Restoration of a Vintage Limestone Portico with Architectural Precast Concrete

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Presents a case study on the use of architectural precast concrete as a cost-effective approach to restore an historic park facility in Chicago, Illinois. The main entrance portico of the facility was originally constructed with an elaborate limestone beam or entablature, carried by massive limestone columns. The carved limestone architrave (soffit), frieze, and cornice (upper projection) pieces of the entablature were attached to backup brickwork and concealed steel lintel beams with metal anchors. After significant stone damage and movements occurred due to long-term corrosion of embedded steel components, several limestone soffit pieces were removed from the building for safety. The restoration design utilized architectural precast concrete with a formed soffit having the identical proportions, texture and color as the damaged architrave stone pieces, and had structural capacity to replace the existing steel lintel beams. The design provided a unique, cost-effective approach for replacing deteriorated and damaged components, while retaining the original, intricate limestone carvings.

The Douglas Park Field House is one of many vintage facilities managed by the Chicago Park District in Chicago, Illinois. Constructed in the early 1900s, it is currently listed in the National Registry of Historic Buildings. The Field House contains gymnasium and classroom facilities that are used by the Park District for recreational and educational activities.

Classic architectural building features include a prominent main entrance consisting of massive limestone pillars supporting an elaborate limestone beam, or entablature, and a roof structure over the entry portico (see Fig. 1). The limestone entablature construction consisted of traditional carved limestone architrave (soffit), frieze and cornice (upper projection) pieces tied to brick masonry backup with metal strap anchors.

As originally designed, the weight of the limestone frieze and cornice pieces were carried by the soffit stones, which were hung from steel lintel beams with pairs of regularly-

Fig. 1.
Main entrance to Douglas Park Field House, Chicago, Illinois.

spaced metal anchors. The steel beams spanned between the limestone pillars, and also supported the weight of the brick masonry backup as well as the cast-in-place concrete roof structure over the portico (see Fig. 2).

Over time, water had infiltrated into the limestone and brick masonry cornice. The steel anchors supporting the hung limestone soffit stones corroded, causing the soffit pieces to visibly shift and displace.

Due to immediate safety concerns, the Chicago Park District directed the limestone soffit stones to be cut and removed, rendering these pieces unrestorable (see Fig. 3). The remaining cornice was temporarily shored, and the main entrance was cordoned off until an engineering assessment and a repair program could be implemented.

STRUCTURAL EVALUATION

The structural engineering firm of Raths, Raths & Johnson, Inc. (RRJ) was selected by the Field House restoration contractor and the Chicago Park District to evaluate the structural condition of the remaining cornice and to design the repairs as required. As part of RRJ's evaluation, exploratory openings were made in the brick masonry backup to examine the condition of the steel beam and metal anchors. RRJ engineers also measured the displacement and rotation of various limestone cornice pieces.

Findings from this investigation revealed that water infiltration had caused widespread deterioration of the brick masonry backup, and corrosion of the embedded metal anchors securing the limestone to the brick backup. The steel beams supporting the limestone and brick masonry cornice were also observed to exhibit light-to-moderate corrosion.

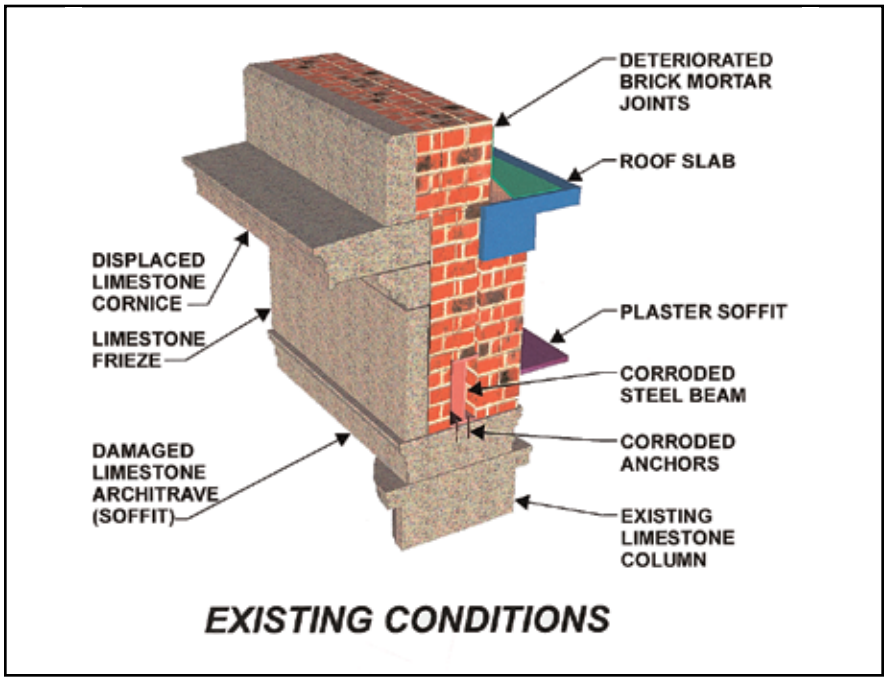

Fig. 2. Existing cornice construction consisting of limestone and brick masonry supported on steel beams spanning between massive limestone pillars.

Fig. 3. Damaged limestone soffit that was cut and removed. Arrows indicate metal anchors used to hang the limestone soffit from the supporting steel beams.

Brick and stone masonry mortar joints with embedded metal anchors were found to be cracked and separated as a consequence of the expansive phenomenon of corrosion. The limestone and brick masonry had significantly displaced and rotated as a consequence of the weakened and deteriorated mortar joints. The widening of cracks due to cornice movement, in turn, allowed more water access to the embedded metal components, which led to further corrosion and deterioration.

