BELOW-GRADE WATERPROOFING FAILURES

– Case Study

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In order to highlight fundamental construction errors, this paper reviews our firm's litigation-related evaluation of below-grade waterproofing failures at a university building in Northern California (*Figure 1*). The nine-year-old facility had experienced periodic groundwater intrusion since original construction.[1]

Consider the front portion with the low-sloped roof: this 70-ft.-long area encloses a partially below-grade boiler room with perimeter cast-in-place (CIP) concrete walls (beginning 20 in. below the at-grade level of the reddish precast panels seen in *Figure 2*) extending down to the concrete footings. Since original construction, groundwater leakage had regularly occurred at the floor-to-wall transitions (*Figure 3*) and, during heavy rain events, this room repeatedly flooded over the top of the below-grade CIP walls (*Figure 4*).

Assisted by a local geotechnical firm, we excavated an OSHA-compliant[2] test hole 13 ft. down to the footings in order to assess suspected waterproofing failures. Upon commencing this excavation process, we exposed a raggedy, ripped, and poorly terminated sheet waterproofing membrane (*Figure 5*) applied atop a layer of bentonite clay. "Bentonite is granulated smectite clay that provides waterproofing

Figure 1 – Boiler room has perimeter cast-in-place concrete walls (commencing below the reddish precast panels) extending down to the concrete footings. (Whitish precast concrete panels extend up from the red panels.)

Figure 2 – A cast-in-place concrete wall encloses a 70-ft.-long boiler room that serves the entire campus.

Figure 3 – Even during dry weather, groundwater infiltrated the boiler room at floor-to-wall transitions. The water stains at the lower cast-in-place wall (at left) resulted from leakage occurring at the top of the concrete wall (see Figure 4*).*

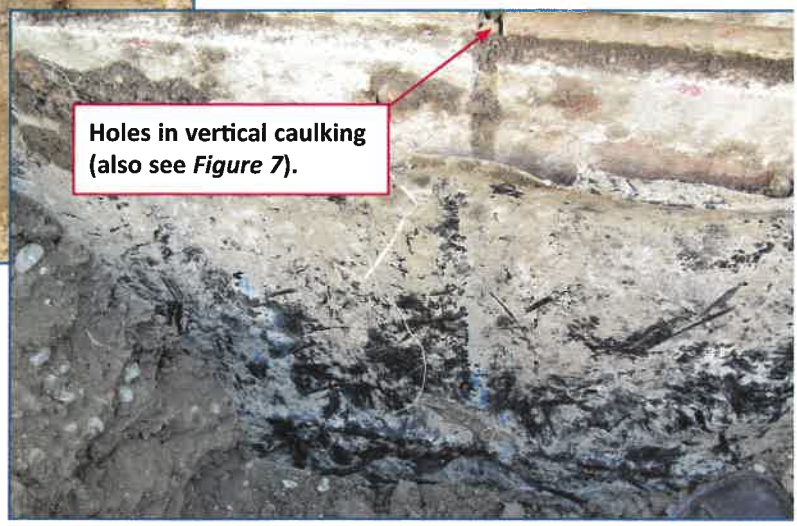
Figure 4 – During rain events, water flooded down from the top of the cast-in-place concrete wall, which commences 20 in. below grade. (The precast panels above are attached to the cast-in-place concrete walls with steel brackets.)

capabilities by swelling to nearly 15 times its dry volume when it absorbs water. In hydrated state, under sufficient hydrostatic pressure, bentonite becomes a water-repelling gel that will adhere to many different materials–concrete, stone, wood."[3]

Unfortunately, the lack of a counterflashed, tightly secured termination bar (*Figure 6*) across the top edge of the shot-pinned (using a powder-actuated nail gun[4]) membrane had facilitated rain- and irrigation-water flow behind the sheet waterproofing.[5] During our investigation, we found below-grade holes (allegedly, per the defense, caused by snails[6]) in vertical

Figure 5 – Upon commencing the excavation process, a raggedy, poorly attached, and extensively torn sheet waterproofing membrane was exposed. (The missing section at the top of this photo was extracted by our crew for sampling purposes.)

