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TERRA COTTA RESTORATION - A CASE STUDY

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ABSTRACT

This paper presents a case study of the completed restoration of an historic three-story building with a terra cotta facade in the northeast United States. The c. 1910 building had experienced cracking of the terra cotta around the jambs and heads of windows after years of neglect. A new owner wanted to restore the facade yet could not afford the preservationist approach of replacing damaged terra cotta with newly cast pieces.

Structural repairs, terra cotta patching and glaze simulation were used to repair the facade, restore the three-story building to its original beauty, and minimize repair costs. This paper will address the investigation to diagnose the problems as well as the techniques and materials used for the restoration. The project was completed in 1997.

BACKGROUND/HISTORY

Built c. 1910, the three-story building in Schenectady, New York, was constructed as the home for a masonic group. The first floor was intended for commercial use, while the upper levels served the meeting space and office needs of the group.

The group disbanded and the building was abandoned for many years, eventually to be purchased by the Board of Directors of Proctor's Theater. Proctor's is an historic theater from vaudeville days which continues to provide outstanding concerts and performances.

The building has a terra cotta facade. Photograph 1 shows the facade during restoration. However, during urban renewal in the 1970s, the terra cotta on the first floor was covered, and remains so today.

The intent of the new owner was to expand the influence of Proctor's by creating a "theater district." The district would encourage the performing arts. Thus, the Board chose to renovate the building for various groups to rent space.

In 1995, our firm was selected to make a cursory inspection of the building. The owners recognized two serious concerns:

1. The existing windows were in terrible condition, and

2. The terra cotta was noticeably cracked around the windows on the second and third floors.

The owners wanted to perform the renovations with minimal expense. They were interested in preserving the historic character of the facade, but cost was a significant factor.

INVESTIGATION

Since there was not any documentation, drawings or specifications for the building, the cursory inspection was performed from the roof, through window openings, and from the ground. It concluded with a report that pointed out that the broken terra cotta was dangerous; pieces had fallen and more were loose. Loose mortar had also fallen and the turrets at the parapets were not structurally sound.

Based upon this report, the Board authorized a full investigation. These efforts centered on the terra cotta cracking, and included interior and exterior removals. The interior removals were made through the plaster finish at the head and jambs of the windows. The jamb removal at the third floor revealed a steel column encased in brick. Corroded anchors from the brick to the exterior terra cotta were observed (see Fig. 1). The brick was in good condition. The window frame was embedded in the brick.

Using a man-lift, the jambs of the window were inspected. Cracks in the terra cotta were parallel with the jambs, approximately 100 mm from windows. These cracks generally began at the head of a window and extended down the jamb of the window. The crack width was approximately 15 mm. There was no cracking between floors.

Adjacent to the interior removal on the third floor, a large piece of cracked terra cotta was removed from the exterior. The terra cotta was approximately 125 mm thick. Underneath the terra cotta was the anchor observed from the interior; it was corroded. In addition, the embedded window frame was also corroded.

The interior removals at the window head uncovered a steel beam with a cover plate which was heavily corroded (see Fig. 2). The beam supported brick above. The corrosion had rust-jacked the plate from the bottom of the flange of the beam. How the exterior terra cotta was supported was not evident from these interior removals.

From the exterior, a plate was observed at the underside of the terra cotta. It was fastened to the window mullions and appeared to support the facade (see Fig. 2).

A length of broken terra cotta was removed. Photograph 2 shows the broken terra cotta before it was removed. Fig. 2 shows the cross-section of wall and how the terra cotta was notched around a steel plate which supported the facade. The lower exterior plate was used as a closure.

The window sills were stone and had been lifted slightly cracked. Removals indicated the window frames were also embedded in the sills and corroded.

The man-lift was used to observe the mortar joints. Most were in good condition. Closer to and at the parapets, the mortar was deteriorated from natural weathering.

The turrets were in extremely poor condition. Most of the problems were due to mortar deterioration, which caused the terra cotta to be loose.

DIAGNOSIS

Several important observations resulted from the investigative removals:

1. The facade was constructed with no weeps or flashings. There was no drip to prevent water runoff on the facade from returning to the window frames.

