The Wilshire Boulevard Temple at 3663 Wilshire Boulevard in Los Angeles, California, was the first synagogue built in Los Angeles and was dedicated in 1929. Designed in the Byzantine architectural style, it is constructed of concrete with a painted Portland cement stucco exterior (Figure 1).

Unfortunately, the building had experienced water infiltration into the interior, believed to be from cold joints in the concrete placement and cracks in the exterior concrete and stucco fabric. Over time, many surface treatments had been applied in an attempt to abate the water infiltration.

In 2011, Levin & Associates Architects was consulted. Examination showed the general condition of the painted surfaces demonstrated adhesion failure, blistering, peeling paint layers, open cracks, faded color, and pollution discoloration (Figure 2). The appearance hinted at a rough, unevenly textured substrate underneath. Unpainted concrete surfaces were badly weathered, revealing coarse aggregates and friable surfaces (Figure 3). The impact of these conditions diminished the beauty of the architecture, lending an unnatural look to the cementitious and stone construction.

An examination of the façade revealed a collection of many different coatings and water-repellent strategies, ranging from Tung oil/cement paint, asphalt tar, and epoxies to oil- and water-based polymer paints (Figure 4). These paints
and treatments form a continuous film or skin that prevents moisture from entering the cementitious substrate. Openings in this film—whether from cracks in the exterior concrete and stucco fabric, failed flashings, or open caulk joints—permit water to enter by capillary action. Conversely, these multiple layers of film-forming treatments serve to block vapor permeability, trapping moisture within.

In nature, substrate humidity will attempt to find equilibrium with the humidity of the surrounding air. This is beneficial to maintain dry mass masonry, stucco, and concrete. For the Wilshire Boulevard Temple, it is a problem. Solar surface heating is one of many factors that contribute to the movement of moisture in and out of mineral substrates. As the sun warms surfaces, water vapor will move to the warmth where it is trapped by the multiple paint layers. On cool nights, the water vapor will condense to a liquid against the paint film. If water continues to come into the façade, these thermal cycles will eventually cause the coating film to delaminate, blister, peel, or crack so that the water vapor can escape. Evidence of this phenomenon was observed at the Temple.

What was needed was a highly vapor-permeable decorative finish that would protect against water intrusion while complementing the architecture and natural beauty of the temple. For this purpose, Levin & Associates chose a sol-silicate mineral coating system composed of a group of complementary water-repellent and stucco-repair products for functional performance and aesthetics that met the requirements.

Sol-silicate mineral coatings are made of sand, potassium carbonate, and water. Upon application, they penetrate the surface by capillary action and, in a chemical reaction, mineralize the coating with the substrate. The unique sol chemistry provides mechanical bonding over acrylic- and resin-based paints. The resulting crystalline mineral surface has millions of distinctive irregular-shaped micropores that naturally resist wind-driven rain while providing extremely high vapor permeability. Sol-silicate coatings are unaffected by acids, UV exposure, or airborne pollutants.

The renovation process was to remove the old paint layers, make concrete and stucco patch repairs, fill cracks, and recoat with a sol-silicate mineral coating. Exposed concrete surfaces would receive a 100% active-ingredient silane water repellent. Friable, exposed concrete surfaces would be stabilized with a consolidation product and protected with the same water-repellent treatment.

The Byzantine revival dome is a large mass at 100 feet in diameter and climbing to a height of 135 feet. Over time, cracks and spalls developed through natural stresses and thermal movement in the concrete shell and the hard stucco layer. After the paint coatings were removed, the concrete and stucco revealed surface cracks from hairline to 1/8 inch wide, with some cracks extending through the concrete shell to the interior space.

The coating surfaces were stripped of the previous coats of paint and rinsed with clean water at 1200 to 1500 psi. Despite aggressive paint stripping, some of the previous water barrier and paint product applications remained. Remnants of asphalt tar were primed with a specialized stain blocker to prevent bleeding through the sol-silicate finish (Figure 5). What was left of the well-adhered acrylic paint, which constituted less than one percent of the coating surfaces, did not require further preparation, as the unique chemical and mechanical bonding properties of the sol-silicate coating permitted application over these remnants.

