



Extending the season with

# Winter work

New techniques and proven tips on how to weather the cold and get more success out of the construction season

Photography: CRREL

## New studies show how to extend concrete pouring opportunities, but old tips still apply

BY CINDY GRAHL | EDITOR

The cold weather last winter may have bothered those who pour concrete for a living, but it was a boon to those who study how to assure a longer pour season. One of these researchers is the U.S. Army Corps of Engineers R&D Center. The center has been carrying out a series of five field studies in its Hanover, NH, Cold Regions Research and Engineering

Lab on admixtures that will extend the concrete pouring season beyond its current 40°F limits without having to build a heated enclosure around the pour site. The study attempted to develop tools to design a mix and place and cure concrete at below freezing temperatures, with test sites including an entrance drive and a bridge.

### Hope from current admixtures

Two readily available admixture ingredients can be used to work the magic, according to

CRREL principal investigator Charles Korhonen. These do two things: they lower the freezing point of the concrete, as antifreeze does to water in a car radiator, and they force the concrete to gain strength faster than usual by accelerating hydration. They also lower the cost of cold weather concrete construction by about a third.

Korhonen says that the internal temperature of the concrete would be at about -5°C and that it would gain strength at about +10°C. Results of the study's Phase One,

U.S. Army research in New England is discovering new ways to extend the concrete pouring season for roads, using easily available admixtures, with a finished product that seems to stand up very well. The next phase of the study will look at freeze-thaw and test the durability of the concrete.

which was just completed, should be published by the end of 2003 or early in 2004, with Phase Two commencing immediately. According to Korhonen, this phase will study the durability of the low-temp concrete and the need for air entrainment. "Phase One did show some results that make us very hopeful about durability," he says, "but we want to look at more freeze-thaw testing," as well as the geometry and thickness of the pours. Phase Two is expected to take about two years.

The concrete, Korhonen notes, would be mixed at about 10°C, using cold rather than hot water to slow slump loss and keep the concrete more workable. "Our concrete looks like normal concrete," he says; air entrainment products can still be used with it. "It should do away with tenting and

heater pollutants, and it should extend the season from two to four months." This means road builders can take advantage of the reduced traffic in winter to do their work, minimizing traffic congestion, and contractors can make greater use of construction equipment and manpower. The best thing, Korhonen says, is that the admixtures are available now.

The study was a pooled fund project of the Federal Highway Administration with several state DOT's participating. The Ohio DOT has expressed an interest in Phase Two, and nine states are kicking in so far.

Other CRREL research is showing development of a new roadbed material that uses a geosynthetic barrier to soak water away from the soil as a way to prevent the damage of the freeze/thaw cycle. The high-tech approach is a blanket-like drain material that channels moisture from above to roadside ditches, prevents moisture from below from migrating upwards and keeps the soil from intruding into the product. A commercially viable product is expected within three years.

#### What Cleveland tests showed

Closer to home, other lab and field tests of winter concrete work began last January in Cleveland, according to Tony Filipovic of Chas. E. Phipps. It is sponsored by the Concrete Foundation Association (CFA) and was done at both the Master Builders facility here in Cleveland and at Osborne County Concrete in Medina. The CFA's technical director, Jim Baty, says the tests were extensive and aggressive, analyzing 36 different mixes set into both 650 cylinders and full-scale 8 ft. walls in subzero weather by studying the compressive strength of the finished product. The goal was to determine how the various mix recommendations performed and validate maturity predictions made by computers. According to Baty, American Concrete Institute standards restricted contractors from concrete work be-



low certain temperatures, and the tests were to determine how realistic these standards were. "We had extremely satisfactory results," says Baty. "All mixes performed as predicted with maturity systems. The empirical results refuted the necessity for extra precautions."

Baty adds that former thought indicated that the most important criterion was the air temperature when the concrete was poured, but the tests showed that good results could be obtained when components were above 60°F when delivered to forms. Capping walls also helps keep the internal temperatures of the pour higher. "Keeping the concrete in a given range, even into the teens with certain mixes, is the key," he says. Mix design was fairly standard, he notes, with calcium, midrange water reducers and a proprietary Master Builders accelerant some of the admixtures used and from 5 to 6.5 sacks per cubic yard. Extending the concrete season, he says, has strong economic impact in a variety of areas. Codes and inspection must take into account the reality of how concrete performs.

