RRJ INSIGHT™

ISSUE NO. 12

A technical newsletter by Raths, Raths & Johnson, Inc. for the construction industry.

"Insight: to see into and understand; an item of knowledge gained by this power."

In this issue of *RRJ Insight* we discuss the restoration of a vintage facility and the major cause for this restoration. The facility was originally built using decorative limestone pieces anchored by a hidden steel beam. After significant damage due to corrosion of the steel components, several limestone pieces were removed from the building because of safety issues. The restoration design utilized precast concrete formed to the identical proportions and color to replace the steel beam and portions of the limestone; while retaining most of the original intricate carvings. Read the *Project Profile* article to see how we retained the original aesthetics. Rust packing around embedded steel components was the major contributor to the damage of this facility, and affects many others across the nation. We give a brief description of the mechanism and symptoms of this phenomenon in the *Tech Tip* article.

INSIDE

Douglas Park Field House in Chicago, Illinois after the cornice restoration was completed.

Project Profile

Using Precast to Restore a Vintage Limestone Facility

The Douglas Park Field House is one of many vintage facilities managed by the Chicago Park District. Constructed in the early 1900's, the Field House is listed on the National Registry of Historic Buildings. **Over time, water has infiltrated into the limestone and brick masonry cornice above the main entrance.** Steel anchors supporting the hung limestone soffit pieces began to corrode, causing the soffit pieces to visibly shift and displace. Due to immediate safety concerns, the limestone soffit was cut and removed, rendering these stone pieces unrestorable.

RRJ was retained by the Field House restoration contractor and the Chicago Park District to evaluate the structural condition of the remaining cornice and design repairs as required. **RRJ investigations revealed that water infiltration had caused widespread deterioration of brick mortar joints and embedded anchors that secured the limestone to the brick.** A steel beam supporting both the limestone and brick masonry was also observed to exhibit corrosion. The limestone and brick masonry had displaced significantly as a consequence of the deterioration. The magnitude of displacement dictated a repair which would require complete removal and reconstruction of the limestone cornice and supporting structure.

RRJ's repair design consisted of shoring the existing roof slab that was supported by the cornice construction, and removing the existing limestone, brick and steel beam. Limestone pieces were photographed and catalogued before removal to facilitate reinstallation in their original locations. The deteriorated steel beam was replaced with a new architectural precast concrete beam spanning between the existing masonry columns. The soffit of the precast beam was cast with the same shape, color, and texture as the original damaged limestone soffit. A waterproofed drainage cavity was incorporated into the design to collect and expel any water that infiltrated through the limestone joints. The original limestone cornice pieces were cleaned and reattached with new stainless steel anchors, completing the restoration. **The repair saved the Park District costs associated with replacing damaged limestone soffit pieces, retained the original ornate stone carvings, and greatly improved the long-term resistance to future water infiltration.**

— David B. Tigue, S.E., P.E.

