HAHN READY MIX

A Study on Scaling

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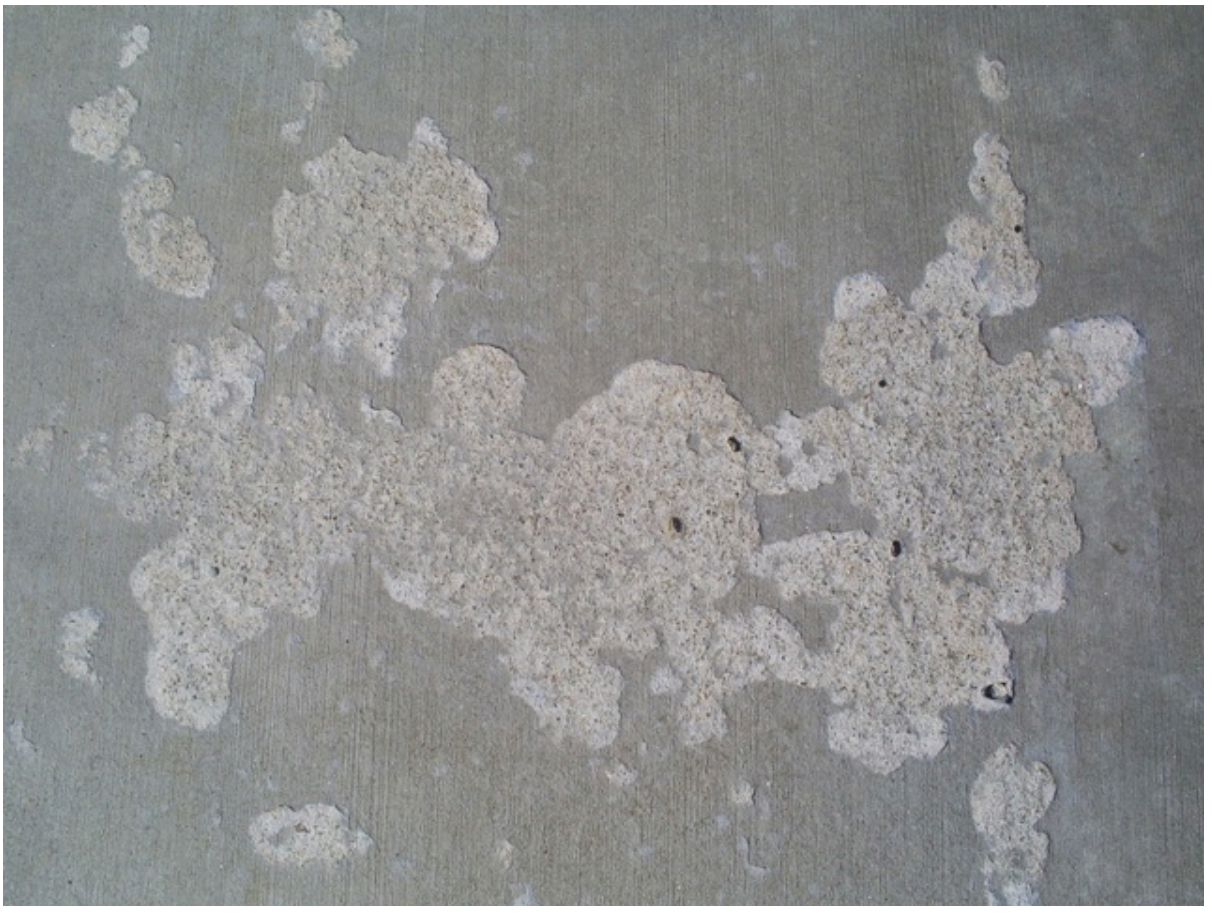
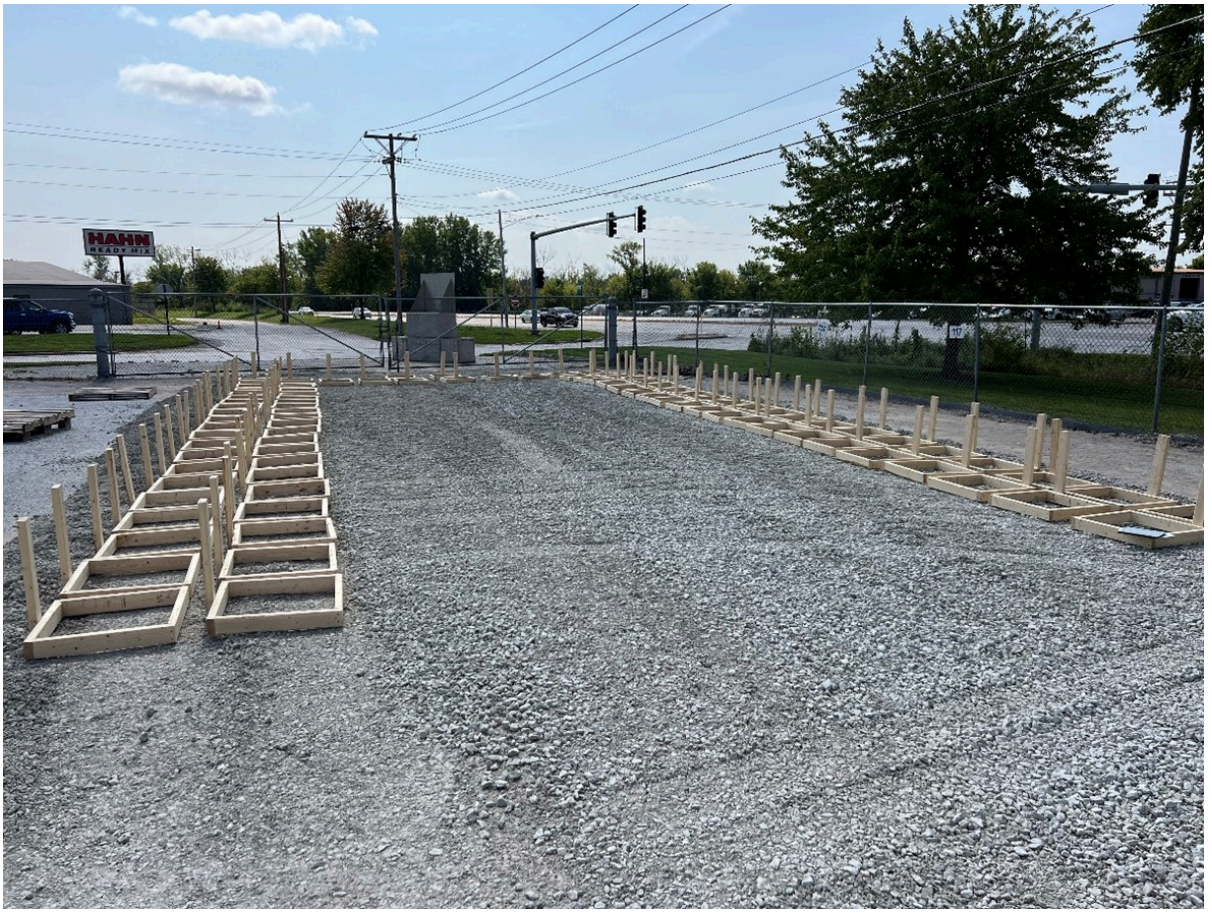


