The Importance of Moisture Protection in Preservation and Restoration

By John F. Maillard CSI-CDT

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Water has destroyed or damaged more structures than wars and natural disasters! Unfortunately, moisture protection often takes the back seat in most restoration projects. Our landmark architects, engineers and conservators have an enormous challenge. They are required to preserve or restore historic structures while meeting new seismic and local codes; new uses that the structures were not originally designed for and limited budgets.

The moisture protection challenges

1. They are practically all non-drainable wall systems. They depend entirely on the exterior surfaces for the barrier preventing the water intrusion. This is not realistic in an imperfect world. Every joint and transition should be perfectly watertight, which requires perfection in installation and materials.

2. Most of the exterior components are very porous (mortars, bricks, stucco, sandstones, marbles and woods). Such substrates absorb moisture that eventually damage or destroy these components. The result is not only interior water damage but also biological growth and mildew.

3. The mortar joints are mostly responsible for preventing the water intrusion. They do not last forever. The repointing procedures are very costly and therefore often omitted or partially performed, and frequently with non-compatible mortars.

4. Our forefathers had a tendency to marry materials that do not want to be married. They joined masonry with wood without adequate transition joints. The mortar joints between these totally different substrates created problems instead of solving them. They were also stingy with the flashings to divert the water away from the masonry units.

Addressing these challenges

1. **The non-drainable wall systems** - Whenever possible, adopt one or two principles of moisture protection: barrier – drainage – diversion. This can be accomplished by installing pan flashing under the windowsill tracks, head flashings, and cap flashings, drip edges to divert the water. Naturally, providing and maintaining sound mortar joints are still the most important barriers.

2. **Porous substrates -** This is a very controversial subject. With the exception of marble and limestone, it is impossible to reduce the porosity by honing and to that end; several conservators are reluctant to specify clear water repellents. This subject is battled for over 40 years by the author and today; it is convinced that the reduction of porosity is necessary and that the clear water repellents such as silanes and siloxanes are a valid solution to this problem.

Following are typical examples of the need for porosity reduction being executed by the author as a contractor.

The Sharon House, Golden Gate Park in San Francisco: The sandstone was cleaned, repaired and 100 percent repointed, then a siloxane was applied. Thirteen years later the building is in pristine condition.

The statue in Spreckels Hall of Music, Golden Gate Park in San Francisco was restored the same year 1992. However, the same client omitted the application of a clear water repellent on the repaired and restored sandstone. Thirteen years later, the fungus and biological growth are back with a vengeance. Every winter it would turn green and every spring it would be cleaned with a standard restoration cleaner.

Finally, It was decided to perform a little test. After cleaning the statue in April of that year, a Silane clear water repellent was applied on one side while covering the other side with a visqueen. The following spring the difference was obvious. The treated half did not have a single trace of mildew.

Hence these examples demonstrate the importance to reduce the porosity of the substrates. We should consider that the clear water repellents are not a barrier or waterproofing solution but instead are a way to reduce the porosity of the substrates when honing is not an option. Depending on the materials, the average water repellency capacity is four to five years. Fortunately re-application is relatively inexpensive compared with re-cleaning.

3. **Mortar joints**- Use of different pointing methods and materials including parging is very much suitable for preventing water intrusion. One such example is Chapel of St.John of Jerusalem in Fribourg Switzerland built in 1512 and kept well pointed all these years and is in remarkable condition today.

4. **Marriage of incompatible materials -** Proper flashing and installing a proper transition joint between the different materials with a suitable sealant will solve this problem.

Masonry Repair and Moisture Protection

A Case study of Russian Church of the Holy Trinity, East New York

By Kevin Yuers

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Trinity was built in 1935 and located in the East New York section of Brooklyn (Figure 1).

Fig 1: Church of Holy Trinity

Constructed in a traditional Byzantine style, the masonry structure features large, onion-shaped domes, semi-circular arches, and high arched windows. It features two distinctive domes, the smaller of which functions as a three-story bell tower and houses three massive church bells. At the top of the bell tower, four louvers–one on each of the four sides–enable sound to travel out of the tower.

Distress observed

By the summer of 2003, the 68-year-old church was showing its age. Years of weather, soot, and air pollution had taken their toll. The church's exterior, particularly the front steps and massive front columns, were soiled with years of dirt and buildup.

