

Extending the Season for Concrete Construction and Repair



TPF-5(003)

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Fresh, unprotected antifreeze concrete at 12°F.

Extending the Season for Concrete

The U.S. Army Cold Regions Research and Engineering Laboratory has developed several formulations for antifreeze concrete that allow curing in subfreezing temperatures. CRREL proposes to extend this technology to common practice in a cooperative study, supported by state departments of transportation and material suppliers.

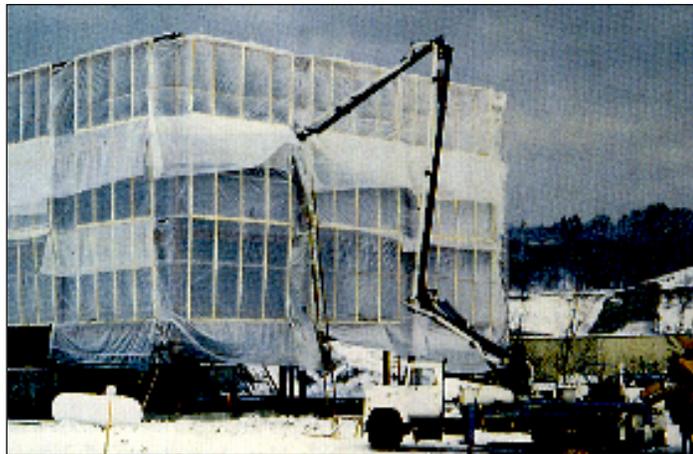
This study will result in a reliable, validated concrete mix (antifreeze concrete) that will gain sufficient strength in a timely and predictable manner at below-freezing ambient temperatures. Participants will receive the guidance and tools necessary to design and test antifreeze concrete. Compared to conventional concrete, the antifreeze concrete will be:

- Structurally comparable.
- Adequate in resistance to freezing and thawing.
- As predictable to formulate and test for quality.
- Competitive in cost.
- Able to prevent frost damage during cure.

Cold Limits Concrete Use

Next year the United States will place 136 million cubic yards of concrete for highway and street construction projects at an estimated cost of \$19 billion.* Freezing temperatures substantially diminish concrete workability, curing speed, final strength, and long-term durability. Therefore, the construction season for highway concrete ends when temperatures drop below 40°F, unless the contractor is willing to pay a substantial penalty for enclosures and heat. As a consequence:

- The construction season is compressed into the warmer months.
- The public encounters frequent inconvenience in warmer months.
- Workers and equipment are idle during colder months.

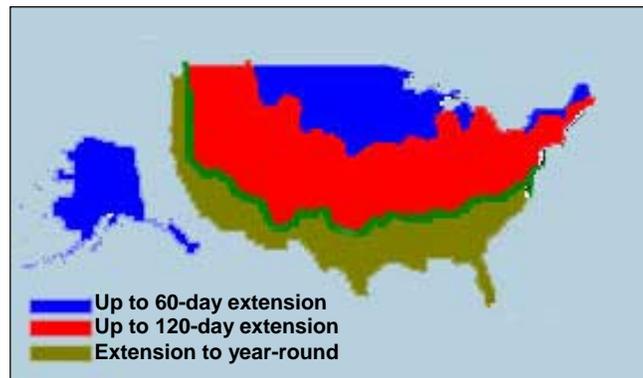


Typical heated enclosure for placing winter concrete.

The Market for Antifreeze Concrete

With the successful development of a robust antifreeze concrete technology, as proposed for this study, there is a potential market for more than 14 million cubic yards of concrete to support winter highway and street construction projects in the U.S. alone.

* *Concrete Construction*, October 1999.



Extension of the construction season using 23°F antifreeze concrete.

Why Antifreeze Concrete?

With a lower freezing limitation on curing concrete, as proposed in this study, winter would actually be a preferred time to place concrete. The advantages include lower construction costs because of:

- Elimination of heating requirements.
- Increased availability of workers and better use of capital equipment.

The resulting advantages are many:

- The concrete itself, and not just the air around it, can cool below 32°F and still develop strength at acceptable rates without frost damage.
- Antifreeze concrete can be safely placed on frozen substrates.
- The concrete can recover full strength, even when exposed to temperatures lower than designed for.
- The construction season can be extended by 60 to 120 days.
- The impact on the public is less because construction can be rescheduled across more of the year.
- There are fewer accidents in work zones because construction can be extended to low-traffic periods.
- There are direct energy savings because added heat is unnecessary.

Use Winter to Expand the Work Season

Scheduling of the 66% increase in highway work zones* during the normal construction off-season could help mitigate the expected increase in work zone accidents. Currently, accidents occur at rates of 3700 injuries and 700 fatalities annually.



Winter construction can reduce summer traffic delays.

Project Deliverables

Deliverables of the project include:

- Antifreeze-protected concrete formulations tailored to achieve specified ultimate strength, early strength, cost, and durability requirements.
- Antifreeze formulations tailored to a specific concrete mixture agreed to by the participants.
- Practical tests that identify when concrete is at a criterion strength value.
- Practical tests that demonstrate and predict the long-term performance of the concrete.
- Technical report to facilitate the implementation of the proposed new technology.

Research Assets

CRREL facilities available to the project include a wide range of testing capabilities relating to temperature performance and mechanical properties.

* *Better Roads*, September 1999.

Project Administration

A project Steering Committee, representing the participants, will review and guide the project. The principal investigator will provide regular updates to the Committee, discuss the progress made to date, and provide critical reviews of research results. Decisions will be made on a consensus basis in most cases. All financial and administrative activities of the project will be handled by the Cold Regions Research and Engineering Laboratory.



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