A recent acute issue

This year, we have seen a significant increase in scaling on exterior concrete pavements placed in the last two years. Interestingly, this has occurred predominately on parking lots placed with a laser screed or truss screed. Petrographic analysis has shown numerous causes including lack of curing, chloride addition, and high surface w/cm ratios. To us, this didn't seem like it could be the whole story. The time period of placement from the scaled pavements corresponds with the switch to 1L cement, and in our opinion, the industry as a whole has not gotten their arms around all of the ramifications of that material change. The problems with scaling this year led us to ask the question: *What if the best practices we've recommended for years aren't appropriate anymore?* Thus the idea was born

to perform our own study with an objective to test scaling and deicer salt resistance with many common methods and materials at our disposal.

The Trials

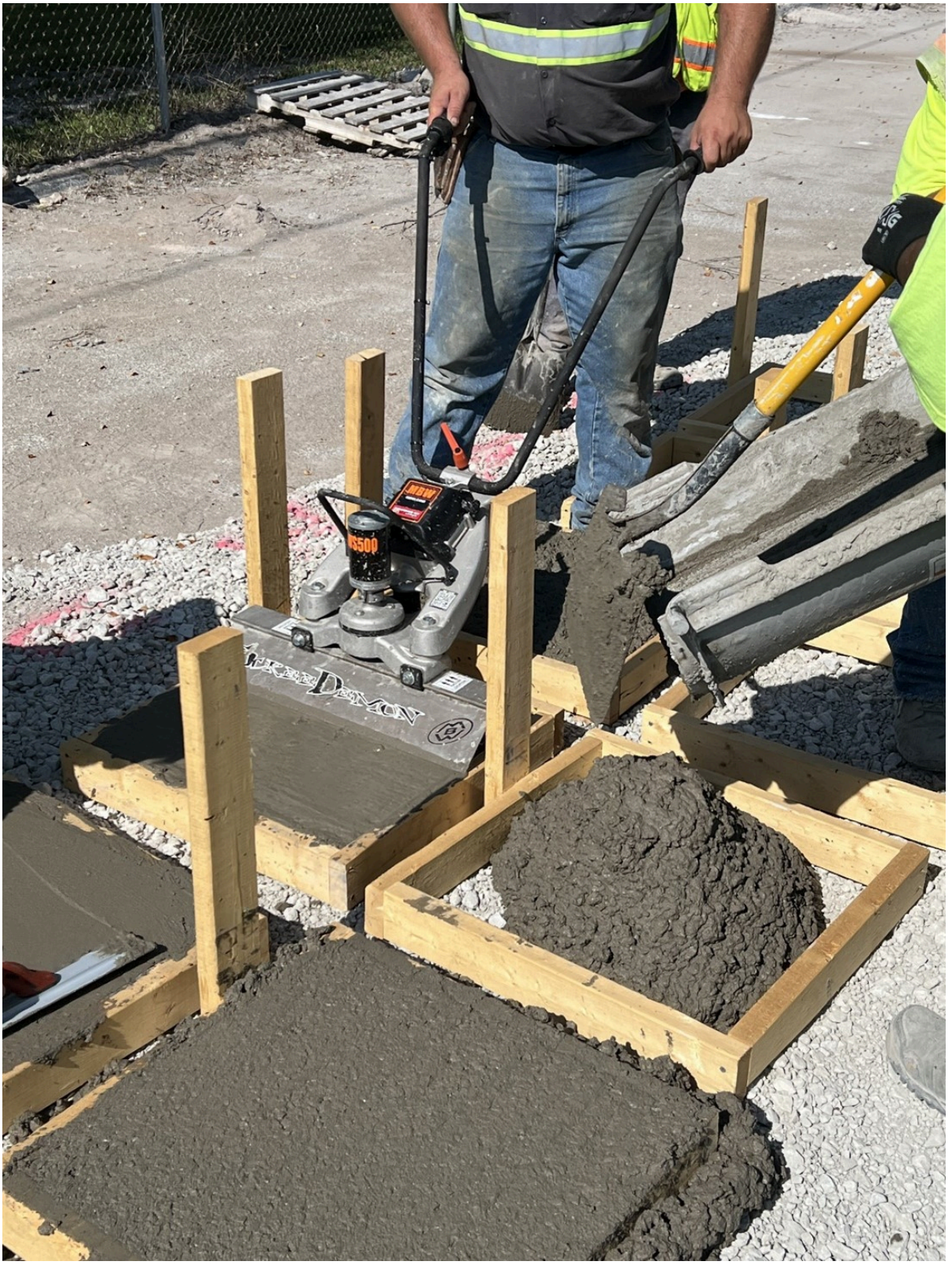


95 2'x2' concrete pads were placed on 4" of compacted base and poured on a hot, windy day with the different materials and methods we are testing. Each pad isolated a single variable, and will allow for assessing performance across the rest of the variables. The pads will remain outside for two winters, and be subjected to regular magnesium chloride "pre-treats" and rock salt additions through each winter. The blind study will involve a panel of at least 5 industry judges who will assess the level of freeze-thaw and deicer salt damage in May of 2025 and 2026 of each individual pad, without knowing what variables are represented on each pad. At the end of the study, we hope to be able to publish a paper to explain our findings and recommend any changes to industry best practices we feel would be beneficial to concrete freeze-thaw durability.

The Variables

1. **Vibration** - Half of the pads were vibrated with a small but powerful vibrating screed to simulate a laser screed or truss screed where we have seen many of the scaling problems. We find it concerning that hand-finished concrete immediately adjacent to scaled vibrated concrete often shows no distress.

Testing this variable might feasibly inform the effect surface vibration has on freeze-thaw durability.