2. Water entering into the mortar joints at the heads of the windows migrated to the steel plates, corroded the steel, and continued migrating into the building.

3. Rust jacking of the steel caused:

    a. Cracking of the terra cotta over the heads of the windows. Fig. 2 shows this effect.

    b. Cracking of the terra cotta at the jambs of the windows just below the head. In addition, rust-jacking of the vertical plate from the steel window frame added to this stress and caused the jambs to split over the height of the window.

    c. The sills to shift and crack.

The diagnosis became quite simple at this point. The damage to the facade was corrosion-related. The only protection against this was the mortar joints. To correct the problems, the rust-jacking had to be stopped. To prevent further damage, the mortar joints must be maintained.

The mortar was determined to be in generally good condition. However, spot replacement of the mortar was required for the facade. Full repointing was necessary at the top of the parapet and for the turrets.

POSSIBLE SOLUTIONS

Three schemes were evaluated. Each included some common features such as a) remove and replace all windows, b) remove all cracked and broken terra cotta, c) repair or reinforce corroded steel framing, and d) repoint deteriorated mortar. The schemes varied in their approaches to dealing with the cracking of the terra cotta facade. These included:

Scheme 1. Fabricate and install new terra cotta to replace the cracked and broken pieces.

Scheme 2. Patch the areas created by the removal of the damaged terra cotta. No attempt would be made to deal with aesthetics. Wait for additional funding to implement Scheme 1.

Scheme 3. Rebuild the areas of damaged terra cotta using synthetic patching materials. Attempt to match the patches with the original terra cotta. If unsuccessful, wait for funding to implement Scheme 1.

Scheme 1 was removed from consideration immediately due to cost, which was estimated at $250,000 - $300,000.

Scheme 2 presented the least cost (approximately $30,000 - $40,000), and the facade would function safely. However, the appearance of the facade would not be appropriate for an historic building.

Scheme 3 was selected because we determined there was probably an 80% chance both function and aesthetics could be restored. The projected cost was $40,000 - $60,000. Since this scheme offered the potential for a long-term solution, the owners were willing to invest additional funds over Scheme 2.

DESIGN

Fig. 3 shows the design detail for the heads of the windows. The intent was to remove the rust and clean and paint the steel. All of the steel would not be exposed because all of the terra cotta was not cracked. This was an economical decision which meant the deterioration had to be stopped or slowed greatly. For the owner, this meant the mortar joints must be maintained.

Flashing was to be installed to protect the steel from further damage. The patching material was to be placed over the flashing and anchored to existing steel. New closure angles were to retain the patches and remaining terra cotta. Embedded steel was to be removed and the terra cotta patched at the jambs. Similar work was done at the sills.

The balance of the facade repairs included spot repointing and cleaning as well as major repointing of the turrets at the parapets.

Mortar analysis resulted in the selection of ASTM C270, Type N mortar (1:1:6 - PC/L/Sand by volume). The patching material was the terra cotta Custom 45 by Edison Coating Co., based upon its compatible properties with terra cotta. In addition, the manufacturer offered a brush-on coating to simulate the terra cotta glaze.

The project was bid by contractors pre-selected for their qualifications with historic masonry. The owner signed a contract in early 1997.