There were no debonded areas of original stucco per se; however, some stucco around larger cracks had been forced apart from the concrete shell. In addition, there were stucco patches from earlier campaigns that exhibited poor workmanship where
The general contractor reported surface cracks in some newly placed stucco patches. These were the result of shrinkage from placing layers too thickly. The warm daily temperatures accelerated surface drying before the core cured. An adjustment to the placement technique included following maximum recommended layer thicknesses and curing times, along with moisture curing in hot weather to allow the core of each layer to harden before the top surface dried.

The surface crack-filling strategy incorporated nonmoving and moving cracks. Cracks were defined as either hairline or larger than hairline.

- Nonmoving hairline cracks required no tooling. The fine-grained mineral fillers in the sol-silicate base coat would fill them with the brush-and-roller application.
- Nonmoving cracks larger than hairline were tooled to a V-shape, opening the surface to 1/8 inch wide, creating a funnel to receive trowel-applied lime-cement glass-fiber-reinforced filling mortar (Figure 7). The filling no effort had been made to match the patch to adjacent surface textures (Figure 6). These two conditions required removal and replacement, matching the surrounding surface textures.
mortar had \( \frac{1}{32} \)-inch fine grains to match the surrounding surface texture. The mortar was tooled smooth and left proud of the surface (its plane left higher than the adjacent surface), allowed to firm up, and then gently wiped with a damp sponge to blend into the surrounding surfaces (Figures 8 and 9).

Vigilance with application quality ensured over-tooled mortar surfaces (as shown in Figure 10) were properly refinished flush to prevent trace shadowing on the dome’s surfaces.

Practical tests were required to determine if through-cracks were static or moving. A representative through-crack was selected for examination (Figure 11).
The plaster surface was removed about two inches to either side of the crack, reaching depths varying from \(\frac{1}{2}\) to \(\frac{3}{4}\) of an inch into the concrete substrate. A wood block, presumed to be part of the original concrete forming, was revealed, positioned in the path of the vertical crack. The block was ground flush to the repair depth, as complete removal was deemed undesirable. After the repair surfaces were pre-wetted, the \(\frac{1}{2}\)-in.-deep repair area received two layers of filling mortar and the \(\frac{3}{4}\)-in.-deep repair area, three layers of filling mortar. Proper curing was observed at each step.

After curing, a hairline crack reappeared at the repaired surface, indicating the through-crack was moving beyond the thermal stress of the soft lime-cement render (the filling mortar). The repair procedure was modified to accommodate this movement with a flexible sealant protected from weathering with the sol-silicate mineral coating.

- The crack was enlarged to \(\frac{1}{2}\) in. wide, extending through the existing stucco layer to a depth of 1 inch into the concrete shell.
- A backer rod and a \(\frac{1}{2}\)-in. layer of sealant were placed at the bottom of the enlargement and again at the stucco surface.
- Sand, matching the grain size of the surrounding stucco, was pressed into the wet caulk surface. The sand camouflaged the smooth caulk surface and provided a silica chemical bond for the sol-silicate mineral coating (Figure 12).

Cracks filled or surfaces finished with lime-cement render were treated with an
application of diluted silicic acid to open-surface sinter layers (a dense sediment surface layer composed of mineral fines, lime, and cement) to improve penetration for the sol-silicate mineral coating (Figure 13). The silicic acid reacts with the free lime, producing calcium carbonate granules that are rinsed from the surface with clean water. This reaction with lime neutralizes the silicic acid.

The sol-silicate mineral-coating system comprised a sol-silicate base coat having mineral fillers in grains up to $\frac{1}{32}$ in. and a sol-silicate top coat without the mineral fillers. The mineral fillers function to fill hairline cracks, to help soften the uneven textures of the weathered surfaces, and to blend the crack repairs and stucco repairs into the façade for an overall harmonized

![Figure 14 – Finished southeast corner façade.](image)
Figure 15 – Finished east façade.

appearance while respecting the character of the aged structure.

The base coat was diluted ten percent with a sol-silicate dilution to counter the absorbency of the coating surfaces to ensure complete mineralization with the substrate. The top coat was applied undiluted to ensure color consistency. Although sol-silicate coatings dry to the touch before ten minutes, each coat was allowed to chemically cure for a minimum of 12 hours.

Three years later, the repairs and sol-silicate coating are in perfect condition (Figures 1, 14, and 15). In this climate, the sol-silicate coating system will protect the temple for decades. At the end of the coating’s service life, the surfaces are simply cleaned and recoated; stripping is never required.

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