 2018.

removal of the stone, the remaining area of the lateral anchor was ground flush with the surface of the backup brick. A new matching limestone unit was installed with new stainless-steel anchorage components. Spalled areas on larger units were repaired in a similar fashion, except that the spalled area was removed over the height of the unit and a dutchman, or partial unit, was installed with stainless-steel lateral anchors.

- Spalls, displacements, and cracking of limestone at shelf angle locations were repaired. This repair included removing the limestone units that bear on the shelf angle. The existing shelf angle was cleaned and painted with a corrosion-inhibiting system, or the angle was replaced if the corrosion resulted in significant loss of cross-sectional area. For shelf angles that remained in situ, the mortar joint below the horizontal leg of the angle was ground out to provide access to the bottom side of the horizontal leg of the shelf angle. Replacement limestone units, or the existing limestone, were installed on the repaired or replaced shelf angle with stainless-steel lateral anchorage. The angles were protected by applying both a corrosion-inhibiting coating as well as a flexible membrane flashing (Fig. 10).
- Cracked limestone soffits were repaired by removing the limestone units set on the shelf angle before removing the units that were hung from the steel structure above. The existing shelf angle and exposed areas of the supporting steel were treated as previously discussed, and a new unit was installed supported by stainless-steel anchors (Fig. 11).
- Deteriorated and displaced brick and the limestone lintels at the continuous shelf angles at the top two floors of the light courts were

removed and replaced. Substrate steel was cleaned and painted, and a flashing system was installed on the shelf angles. Matching brick and new limestone lintels were installed with stainless-steel anchors.

- Light court parapets were reconstructed. This involved installing through-wall flashings below the coping and cleaning and painting concealed supporting roof beams.
- Deteriorated brick on the inside wythe of the south parapet wall was replaced, and similar repairs were performed on the brick piers on the other parapets at main roof areas.

Based on the investigation, the following scope of work was considered medium priority:

- Cracks that were not related to corrosion in the limestone were repaired by routing the cracks and installing mortar into the joints in three ¼-in. lifts of mortar.
- Cracks that were related to thermal or structural movements in the limestone on the main facade were routed, and backer rods and sealant were installed with ground limestone broadcast into the finished surface of the sealant to minimize the visual impact of the repairs.
- Cracks related to thermal or structural movements in the limestone that were not on the primary facades were routed as previously described, and backer rods and sealant installed in the joints.
- Cracks related to corrosion of underlying steel supports or anchors were partially or completely replaced following repair of the underlying corroded steel.
- Mortar joints between limestone units were all repointed (Fig. 12).
- Sealant and lead tees were installed in upward-facing mortar joints between limestone units.

The following scope of work was considered maintenance and the lowest priority:

- The limestone was cleaned using a water-misting system in combination with biocide treatment to minimize accelerated limestone deterioration and improve the appearance of the building's primary public facades (Fig. 13).
- Inclusions in the limestone are being monitored as part of the ongoing maintenance of the facade. No repairs or treatments of the inclusions are determined to be necessary until a crack or spall has manifested.

Initially, Amtrak requested that the facade restoration work be phased based on priority because funding potential was not known and would frequently vary based on emergency needs at other Amtrak facilities. Funding finally became available in 2012, more than seven years after the documents were prepared. A follow-up inspection was performed to update and reprioritize the repairs as necessary. Based on the conditions observed during the follow-up inspection, numerous conditions that had been considered medium priority in 2005 were reprioritized to high priority in 2012. In addition, some of the conditions that had previously been classified as high priority had deteriorated to a point that sidewalk protection was recommended and installed around the majority of the publicly accessible areas of the exterior of the station (Fig. 14).

CONCLUSION


Regardless of the extent of investigation and inspection in a facade project, all repairs cannot be anticipated, and all distress cannot realistically be observed and documented. As such, unanticipated conditions are inevitable. These can include concealed conditions that differ from those identified in the original



Figure 15. Overall view of completed rehabilitation of the north facade of Old Cook County Hospital in 2020.

contract documents, concealed distress, and load redistribution resulting in distress from repair operations. Designers, consultants, and owners can anticipate these conditions to some extent based on experience with similar buildings, but surprises are inevitable. Contractually, unanticipated conditions can be addressed by including unit costs and potential quantities for anticipated repairs and including a lump-sum contingency. In the case of Old Cook County Hospital, a contingency was recommended, but was controlled and used at the discretion of the general contractor, rather than the design professional and masonry subcontractor. In contrast, establishing a lump-sum contingency was not allowed for 30th Street Station because Amtrak is a quasi-governmental entity. Therefore, unit prices, potential quantities, and contingency unit prices were included in the bidding process.

As shown by the two exemplars presented, preservation of masonry facades requires design professionals to manage and balance a combination of many considerations, including existing conditions, historic preservation issues, code requirements, budget, unforeseen conditions, client expectations, and available funding. The selection and application of an appropriate treatment as defined by the Secretary of the Interior's Standards for the Treatment of Historic Properties, including the varied approach encompassing preservation, restoration, and rehabilitation as illustrated in the examples presented herein, is another consideration in determining an appropriate scope of repairs. The application of specific treatments requires the preservation professional to understand when it is appropriate to replace undamaged

original fabric to minimize future distress, while managing the client's expectations with regard to budget and tax incentives. Nevertheless, as demonstrated, there are multiple approaches to working within the Standards while meeting client's expectations that can provide successful rehabilitation or restoration facade projects. Achieving such success requires the ability to prioritize, balance, and reassess goals as necessary throughout the project (Fig. 14 and 15). 

REFERENCES

- Amtrak. 2015. "A Closer Look: Philadelphia 30th Street Station." Amtrak history blog, January 27, 2015. <https://history.amtrak.com/blogs/blog/a-closer-look-philadelphia-30th-street-station>.
- Burns, A. 2022. "30th Street Station." American-Rails.com, last updated April 23, 2022. <https://www.american-rails.com/30th.html>.
- Grimmer, A., and K. Weeks. 1995. *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*. Washington, DC: US Department of the Interior National Park Service Technical Preservation Services.
- Grimmer, A. 2017. *The Secretary of The Interior's Standards for The Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*. Washington, DC: US Department of the Interior National Park Service Technical Preservation Services. <https://www.nps.gov/tps/standards/treatment-guidelines-2017.pdf>.
- Tatum, T. 2018. "Cook County Hospital Administration Building, 1835 West Harrison Street." Preliminary Summary of Information Submitted to the Commission on Chicago Landmarks in August 2018. City of Chicago Landmark Designation Report.

- US Department of the Interior National Park Service Technical Preservation Services. n.d. "The Secretary of the Interior's Standards for the Treatment of Historic Properties." Accessed May 30, 2021. <https://www.nps.gov/tps/standards.htm>.
- US Department of the Interior National Park Service Technical Preservation Services. n.d. "Standards for Preservation." Accessed May 30, 2021. <https://www.nps.gov/tps/standards/four-treatments/treatment-preservation.htm>.
- US Department of the Interior National Park Service Technical Preservation Services. n.d. "Standards for Rehabilitation." Accessed May 30, 2021. <https://www.nps.gov/tps/standards/four-treatments/treatment-rehabilitation.htm>.
- US Department of the Interior National Park Service Technical Preservation Services. n.d. "Secretary's Standards for Rehabilitation." Accessed May 30, 2021. <https://www.nps.gov/tps/standards/rehabilitation.htm>.
- US Department of the Interior National Park Service Technical Preservation Services. n.d. "Standards for Restoration." Accessed May 30, 2021. <https://www.nps.gov/tps/standards/four-treatments/treatment-restoration.htm>.

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