CONSTRUCTION

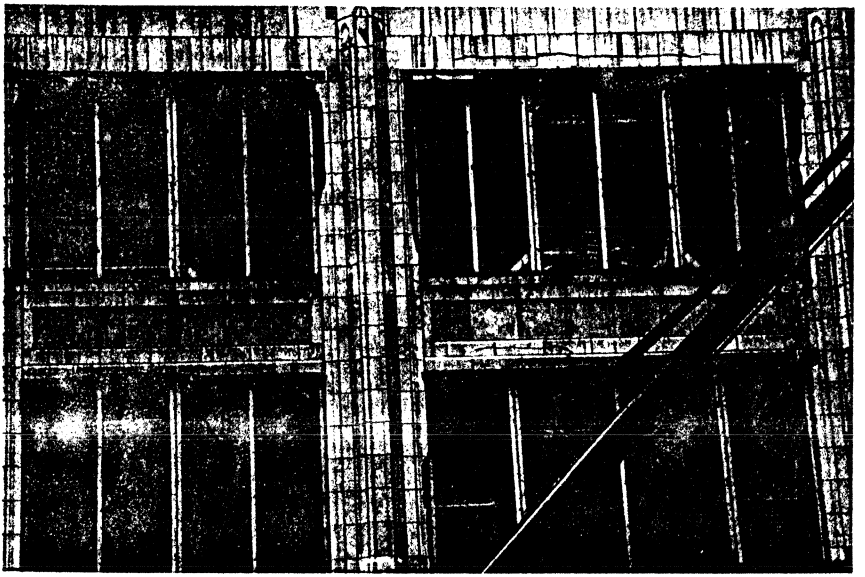
Work began with a sample area as required by the project specifications. The sample was required to demonstrate the patching techniques. Samples of the terra cotta obtained by the removals were sent to the patching manufacturer to check for compatibility and match the color of the patch and coating. The sample area indicated successful techniques, but the color match for the patching material was revised once.

One of the most difficult aspects was installing the flashing, because the steel was not fully exposed. A self-adhering membrane was used so moisture could not get under the flashing at discontinuous ends. This was a compromise due to cost restrictions; it would have been preferable to remove all the terra cotta at window heads and install flashing. Photograph 3 shows the work completed corresponding to Photograph 2.

Photograph 4 shows work at the jambs. New anchors were installed to the brick back-up. Photograph 5 shows the completed work corresponding to Photograph 4.

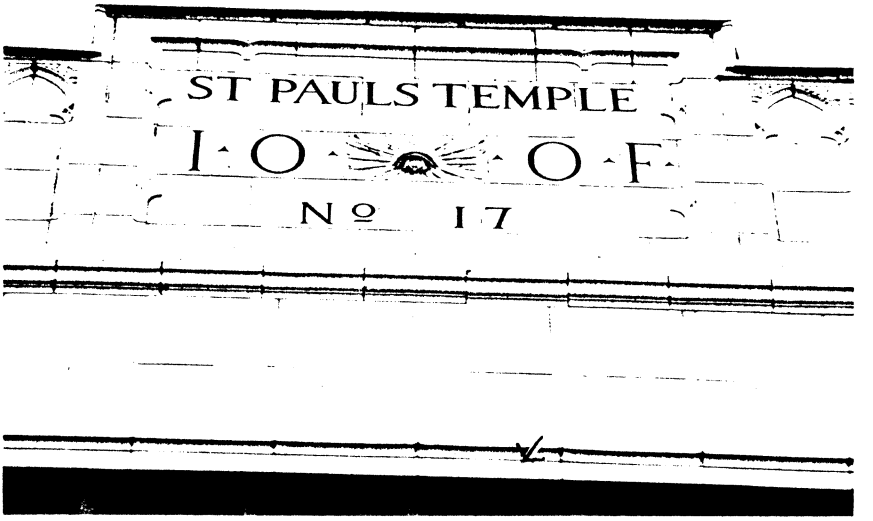
ACKNOWLEDGMENTS

The author is grateful to the Board of Directors and Ms. Karen Johnson of Proctor's Theater for allowing the information in this paper to be made available. The project architect, Mr. Don Stracher of Stracher-Roth-Gilmore Architects, Schenectady, New York, developed the window redesign. The masonry contractor was Ganem Contracting, Clifton Park, New York.