Figure 6 – The sheet waterproofing had been "shot-pinned" to the reddish precast panels without a termination bar that would have served to prevent the membrane from tearing loose during later backfilling. (Note at the top of this photograph the holes in the vertical caulking separating two of these panels; also see Figure 7 *and* Figure 8. *)*



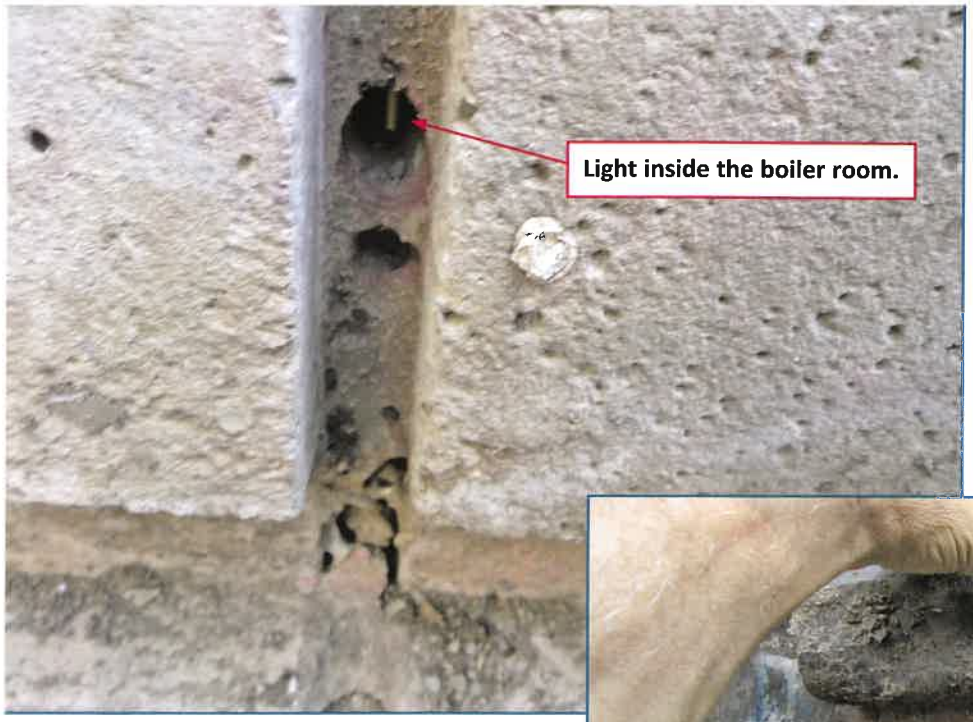


Figure 7 – (Same caulk joint seen in Figure 6.*) The defense argued that these below-grade holes were caused by snails. At the upper hole, light from inside the boiler room can be seen.*

Figure 8 – Damaged caulking at transition between the reddish precast panels (atop steel framing) and underlying cast-in-place concrete wall. A probe inserted into this hole readily extended into the boiler room at the area of water staining seen in Figure 4.

caulking at the reddish precast panels, as seen in *Figures 6–8*. A test probe inserted into the damaged caulking seen in *Figure 8* extended into the boiler room at the area of water staining seen in *Figure 4*. Further, per the exemplar "clump" seen in *Figure 9*, we noted that large portions of the bentonite clay had washed out of the system. Finally, as evidenced by *Figure 10*, we observed that the horizontal caulk joint separating these two wall systems was not bonded to the precast panels, providing yet another route for water infiltration into the boiler room.

As evidenced by *Figure 11* (near the top of the trench), *Figure 12* (halfway down), and *Figure 13* (very near the bottom), contractor(s) had extensively damaged the sheet waterproofing membrane during the backfill process. Groundwater infiltration through these numerous breaches certainly contributed to the ongoing leakage at the floor slab-to-wall transition seen in *Figure 3*.

