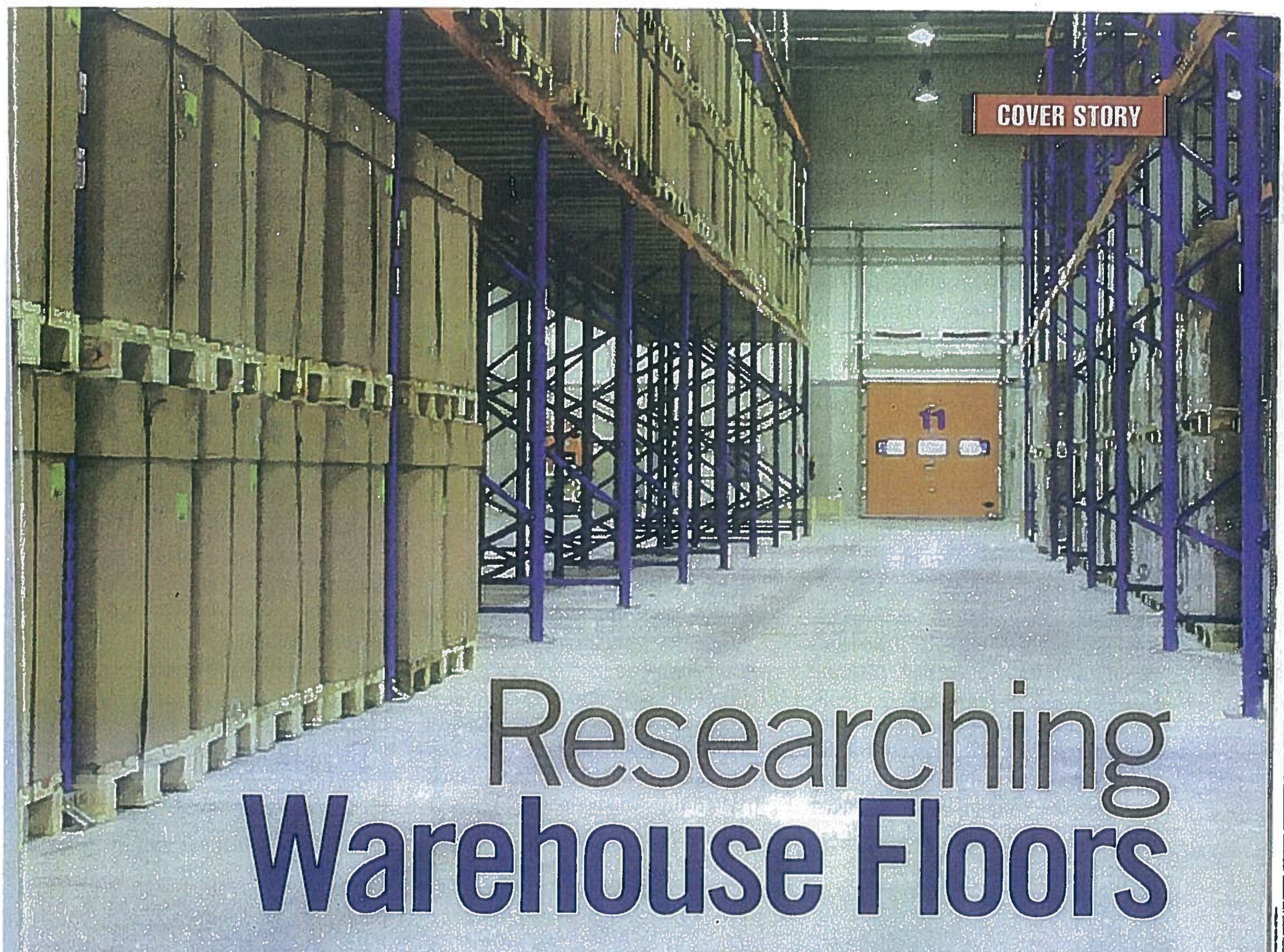

Researching Warehouse Floors

Are there ways to reduce curling and shrinkage in floors?