Baty adds that "cold weather concreting is definitely possible throughout the winter, but there are some protective measures that the contractor must take to ensure the quality and strength of the concrete." He suggests one resource, the CFA's "Cold Weather Guidelines for Plain Unreinforced Concrete Walls & Footings" for those pouring foundations, with ordering information

## Protecting equipment

**D**ennis Hobart, at Midwest Underground, advises winter workers to pay special attention to certain things: For instance, winter demands special attention to equipment and materials; protective storage for these is a key factor. Repairs and downtime for equipment will increase and must be factored into scheduling, as must any extra work hours that will be needed. Also, pay attention to maintenance of specialized equipment; with hydraulic equipment, which uses water in its operation, take care to use special water-concentrated mixtures to avoid freezing these components.



Studies in New Hampshire examine roadway concrete poured under deep winter conditions. Here in Cleveland, concrete is also being tested using cold weather pouring, this time of foundation walls. These local studies will look at various recipes to see if they live up to computer predictions and see how the pouring season can be extended without diminishing results.

available at 866-232-9255. Look for further updates on the CFA Web site at [www.cfawall.org](http://www.cfawall.org).

### But what about now?

Until we know more about the results of the CRREL and CFA tests, here are some of the traditional recommendations from Clayton Companies LLC for pouring concrete in cold weather, which is defined as below 40°F:

1. Thaw the substrate with heat or insulation. All surrounding surfaces should have approximately the same temperature. (Make sure insulation, windbreaks and heaters are ready if needed for other steps as well.) Vented heaters will eliminate soft, dusted floors but they should be attended at all times.

2. Use hot water in the mix and heat the aggregates. Remember that adding water can increase set up time.

3. Increase the cement content in the mix or use a high early-strength concrete, and add an accelerating admixture such as calcium chloride.

4. Because concrete gains little

strength at low temperature, fresh concrete must be protected until it attains a compressive strength of about 500 psi. Provide triple insulation at corners and edges of walls and slabs. Leave forms in place as long as possible to distribute heat.

5. Do not expose surfaces to a sudden temperature drop—gradually reduce insulation or the enclosure temperature (no more than a 50°F drop in 24 hours. See [www.claytonco.com/concretepage /concrete\\_coldweather.pdf](http://www.claytonco.com/concretepage/concrete_coldweather.pdf) for more.

### Making repairs

Finally, Mike Childress of the Sika Corporation, a manufacturer of concrete repair and protection systems, offers his expertise about doing concrete repair work, many of which make sense for winter work in general. He knows how Cleveland weather can affect projects, he says, adding that “I see a lot of shortcuts in practice that end up biting the contractor later.” To avoid being bitten, he suggests the following:

1. It is very important to pre-condi-

tion all materials to be used. This can be done in a number of different ways; the most obvious way is to store the materials in a controlled environment, like a room with heat. But bridge and parking garage restoration crews don’t have this luxury. Innovative techniques here range from makeshift tents with heaters to practices as simple as putting a case of epoxy or caulk on the floorboard of the pickup with the heater on high. Making an effort here will make life much easier for the applicator, as materials are typically easier to work with when conditioned.

2. Protect the work surface from frost before, during and after the application. Frost can cause debonding issues for epoxies, coatings and sealants before application; mortars, frost or freezing water can stop the hydration process altogether. An ounce of prevention can literally save a contractor from having to come back and tear out and fix failed work later. Protect the work after it is installed with concrete blankets, tarping, tenting, etc.

3. Use clean burning fuel when heating an area. LP or natural gas burns much cleaner than kerosene and should be used to prevent bond-inhibiting films from forming. To prevent out-gassing and the associated blistering and “fish eyes” when applying coatings, heat an area prior to application, then turn the heaters off and apply the coatings as the area is cooling. Once the coating achieves its initial set, turn the heaters back on.

These timely tips can help concrete contractors keep going and make good progress doing winter work. **BXM**