THE HOMER BUILDING:
BUILDING ON AN HISTORIC PAST,
PREPARING FOR THE FUTURE

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SUMMARY

This paper addresses the analysis and repair of the cast stone façade at The Homer Building in Washington DC. Topics include the analysis of causes of damage, development of repair specifications, development and application of quality control procedures, non-structural considerations affecting the repair procedure, and a brief discussion of the relative performance of the various materials present on the structure.

1. BUILDING HISTORY

The original Homer building, a Neo-Classical concrete structure with a glazed terra cotta façade, was designed in 1913 by Washington D.C. architect Appleton Prentiss Clark as an expression of the Beaux Arts aesthetic in the nation's capital. Mr. Clark's initial plans called for a taller building but shortages of funds limited the building to four stories (See Figure 1). The site is listed on the National Registry of Historic Places and in 1983 was designated as an historic landmark.

In 1988 the core of the building was demolished saving only the façade. Over the next two years, the original terra cotta and cast iron façade was reconfigured to accommodate a fifth floor, two additional bays were constructed using the same façade details, and a seven-story cast stone and masonry addition was added above the original structure bringing the total height of the building to 12 stories. Finally, a completely new 12-story addition with limestone clad columns and cast stone panels was added to the east of the original structure resulting in the building as it exists today (See Figure 2).

Figure 1 : The Original Homer Building circa 1942

Figure 2 : The current façade

2. OBSERVATIONS/DISCUSSION

Cast stone is present throughout the new façade of the Homer Building and is the primary facing material of the seven-story addition. It was fabricated either as solid cast stone elements comprised of several compacted layers, or "lifts", or as a composite of cast stone facing placed on precast concrete back up.

During a routine survey in 1995, several deficiencies were noted in the cast stone façade, including spalls, cracks, and failures of previous repair attempts. These observations led to a full survey of the new façade and the development and implementation of a comprehensive repair of the cast stone.

2.1 Surface Damage

Many of the cast stone segments had surface material loss typical of cast stone several decades old. The surface of some panels was rough and granular and crumbled when rubbed by hand. Interestingly, these deteriorated panels were often adjacent to cast stone panels that remain in excellent condition, making the damage even more striking (See Figure 3). In addition, the juxtaposition of the deteriorated cast stone against pristine limestone pieces of the same period highlighted a significant variation in durability between the natural and man made materials.

The majority of spalling occurred at corner locations and edges, at previous patch locations, and most significantly at bollard bases. Based on our observations, the previous patch failure was due to improper patch preparation (See Figure 4).

The cornice and window sills were soiled and stained with algae growth due to a lack of proper flashing which allowed water to run over the surface of the stone and resulted in extended periods of saturation.

Much of the surface damage to the stone can be attributed to poor production practices including insufficient compaction and improper curing.

Figure 3 : Surface damage

Figure 4 : Cracking at bollard base

2.2 Cracking

Cracks, defined as separations with a depth greater than ¼" (6.4 mm) and wider than 1/32" (0.79 mm) were observed throughout the façade, including the sides of the mullions, the window surrounds, the 6^{th} floor spandrels, and the pilaster bases.

Original contract documents indicate that the cast stone cracks were present at the time of delivery and were likely due to improper handling during fabrication and delivery. There were also locations where cracking was due to insufficient cover over reinforcing bars. A review of the building and shop drawings clearly indicated that the size of the cast stone units far exceeds industry standard size and recommended aspect ratios for cast stone. The Cast Stone Institute recommends lengths up to 6' long and suggests keeping the lengths to within 15 time the minimum thickness whenever possible. Some of the cast stone segments on this project are nearly 20 feet long and three feet high. These non-standard panel configurations contributed to difficulties in handling and installation.

2.3 Crazing

Crazing, defined as fine and random cracking extending only through the surface of the stone, was found throughout the building. There were some locations where this crazing was severe and had developed into cracking (See Figure 5).

Crazing is a result of surface tensile stress caused by shrinkage of the surface relative to the mass. In addition, studies indicate that concrete having rich oversanded mixes as well as those cast against smooth, impermeable surfaces are highly susceptible to crazing. Both conditions were present on the cast stone of the Homer building and crazing was notable at several spandrel panels. Several of these areas were sanded to verify that the cracking was limited to the surface and did not pose any structural concerns.