RRJ survey measurements revealed that the entire limestone cornice over the entry portico had moved about 2 in. (50 mm) outward, away from the roof structure. The overhanging edges of the projecting limestone cornice stones were further found to have rotated about 2 in. (50 mm) downward. The magnitude of measured displacement dictated complete removal and reconstruction of the limestone cornice and supporting structure.

REPAIR CONSIDERATIONS

RRJ presented the Park District with two alternative schematic repair techniques to reconstruct the limestone cornice and support structure.

The first repair scheme consisted of replacing the damaged limestone soffit stones with new pieces that would be carved to match the original stone. The new stones would be hung from new, cast-in-place concrete beams that would replace the existing corroded steel beam and brick backup. The ornate, carved frieze and cornice limestone pieces would be reconstructed on the hung limestone soffit, similar to the original construction.

The second technique utilized architectural precast L-shaped beams to resupport the carved limestone cornice (see Fig. 4). The exposed bottom beam surface would be formed and cast with an architectural concrete face mix to match the same profile and appearance as the original soffit stones.

The Park District's decision to repair the structure with architectural precast concrete was based on this solution's structural advantages, improvements to long-term durability, and cost-effectiveness. Concerns for future adverse effects of long-term deterioration on the hung limestone over the main entrance weighted against a repair solution to restore the cornice using methods similar to the original construction.

FINAL REPAIRS

RRJ's final 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 beams were replaced with the new architectural precast concrete beams spanning between existing limestone pillars. The soffits of the precast beams were formed and cast with the same shape, color, and texture as the original damaged limestone soffit (see Fig. 5). Concrete face

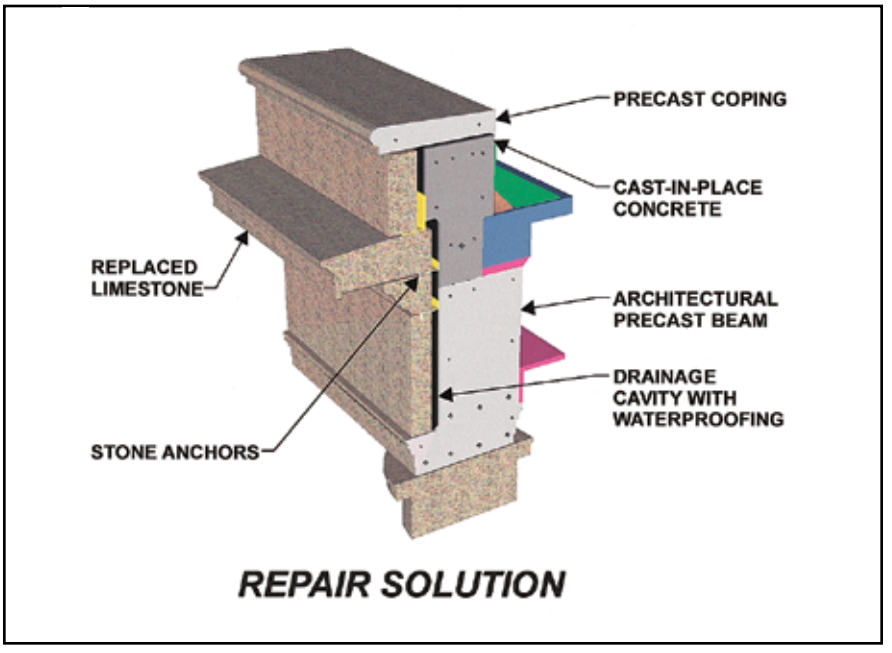

Fig. 4. Repair solution consisting of new architectural precast beams used to re-support ornate, carved limestone pieces.

mix materials and formwork details were determined by the precast manufacturer from an examination of the damaged limestone soffit pieces.

The beams were structurally designed to support the weight of reinstalled limestone entablature pieces, a new cast-in-place concrete parapet, and the portico roof construction self weight and snow loads. The existing concrete roof structure was re-supported on top of the new precast beam, and steel reinforcing bars were epoxied into both the roof structure and the limestone pillars, to laterally secure the new concrete cornice structure.

After completing the structural repairs, the original carved limestone cornice pieces were cleaned and reattached to the new precast beam with new stainless steel anchors. A waterproofed drainage cavity was incorporated into the design to collect and expel any water that infiltrated through the limestone joints.

Several years prior to the renovation work, the original coping stone pieces over the portico cornice had been removed and replaced with a painted metal cap flashing. This flashing was discarded and replaced with a new metal cap flashing that was concealed beneath new precast concrete coping pieces cast with the same shape and appearance as other original limestone coping pieces observed elsewhere around the roof perimeter.

Fig. 5. Erection of the new precast beams. The beam soffits were cast with the same shape, color, and texture as the original damaged limestone soffit.

CONCLUDING REMARKS

Erection of the temporary shoring to support the roof structure began in July 1995. The portico restoration work was completed by November 1995. The project contract amount was approximately $250,000.

The completed cornice restoration work saved the Chicago Park District costs associated with replacing the damaged limestone soffit pieces, retained the original ornate limestone cornice carvings, and greatly improved the long-term resistance to future water infiltration.

CREDITS

Owner: Chicago Park District, Chicago, Illinois.

Structural Engineer: Raths, Raths & Johnson, Inc., Willowbrook, Illinois.

Contractor: F. H. Paschen Venture, Des Plaines, Illinois; II in One Contractors, Inc., Chicago, Illinois.