FIRST CONGREGATIONAL CHURCH
OF LONG BEACH, CALIFORNIA

Project Leader:
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Consulting Engineers:
Critical Structures Inc., of Long Beach, CA.

Architectural Consultants:
Drisko Studio Architects of Los Angeles, CA.

General Contractor & Masonry Specialists:
Giampolini Courtney Inc., of Emeryville, CA.

Terra Cotta Manufacturers:
Darwen Terracotta Ltd., of Blackburn, UK.

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Restoration of 1914 brick and terra cotta church facades suffering extensive seismic structural damage, and spalling caused by corrosion of steel armatures and anchors in a marine climate.

The historic downtown Long Beach landmark was built at a cost of $210,000 in the Italian Romanesque style to the designs of H. M. Patterson (1856-1928) with interiors and stained glass by J. E. Mackay (1864-1938), and seats 1,500 people. Its thriving, liberal congregation supports poor Latino neighbours through offering free kindergarten and other programs, including soup kitchens for the unhoused.

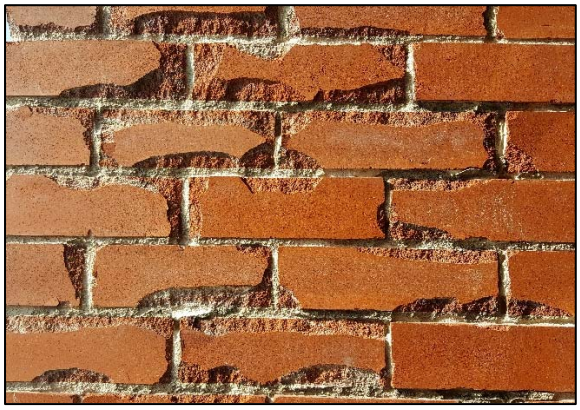
When sponsoring cleaning and off-site conservation of its fabulous east Rose Window, the church discovered structural cracks in the 18 ft. diameter terra cotta tracery and called for expert help from nearby British-licensed architect and architectural ceramics expert, John Fidler, who wrote British Standard 8221/2: 2000, *The Cleaning and Surface Repair of Buildings*.

Following extensive field inspections, surveys and exploratory openings, Fidler's team concluded that previous seismic upgrades after partial façade collapses in the 1930's and '60's had stiffened the mass brickwork segments around the original steel frame but had not addressed structural and other issues in the ornate terra cotta, especially at the Rose Windows.

Inspection of cracked Rose Window tracery

Spoke removed to reveal steel corrosion

The ceramic window tracery was extensively damaged by multiple longitudinal cracks and spalls, the latter caused by shear forces due to severely corroded mild-steel connection dowels and rods. The hollow terra cotta blocks had been located against a flimsy steel armature attached to the brickwork, and kept in place with a few wire ties and crude brick-aggregate concrete packing. Lower down the façade, at Frieze and Plinth levels, large diameter steel dowels interconnecting blocks through their meeting sides, had also corroded and cracked many units. Elsewhere, accidental chips, scuffs and missing cornice edges provided evidence of terra cotta damage due to previous falling masonry.



Spalled brickwork

Rotating corbel bricks supporting the faux machicolations and overhanging gable.

Inspection of the brickwork revealed additional problems. The church architect Patterson originally specified a smooth red, sand-face, pressed brick for the outer wythe of masonry, and he must have known it was an absorbent material, because he also ordered an application of oleo-resinous water repellent to keep Long Beach's salty ocean mist out of the brickwork. However, the salt-laden moisture did penetrate the system over time, and cryptofluorescence developed behind the surface, resulting in the pressed brick faces spalling, particularly along joint edges. Furthermore, towards the top of the walls, at the heavy overhanging gable level, the corbelled brickwork of the faux machicolations was observed to be rotating and at risk of causing another structural collapse.

Stabilization and Repair Strategy

The team devised a conservative stabilization and repair strategy that was readily adopted by the church congregation. Because of budgetary constraints, the most damaged east façade and lower elements of the north elevation were to be fully treated in this campaign. Only severely damaged terra cotta units and bricks would be replaced with new matching materials, recognising that accidental collateral damage, and logistical practicalities would dictate a larger number having to be ordered. At the east Rose window, 100 percent of the tracery was to be replaced but only a limited number of damaged splayed border units. However, a more robust, seismically resistant, stainless-steel armature would be required upon which to hang the tracery.

Superficial terra cotta damage would be left alone. And intermediate damage repaired by use of patching treatments. Rotating bricks would be 'pinned' to the substrate masonry with countersunk helical friction anchors. While spalled bricks would be replaced with new matching material bedded in lime mortar.