Fig 2: Distress in plastering

Much more of a concern than the cosmetic problems, however, was the fact that the mortar in the brick exterior was beginning to erode and water had begun leaking into the bell tower and the south-east chimney. Water had also begun entering the bell tower's louvers during heavy rains.

Water that made its way into the bell tower would pool on the third level's concrete floor and then seep through to the second level and into the choir area of the church below. The plaster on the ceilings and walls of the church was being destroyed (Figures 2 & 3) by the water damage. But most distressing was the fact that the many historic religious paintings were being damaged and destroyed (Figure 4).

Fig 3: Distress in internal walls

Fig 4: Damages in wall paintings

Planning of Repair

In the summer of 2003, the church decided to repair and upgrade the structure to address the immediate leakage problems and avoid further damage to the structure and its contents. The upgrade involved a general cleaning of the front entryway, cleaning and sealing the exterior of the bell tower and southeast chimney, repairing the brick in those areas, and protecting the chimney and inside of the bell tower against further leakage.

Repair Methodology

The first step in the process was to remove 68 years of urban grime from the outside of the bell tower and the southeast chimney. A local contractor was hired to power wash all the brick work in these areas using a high-pressure compressor. Then, the original, eroding mortar was removed from around the brick and replaced with new standard brick mortar grout.

Once the brick had been repointed, two coats of a fast-drying water repellent sealer were applied with a sprayer to the exterior vertical surfaces. The church elected to use a sealer containing a blend of silane and siloxane compounds designed specifically for brick, masonry, and concrete that reacts with silicates below the surface of the brick to form an insoluble, water-repellent barrier. Because the finished application is invisible, the original appearance and breathability of the brick are maintained. The sealer is designed to not fade, yellow, crack, peel, or wear away.

When the exterior work was done, the church's interior leakage problems were addressed. On the third (top) level of the bell tower, where a sloped concrete floor had recently been created to direct any incoming water to an external drain, a local contractor applied a cementitious crystalline water-proofing product to fortify the concrete and stop water from leaking through to the second level of the tower.

Fig 5: Cementitious crystalline waterproofing on external surfaces

The crystalline waterproofing product reacts with concrete to form crystals that migrate into the concrete to block pores, voids, and tiny cracks that would allow water penetration. Over the life of the structure, these crystals will continue to react with incoming water to self-seal small cracks, providing long-lasting protection against leakage. For extra reassurance, the church opted for a product with a 10-year guarantee.

A similar sloping concrete slab was constructed on the second level of the bell tower to direct water to another external drain. This time, a crystalline concrete waterproofing admixture was incorporated right into the concrete slab, providing another layer of protection against leakage.

For the southeast corner chimney, the contractors created a new concrete cap top, which also incorporated a crystalline concrete waterproofing admixture. The entire chimney was then power washed, repointed, and spray-coated with two layers of water-repellent.

To finish off the repair and renovation project, the church then hired local contractors to clean the structure's front steps and massive columns. While it took some experimentation to find a solution that would remove nearly 70 years of city dirt and grime, eventually a specialized brick and concrete cleaning product was located that enabled the team to clean the columns and stairs and restore them to their original luster.

To minimize inconvenience to the church's congregation, repairs were completed between Monday and Friday over a period of 1-1/2 months. The project was completed in the fall of 2003.

Results of the renovation have been highly successful. Outside, the church entryway looks new. More importantly, though, the repair and water-proofing efforts in the bell tower and southeast corner chimney have proven to be highly effective. Despite a number of heavy soaking rains in the 9 months since the project was complete, no further water infiltration or damage has been detected.

Pleased with the results of the initial repair project, the church is now considering undertaking similar work in the rest of the structure as a preventative measure. Satisfied that the leakage problems have been solved, the church has begun selecting artists to commence repairs on the plaster and religious paintings and depictions inside the church.

Owner: Russian Orthodox Church of the Holy Trinity,Brooklyn, NY

Repair Contractor/Supplier : The Crystol Group.Huntington Station, New York

Material Suppliers:Crystol Concrete Products Goldens Bridge, New York & Kryton International, Inc.,Vancouver, British Columbia, Canada