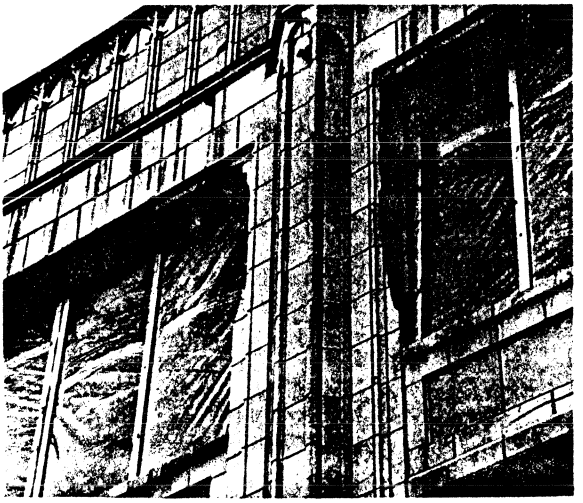


Photograph 1 - Facade during restoration

Photograph 2 - Broken terra cotta and head of window

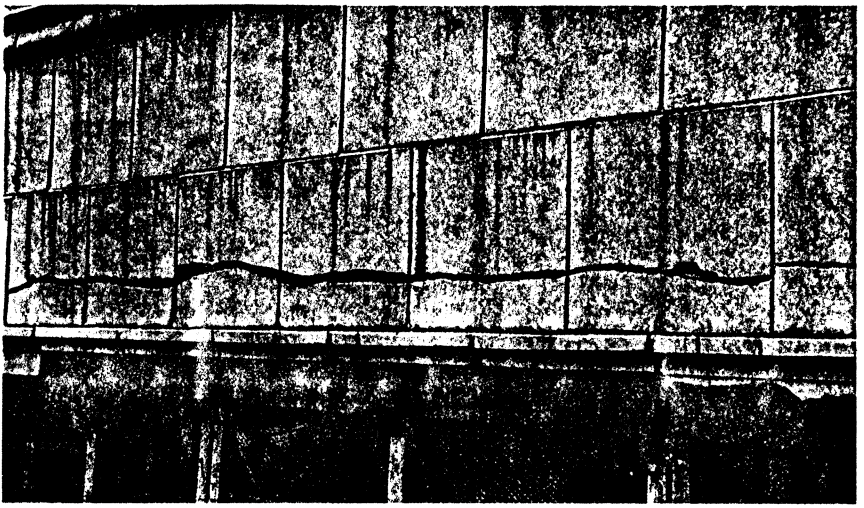


Photograph 3 - Repair completed at head of window (arrow)