2.4 Delamination

The cast stone had delaminated at the lift lines at several locations, in particular at sill and spandrel locations. (See Figure 6) These delaminations are typically due to poor production practices including movement while the concrete was plastic, insufficient compaction, and improper curing. The tests described in Section 3.1 below verified that insufficient compaction was an issue on this structure as was a high absorption rate.

Figure 5: Crazing and spalling of old patches

Figure 6 : Delamination of the cast stone at lift line

3 REPAIR

3.1 Material Testing

Prior to selection of a repair procedure several material tests were performed on the cast stone including a variety of strength tests, anchor pull-out tests, chloride, absorption, permeability, air void, cyclic freeze/thaw tests, and tests of the adhesion of coatings and epoxies.

These tests indicated that the stone was fabricated without coarse aggregate, was non air-entrained, contained a significant volume of voids, had a higher than standard absorption, and confirmed that the material was insufficiently mixed and not uniformly compacted, particularly around reinforcing steel.

In addition, studies showed planes of weakness at the interface of cast stone lift lines. The freeze/thaw tests indicated that only one of the coatings provided enough protection to complete the 300-cycle freeze/thaw duration mandated by the test (ASTM C666 – Method B).

3.2 Repair Options

Various repair options were considered including removal and replacement of all cast stone with new material, over-cladding of all cast stone, and in-situ repair. The full removal and replacement option was rejected primarily due to tenant disruption. Removal of the cast stone panels would necessitate entry into each office and dismantling of interior finishes to access the connections

Encapsulation was rejected for several reasons including the deleterious effect on the aesthetics of the building and the potential for trapping moisture within the wall system thereby accelerating the deterioration of the cast stone rather than correcting it.

The in-situ repair scenario was finally selected as the most viable option because of its minimal impact on the building users and its ability to address all structural concerns regarding stabilization and mitigation of future damage to the cast stone.

3.3 Repair Procedure

The intent of the repair procedure was three-fold: stabilization or removal of the damaged cast stone, prevention of future damage by limiting water infiltration, and minimization of disruption to the building occupants.

The final repair included removal of all loose cast stone material, removal of all previous patches, and installation of stainless steel pins bedded in epoxy at 6” (152.4 mm) on center throughout the façade (See Figures 3 & 10). These pins and epoxy serve to stitch the various cast stone lifts together and anchor them to the stable concrete back up material where present.

In addition, the procedure included the epoxy injection of all cracks, removal and replacement of all cast stone bollards and pedestals, cleaning the stone of all biological staining and finally coating of the entire cast stone façade with an architectural coating (See Figure 10).

In total the contractor installed more than 100,000 stainless steel pins and performed several hundred linear feet of epoxy repair over a span of approximately three years.

3.4 Quality Control Procedures

In order to determine if the non-standard repair procedure was being implemented as specified and that the repair was working as intended several quality control measures were taken. These included standard cube strength tests of all of the new patch material, cores taken at pin locations to verify embeddment depth, and cores taken at cracks injected with epoxy to verify that the material had infiltrated the crack.

These tests of the pins and epoxy were vital to the quality assurance program because the repair scheme relied so heavily on the proper application of these items, and much of that repair work was internal and could not be verified by visual inspection of the façade.

Figure 9 : Epoxy injection, pin installation, and patch preparation

Figure 10 : Coating installation

4 CONCLUSIONS

4.1 Causes of Damage

The damage to the cast stone at the Homer Building was due to a confluence of design and fabrication deficiencies including an original design that specified non-standard cast stone sizes, poor quality control at the manufacturing plant and acceptance at the site of flawed materials. This resulted in a product with highly variable, and often unacceptable, material properties.

4.2 Repair

Based on the quality control tests and the performance of the repairs over the past three years, the in-situ repair has been successful. The coating, which was applied in a color similar to the original stone color, has provided an attractive and water repellent surface that will limit the ingress of water into the stone while preserving the original aesthetic of the structure.

4.3 Material Selection

The selection of cast stone as a building material was often an attractive choice due to its resemblance to natural stone, it ability to form complicated profiles to satisfy architectural desires, and its lower cost versus natural stone materials.

When properly cast and cured, cast stone can provide a dense surface that is resistant to weathering and dirt. However, as evidenced by this project, if the material quality is not strictly monitored during fabrication and installation all benefits are lost on an elaborate and costly repair and the natural stone products prevail.