It also is important to note the absence of any mechanism—such as a prefabricated drainage composite or a backfilled layer of ¾-in. "drain rock"—to:

- promote direct drainage down to the footing drains at the bottom of the trench, and

Figure 10 – The caulk joint between the two wall systems was not watertight due to failed bonding at the precast panels.

Figure 9 – During excavation, we found this clump of bentonite clay directly below the ripped membrane seen in Figure 8.

Figure 11 – Multiple breaches in the membrane due to damage during backfilling were observed at all levels of the excavation.

Figure 12 – Contractor(s) severely damaged the sheet membrane during the backfilling process.

Figure 13 – (below) Near the bottom of the excavated trench, breaches in the waterproofing still remained prevalent.

- to thereby relieve hydrostatic "head pressure" against the extensively ripped sheet membrane caused by groundwater trapped in the poorly draining clayish backfill.

ALLEGED SNAIL DAMAGE AT THE VERTICAL CAULKING

As noted, the defense argued that the holes seen in *Figures 6–8* in the vertical caulking at the reddish precast panels resulted from post-construction consumption of the polyurethane by snails. We observed no such snails (or comparable polyurethane-eating gastropods) at the site. Instead, we opined these joint failures resulted from improper installation of the caulking in a manner inconsistent with industry standard ASTM C1193, *Standard Guide for Use of Joint Sealants*,[7] and the manufacturer's installation instructions.

In particular, we reported:

- the thickness of the applied caulking did not meet the manufacturer's minimum requirements, and
- the absence of a required foam backer rod that would have provided structural support to this polyurethane caulking as these precast panels thermally expanded and contracted on a daily basis.

In short, we opined that these holes most likely had been caused by stretching of the unduly thin caulking.

SUMMARY REVIEW OF CONSTRUCTION ERRORS

During the ensuing litigation process, we highlighted key errors by the contractor and its subcontractors:

- Failure to terminate (or otherwise satisfactorily counterflash) the sheet waterproofing membrane above grade in general accordance with industry standards: "Membrane waterproofing of all types . . . should terminate at least 8 in. above grade."[8]
- Failure to install a continuous termination bar at the top edge of the sheet waterproofing, as required by the project specifications and associated contract documents.
- Failure to provide a backfilled layer of ¾-in. drain rock in accordance with the project specifications and associated contract documents.
- Failure to prevent damage to the sheet waterproofing during the backfilling process, in accordance with the project specifications and associated contract documents.
- Failure to provide a watertight seal at the horizontal caulk joint (*Figure 10*) at the transition from the reddish precast panels to the underlying CIP concrete wall.
- Failure (as evidenced by *Figures 6–8*) at the precast panels to provide vertical caulking conforming with industry standard ASTM C1193 and the manufacturer's installation requirements. (The defense provided no credible evidence of attacks by snails.)

We opined during deposition that these egregious construction errors should have been obvious to a competent contractor. The case settled prior to trial. The failed waterproofing system has been successfully replaced with a liquid-applied urethane elastomeric coating and associated upgrades to the perimeter drainage.