Photograph 4 - Broken terra cotta removed

Photograph 5 - Completed jamb repairs



Photograph 6 - Routed crack

Photograph 7 - Repaired terra cotta

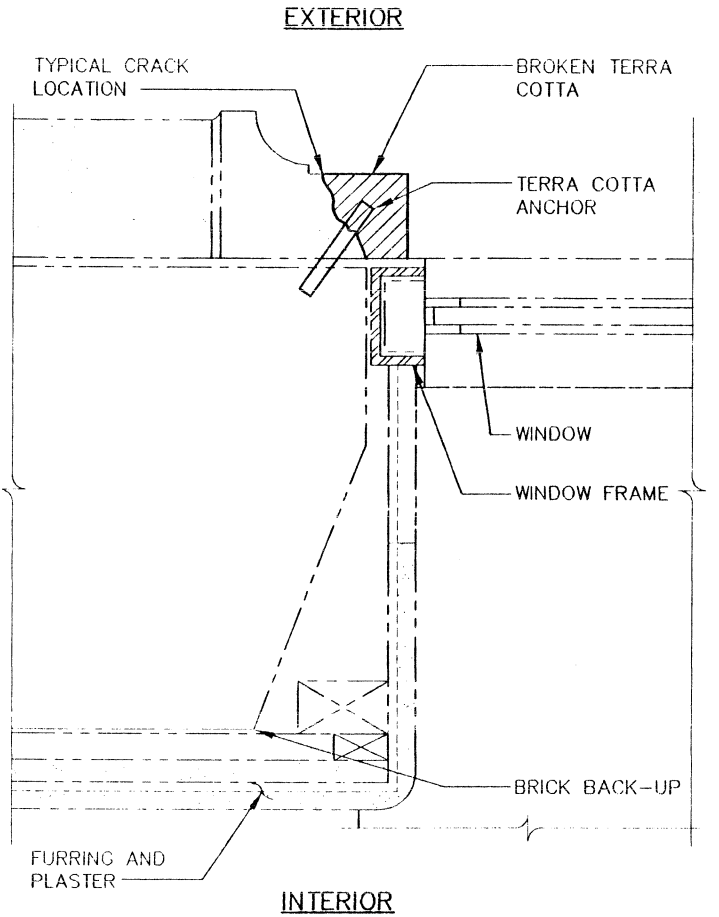


Fig. 1 – WINDOW JAMB

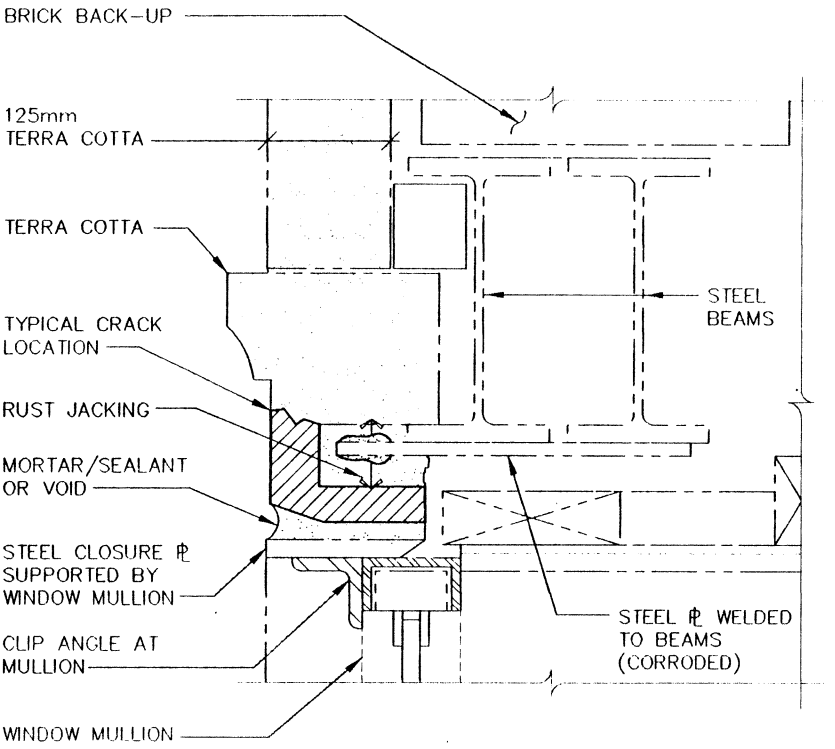


Fig. 2 – WINDOW HEAD

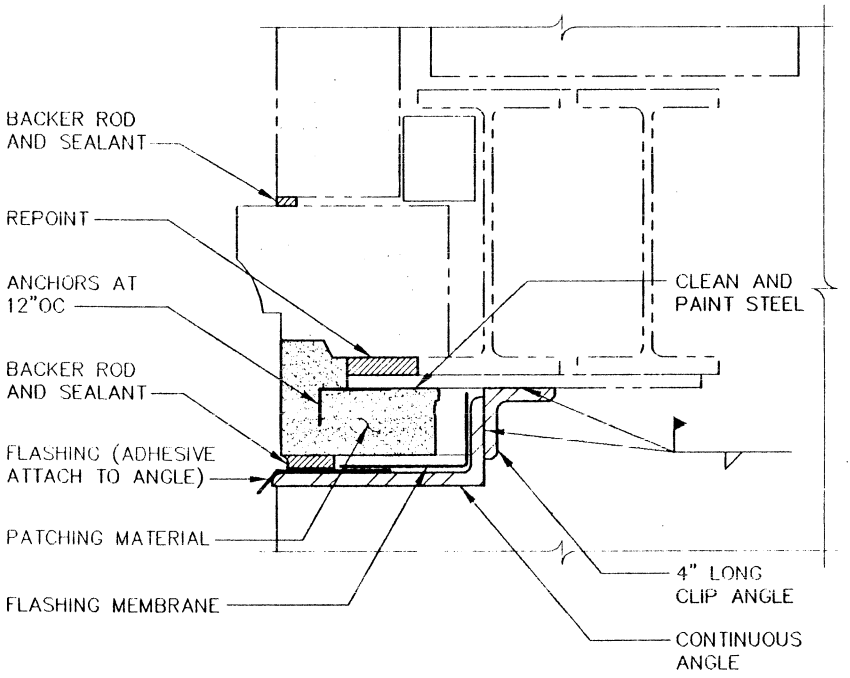


Fig. 3 – REPAIR DETAIL