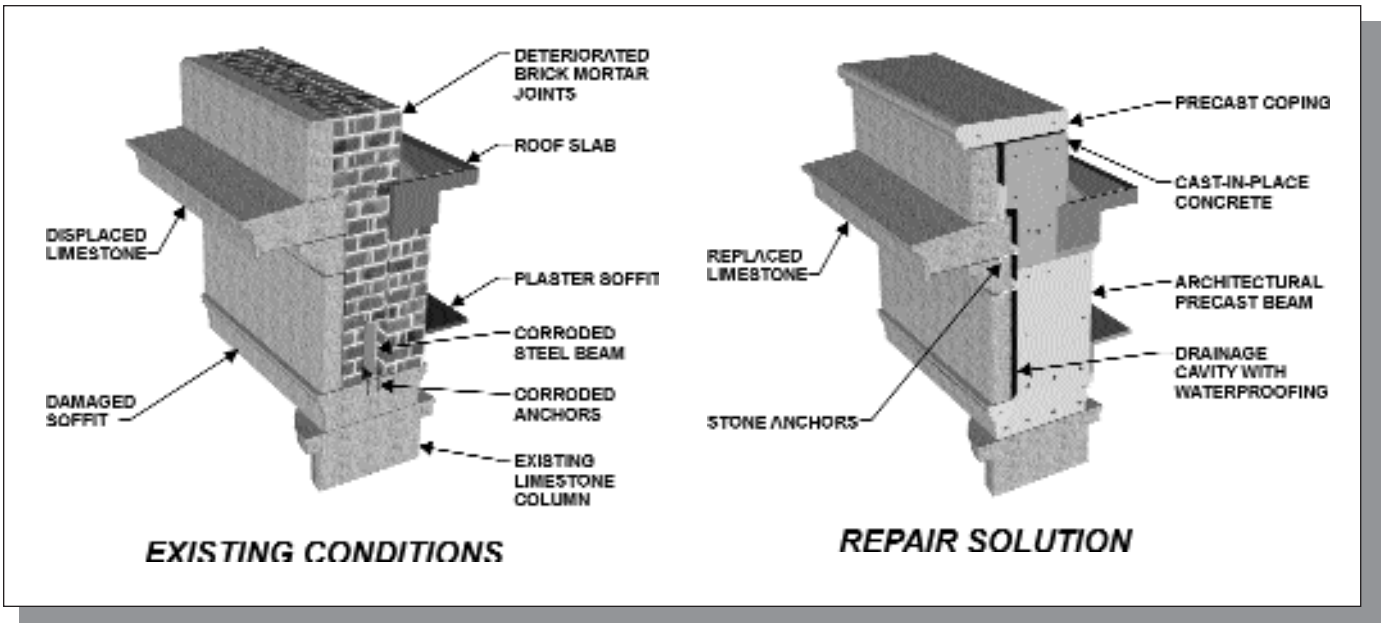

Figure 1 — One-piece precast soffit/beam replaces limestone soffit and corroded steel beam.

Tech Tip

Rust Pack Causes Building Damage

Several large pieces of limestone at the Douglas Park Field House were pushed apart by expansion or packing of rust flakes caused by corrosion of the supporting metal anchors and steel beams. These displacements caused cracking, and in-turn, allowed more water access to the embedded metal components which led to additional corrosion and rust flaking. **Damage due to rust packing is a significant consideration in older structures utilizing unprotected steel supporting members.** This article highlights the mechanism and symptoms of rust pack damage.

Rust packing is the term used to describe the build-up of flakes of oxide or rust which results from the corrosion of steel. It occurs in all ferris types of structural components including steel plates and beams of bridges, embedded steel supports of masonry buildings, and steel reinforcing of concrete structures. Corrosion, which can result in significant damage and restoration costs, occurs when the unprotected metal is exposed to moisture and oxygen. **The mechanism for damage to surrounding materials occurs when the rust flakes build-up, increasing the volume of the steel member, creating forces against the surrounding building materials, and therefore causing movement and/or cracking.** The volume of oxide or rust produced by corrosion is about eight times that of the parent metal — full corrosion of $^1/_8$ inch of metal will cause about 1 inch of rust pack.

In masonry buildings, for example, the diagnostic engineer looks for rust pack effects at the steel lintels over windows of the upper floors, where environmental exposure due to rain and wind are more severe than lower in the building. Frequently RRJ finds that steel lintels on lower floors of older buildings, are in good condition, while those at the roof or upper floors have expanded causing cracking and other significant masonry damage, necessitating repairs. Close examination is required for this evaluation to be properly performed.

Once water infiltrates, the potential of an endless cycle of corrosion and deterioration is started. The process occurs over a significant time frame and is not reversible. Conditions causing it vary depending on the environment, atmospheric conditions, and the amount of moisture retained on the metal surfaces. During the first stage, a rust film is developed that initially protects the metal from corrosion, but over time rust scale develops which assists the retention of moisture, accelerating the corrosion.

Corrosion studies of buildings in Baltimore, Maryland suggest that corrosion rates of between 1.6 and 2.4 mils per year would consume $^1/_8$ inch of metal in about 52 to 78 years. Actual RRJ observations of buildings of this era confirm these studies. (For more information contact RRJ or refer to the *RRJ Insight* Issue No. 6 in which restoration of a 1920's structure was described.)

— Otto C. Guedelhoefer, S.E.

Figure 2 — Rust packing of lintel caused cracking of brick wall.

Professional Services

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RRJ is available to help you with any questions you may have regarding our services or a specific article in our newsletter.
For additional information call:

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