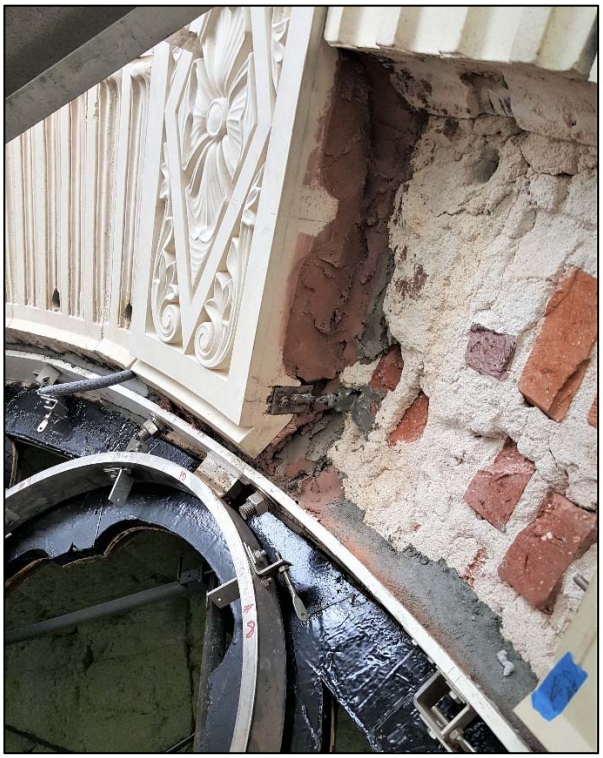
The inboard Mahogany tracery face of the east Rose Window was left mostly untouched and insitu, since its varnished finish and painted plaster Frieze contained hazardous materials and their abatement and the woodwork's temporary removal and reinstatement would have added substantially to contract time and cost.

Construction

The outboard face of the Mahogany tracery was waterproofed with a polymer-amended asphaltic coating. Then a prefabricated type 316 stainless-steel armature with an additional type 410 stainless rim was hoisted into position and secured to the mass masonry with long, radially positioned, epoxy-resin adhered stainless-steel threaded rod anchors. And the old wood and new steel structures tied together with stainless-steel wire.

New hollow terra cotta from England was then installed to replace the damaged blocks (surprisingly, originally from the Atlantic Terra Cotta Co., in Perth Amboy, NJ), each secured in place with stainless-steel anchor clips and neoprene shims. At the splayed rim, new terra cotta veneer pieces were installed on anchors as indents and their back cavities grouted solid.

Master mason Shawn Tibbs installing units



Keystone veneer installed for replacement

Use of Edison Coatings Products

Away from the Rose Window, terra cotta and brickwork mortar bedding in structural situations employed Edison's Spec-Joint 46 mortar Type N, while brickwork repointing used Edison LP-20M Type L custom-colored, high-calcium, air lime putty mortar to match existing.

Where deep, voluminous cavities behind newly installed terra cotta units under structural load required non-shrink grouting in tight situations, the contractor used Edison's Pump-X53, advantageous due to its low-water content, superplasticizer ingredient, and higher compressive strength.

For the patch repair of extant terra cotta, the team specified Edison Coating's combined, custom color-matched kit-of-parts: Custom 45TC mortar, Thin-fill 55 mortar, Aquathane 210 coating and Aqua-Spec 220 speckle finish.

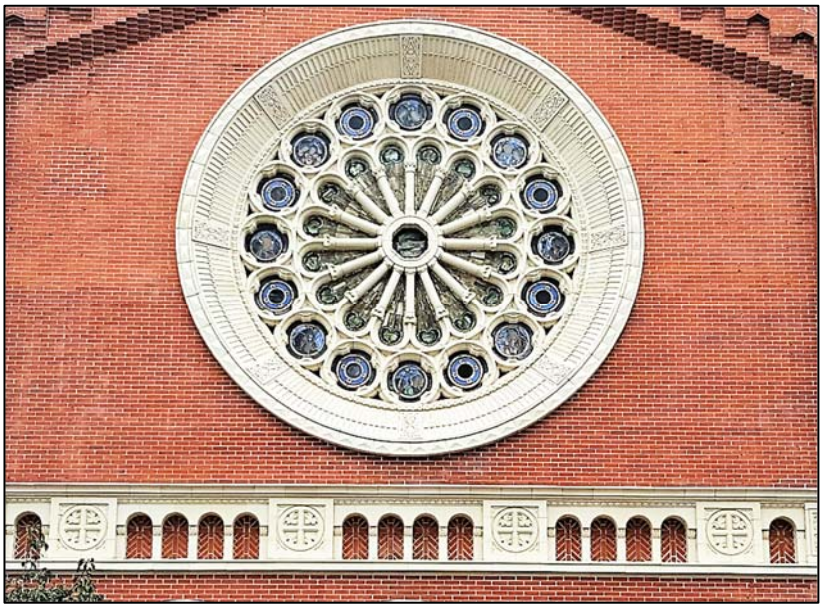
At the brickwork, countersunk holes were patch filled with custom color-matched Custom 45 mortar.

Tower porch cleaned and patch repaired

Porch cornice return recreated, part-way through restoration, awaiting additional carving and coatings

Counter-sunk helical friction anchors installed

Countersunk anchor holes patched



East Rose Window, Frieze and Brickwork Restored