REFERENCES

1. California's Code of Civil Procedure §337.15 provides a "statute of repose" that bars actions to recover damages for construction defects more than 10 years after substantial completion of the work of improvement.
2. https://www.osha.gov/Publications/OSHA3971.pdf
3. Henshell, J. *The Manual of Below-Grade Waterproofing Systems.* John Wiley & Sons, Inc., 2000: "A complex electrochemical process promotes bentonite's spontaneous swelling in the presence of liquid moisture. As a consequence of repulsive ionic forces created between the microscopic particles… by the water molecules, the hydrated bentonite exerts an osmotic or swelling pressure. To perform at peak waterproofing efficiency, the bentonite must be compressed under continuous pressure… [of] at least 40 psf."
4. A powder-actuated nail gun (e.g., a Hilti gun) is used to attach materials to hard substrates such as steel and concrete. This technology is powered by a controlled explosion of a small chemical propellant charge, similar to the process that discharges a firearm.
5. Henshell, J. *The Manual of Below-Grade Waterproofing Systems.* John Wiley & Sons, Inc., 2000: "Bentonite panels pose a termination problem at grade. To maintain the required lateral pressure, they should be terminated 6 in. below grade with a membrane flashing strip… or metal cap flashing over the termination joint. The flashing should extend 8 in. above grade and overlap the bentonite by 6 in. Termination bars are the best method for anchoring panels and sheets." (Note: some waterproofing system manufacturers specify different dimensions for these critical transitions.)
6. We observed no such snails (or comparable polyurethane caulk-eating gastropods) at the site.
7. ASTM C1193, *Standard Guide for Use of Joint Sealants.* Conshohocken, PA. https://www.astm.org/Standards/C1193.htm.
8. Henshell, J. *The Manual of Below-Grade Waterproofing Systems.* John Wiley & Sons, Inc., 2000. (Also reference the 2016 updated second edition of this manual.)

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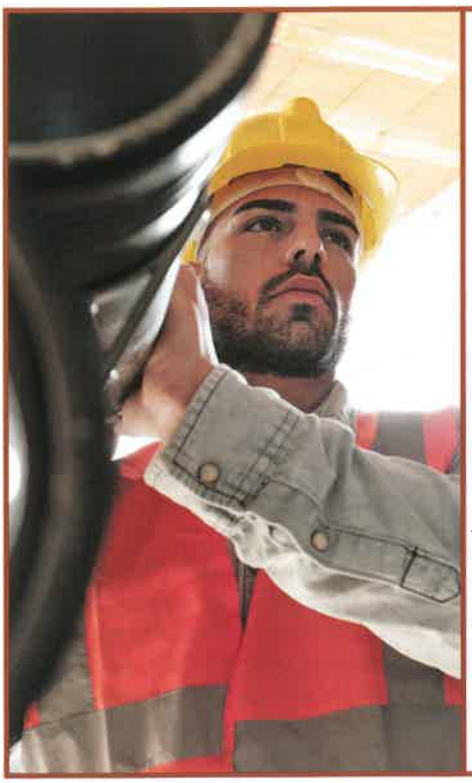

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Will DACA Revival Address Worker Shortage?

A federal judge in New York City has reinstated the Deferred Action for Childhood Arrivals (DACA) program, which will allow undocumented immigrants brought to the US as children to apply for work permits. US District Judge Nicholas G. Garaufis said he was "fully restoring" the program, according to an article in *Washington Post* on December 4, 2020.[1] The Trump administration attempted to end the program in September of 2017, and in July of 2020 a memo was issued shortening work permits to one year.

As of 2014, 27.3% of construction workers were "Hispanic or Latino," according to the US Bureau of Labor and Statistics,[2] giving the construction industry the highest share of this occupational group. The judge's ruling will also allow for DACA recipients, colloquially called "Dreamers," to receive two-year work permits, as opposed to the one-year permits granted under the Trump administration's rules.

The Center for American Progress estimates that the ruling could affect at least 300,000 immigrants. President-elect Joe Biden has said that he will push for "a path to citizenship" for Dreamers and other undocumented immigrants.

1. Sacchetti, Maria. *The Washington Post.* 2020. https://www.washingtonpost.com/immigration/daca-restored-dreamers/2020/12/04/37254908-367a-11eb-8d38-6aea1adb3839_story.html
2. Bureau of Labor Statistics, US Department of Labor, *The Economics Daily,* Hispanics and Latinos in industries and occupations on the Internet at https://www.bls.gov/opub/ted/2015/hispanics-and-latinos-in-industries-and-occupations.htm (visited December 05, 2020).