



COLD WEATHER GUIDELINE: REPAIR MORTARS AND NON-SHRINK GROUTS

Cold weather application of water-based cement products such as our repair mortars (the MEADOW-CRETE® line, the MEADOW-PATCH® line, MEADOW-PLUG®, SPEED-E-ROC®, SPECTRUM RE-KOTE TF, the FUTURA® line) or our non-shrink cementitious grouts (CG-86 grout series, 588-10K and 1428 HP) (also Canadian products 800 grout series, 825 PARGE-ALL, V-1, V-3) can be challenging to properly accomplish. The challenge facing the applicator of these cementitious materials (repair mortars, non-shrink grouts and concretes) in cold weather is to prevent freezing or freeze/thaw cycles in these cement-based materials before sufficient strength has been achieved. Since water begins to freeze when exposed to temperatures of 32°F (0°C) and below, this potential freezing of the mix water can cause permanent damaging effects to cement-based materials. Protection of cementitious materials from the damaging effects of freezing during curing (hardening) and until they have achieved adequate strength to withstand the forces of freezing are paramount to avoid costly jobsite issues for the contractor. These issues can appear almost immediately or months and even years later following placement.

These damaging effects will cause low strengths, poor bond, cracking, softness and loss of abrasion resistance of the repair mortar, non-shrink grout and concretes. They will primarily appear as surface scaling or loss of surface, dusting and delamination. These effects will decrease the short and long term performance and overall longevity of the cementitious material. This will also result in a higher life cycle cost to the facility or structure's owner.

WHEN SHOULD YOU BE CONCERNED ABOUT COLD WEATHER? IS IT COLD ENOUGH FOR A JACKET?

American Concrete Institute ACI 306 defines cold weather when the following conditions exist for three consecutive days:

- The average daily temperature falls below 40°F, and
- Air temperature does not rise above 50°F for more than half a day in any 24-hour period.

WHAT HAPPENS WHEN CEMENTITIOUS PRODUCTS GETS COLD?

- The water in the mix begins to freeze at 32°F.
- When water freezes, it dramatically expands as it freezes (turns into ice). This expansion causes cracks to form which shatters the internal cement structure, especially towards the exposed surfaces.
- Up to 50% permanent strength loss can occur if the cementitious material freezes before achieving 500 psi and the short and long term durability will also be severely compromised.

Damaging and lasting effects will occur if the repair mortar, non-shrink grout or concretes are exposed to multiple freeze thaw cycles in a wet environment before it achieves a minimum 3,600 psi.

- In addition to low strengths, this can cause poor bond, cracking, softness and loss of abrasion resistance along with surface scaling or loss of surface, dusting and delamination.



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New Concrete Exposed to the Damaging Effects of Mild Freezing at an Early Age

- Cold weather will also dramatically slow the rate of set. For every 10°F difference from 75°F, set time will increase by 33% of the initial value. Meaning, if the set time is 6 hours at 75°F, at 45°F the set time will be over 14 hours, more than double the initial set time.
- Strength gain will also be dramatically slowed. The compressive strength development will be delayed up to 60% in cold temperatures. Meaning, if the designed strength is 5,000 psi at 7 days at 75°F, then in cold weather, unprotected, the compressive strength at 7 days could be as low as 2,000 psi.
- Repair mortars, non-shrink grouts and concretes will stop curing and no additional strength gain will occur at or below 32°F product temperature.

- Polymer-Modified cementitious materials (MEADOW-CRETE GPS, MEADOW-PATCH T1 & T2 and SPECTRUM RE-KOTE materials modified with ACRY-LOK and INTRALOK) have a minimum application and material temperature requirement of 45°F. The polymer-modified cementitious material must be maintained above the minimum application temperature of 45°F for 48 hours or the polymer will not function (dry). This will cause the polymer to lose all performance. Once the polymer is exposed to cold temperature, below the manufacturer's minimum, the damaging effects to the polymer in the fresh material cannot be reversed, causing permanent short and long term performance issues.

HOW TO ADDRESS AND AVOID POTENTIAL COSTLY DAMAGING JOBSITE ISSUES?

- Protect from freezing by use of insulated or electric curing blankets, external heating or other suitable method for up to 48 hours after application. Cementitious materials exposed to the exhaust fumes by gas heaters may carbonate (form a dusty, soft layer on the surface). Follow all the recommendations of the gas heater manufacturer for proper use and ventilation procedures.
- The cementitious material must be protected from freezing at an early age, for up to 48 hours and until it achieves a compressive strength of at least 500 psi.



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- A cementitious material that is saturated with water should not be exposed to cycles of freezing and thawing until it achieves a compressive strength of at least 3,600 psi.
- Do not apply to frost covered concrete or sub-base. Bring the existing concrete or sub-base to above freezing with insulated or electric curing blankets, external heating or other suitable method prior to the application of the cement mortar or concrete.

REFERENCES:

ACI Committee 306, "Cold Weather Concreting" (ACI 306R) American Concrete Institute, Farmington Hills, MI

ACI Committee 201, "Guide for Conducting a Visual Inspection of Concrete in Service" (ACI 201R) American Concrete Institute, Farmington Hills, MI

NRMCA Publication #27, "CIP 27 – Cold Weather Concreting", National Ready Mixed Concrete Association, Silver Spring, MD



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