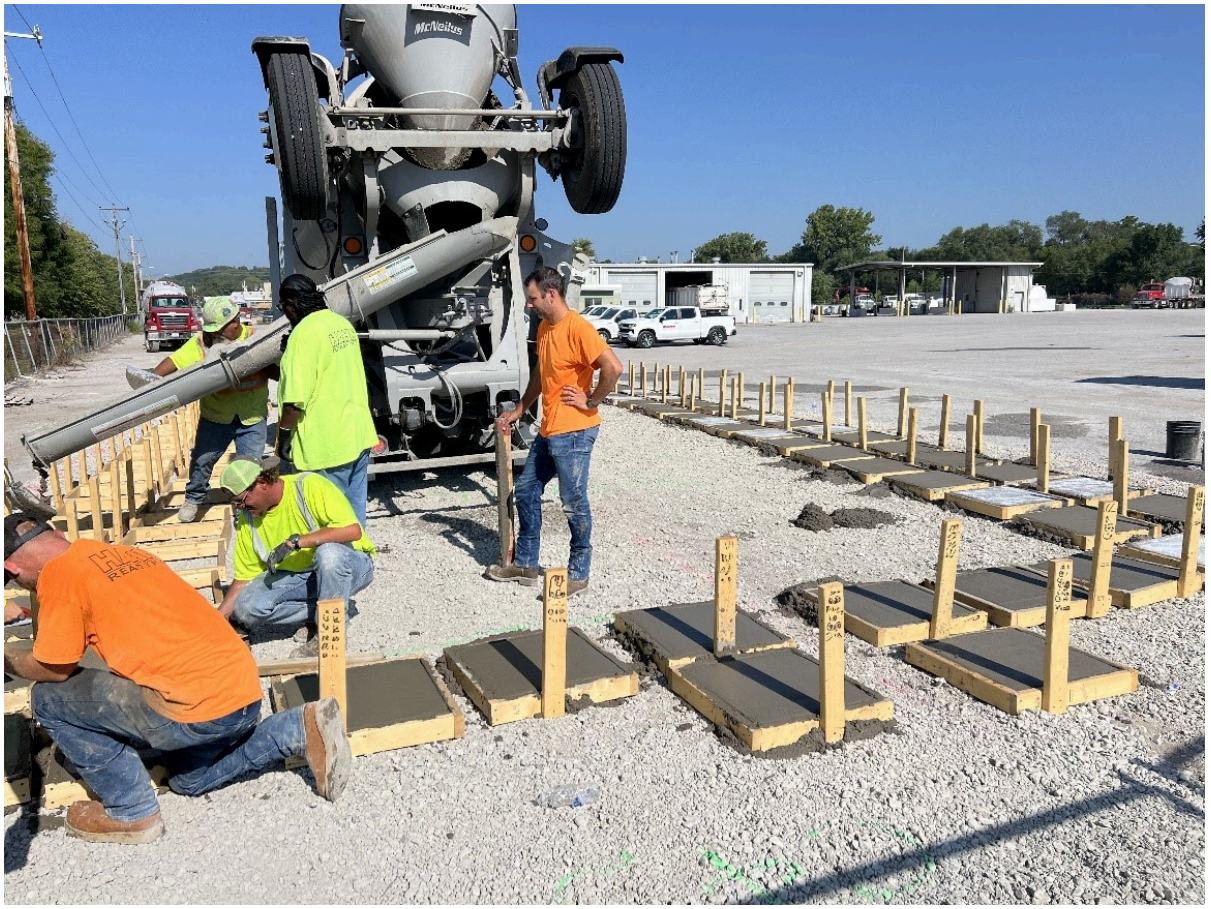


2. **Slag** - Half of the pads were poured with a ternary mix design with 20% slag and 15% fly ash. The other half was poured with a 20% fly ash mix design. Slag has been postulated in some studies over the years to decrease deicer salt resistance, although the mechanisms of slag's benefits to the hydration products of cement should provide a denser paste matrix with *more* resistance to salt. Hopefully we'll get to the bottom of this.

Constituents	Mix Design A	Mix Design B
1L Cement (11)	375	456
Class C Fly Ash	78	124
Grade 100 GGBFS	120	0
#67 Crushed Limestone	1730	1730
Natural River Sand	1520	1500
Water	33.6gal	33.6gal
HRWR	2oz/hwt	2oz/hwt
AEA	3oz	3oz
W/CM Ratio	.489	.484

*Units in pounds unless otherwise noted.

3. **Curing Compounds** - The lack of curing compound usage has long been a weakness in the concrete construction industry, but we suspect it is even more important now then it ever has been. Some pads in the study received no curing compounds, while others received a number of various types of products including a wax compound, a PAMS compound, a sodium-silicate compound and a solvent based cure and seal compound.
4. **Curing Compound Application Timing** - Of the pads which received a curing compound, half were applied at 45 minutes after screeding and half were applied at 4 hours after screeding. Differences in performance of this variable should inform necessity of early curing or if late age curing is acceptable.



5. **Sealers** - The final variable tested was the use of a sealer for deicer salt protection. A third of the pads (not counting the cure and seal pads) received no

sealer, a third a topical silane-siloxane applied 30 days after placement, and a third were placed with an integral sealing admixture.

More to come...

While this study just scratches the surface of the variables that could be tested, we hope it will be informative and provide direction to the industry if one variable or some combination of variables performs poorly or the same if some combination provides excellent freeze-thaw durability.

Recently, this study concept has gotten some national attention and it has been suggested that perhaps parallel studies should be performed in other areas with different local materials.

We'll keep you updated on the study, and feel free to reach out if you have any questions or want to know more details about how the study was performed.

Read the whole story