BY JOE NASVIK

The idea of initiating a field test to learn more about shrinkage and curling in warehouse floors is something that CONCRETE CONSTRUCTION magazine has considered for the past couple of years. So when Greg Scurto, president of Scurto Cement, Gilberts, Ill., offered us the opportunity to do a research project using a 60,000-square-foot warehouse floor they were planning to build for their own use, CC accepted. Several different mixes will be placed with areas between 5000 to 10,000 square feet in mid-February. The enclosed warehouse will be maintained between the temperatures of 50° F to 55° F and concrete placed under normal wintertime conditions. The 10 different floor mixes—all including accelerating admixtures—will be monitored for the next two years to observe shrinkage, curling, and moisture loss in the concrete. It is hoped the information will help everyone design and install better floors.

When concrete is placed in the field, there are variables that can't be controlled, especially when compared to laboratory research. Lab research projects can control almost all of the variables. But contractors deal with jobsite conditions as they install state-of-the-art work. It's hoped the results will reflect real conditions and be applicable to typical jobsites. A steering group is working out the details of the study, and several manufacturers are supplying product and additional help.

The focus of research

The floor you build is different than what it becomes a couple of years later. Floors are at their best for the short period of time after they are placed and finished. Flatness measurements, F_F and F_L, are recorded at this time to measure the contractor's skills at placing and finishing. However, floors begin to shrink and curl shortly afterward. Curling develops at contraction joints and cold joints because the bottom surface of a slab typically retains water longer than the top. As the bottom dries out more, the amount of curling changes but remains. The amount of curling and movement changes with different concrete mixes, the presence or lack of vapor barriers, and ambient conditions.

This field test will collect information about how quickly moisture not needed for cement hydration moves through a fresh slab and escapes into the atmosphere. The concrete mix's permeability influences this rate but so does the floor finish. When a floor is hard-troweled (a "burned" finish) how much longer does it takes moisture to move through the slab's surface? It's possible that enough moisture is retained to cure the concrete for many uses and environments. By monitoring the relative humidity of each mix and the different finishes until a predetermined relative humidity (RH) is reached, the differences can be plotted.

The field test will have three primary objectives: to measure shrinkage, to plot curling along joint lines, and to measure moisture movement through slabs throughout the curing cycle.

Controlled variables

Because the slab will be placed during the winter, accelerators will be added to every load of concrete placed. Half of the loads will have 2% calcium chloride and the other half will have a nonchloride accelerator (NCA)—each placed at the batch plant. Completing the floor placement will take three days with the room temperature held fairly constant. Today, many or most floor constructions include vapor barriers, so this floor will as well. The addition of a vapor barrier also will act as a slip sheet for all mixes, reducing the coefficient of friction but increasing early curling with less ultimate curling.

The field test's premise is that most floors today are cast with ¾-inch top-sized aggregate concrete mixes, so one of the mixes will be a common ¾-inch concrete mix—with an NCA accelerator.

Test variables

Because field tests have uncontrolled variables, the relevance of this data will come from comparing the differences between mixes placed under similar conditions. The variables include:

- Comparing shrinkage differences between mixes in the first 30 days
- Comparing differences in curling between mixes in the first 30 days
- Measuring the amount of curling and shrinkage at intervals until two years after placement
- Determining shrinkage and curling differences between calcium chloride and NCA slabs
- Plotting internal stresses for each mix to determine whether some mixes can resist shrinkage more than others
- Measuring the effect that polycarboxylate superplasticizers (with less total water in the mix but the same placing slump) has on shrinkage and curling
- Measuring the effect that higher and lower loadings of macro fibers have on shrinkage and curling
- Plotting the time to reach a defined relative humidity with different finishes: bead blasted, bull floated, medium trowel, and hard trowel
- Plotting the time for different mixes to reach a defined relative humidity

Future progress

Measurements will be taken at the time of placement and every three months for two years. As the information becomes available, CC will report the results and the implications. **CC**

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