CEMSTONE®

COLD WEATHER CONCRETE PROTECTION PLAN

800-CEMSTONE | CEMSTONE.COM

10 COLD WEATHER TIPS FOR STRUCTURAL CONCRETE

01 Properly air-entrained exterior structural concrete should not be subjected to multiple freezing and thawing cycles in a saturated condition before developing a **COMPRESSIVE STRENGTH OF 3,500 psi.** If surface defects are a concern, a compressive strength of 4,500 psi needs to be achieved.

02 **FROZEN SUBGRADE** can cause the concrete to freeze as well as cause finishing and durability issues. The subgrade should be free of snow and ice and have a temperature no greater than 20°F cooler than the concrete being placed.

03 **MINIMIZE RAPID TEMPERATURE CHANGES,** particularly before the concrete has developed sufficient strength to withstand thermal stresses, which can cause cracking. Gradually remove insulation and other protection methods so that the concrete surface temperature decreases no more than 50°F for concrete 12" or less in thickness in a 24 hour period.

04 The use of **HIGH EARLY STRENGTH CONCRETE OR ACCELERATING CHEMICAL ADMIXTURES** is recommended during cooler temperatures to increase the speed of hydration and mitigate free water within the concrete from freezing. Avoid using calcium chloride as an accelerator if the concrete contains steel reinforcement. Accelerating admixtures must not be used as a substitute for proper curing and frost protection.

05 **TEST CYLINDERS** for normal strength concrete must be cured at an initial curing temperature of 60 to 80°F. Cure boxes, blankets or other curing methods must be used in order to comply with ASTM specifications. ASTM C31 also requires that cylinders must be initially cured in an environment free of evaporation and be stored for no longer than 48 hours prior to being taken to the laboratory for final curing and testing.

06 To keep your project on schedule, consider using **CONCRETE MATURITY** to determine the in-place concrete strength in lieu of field cure cylinders. Concrete maturity is the relationship between concrete temperature, time, and strength gain. It is measured through the use of in-place sensors.

07 **DO NOT USE UNVENTED HEATERS.** Carbon dioxide from unvented fossil fuel heaters can cause carbonation of the concrete. Carbonation can result in craze cracking and a soft, chalky surface that will dust under traffic.

08 Allow ample time for **BLEED WATER** to dissipate before concrete finishing. Trapping or finishing bleed water into the concrete can cause higher water-cementitious materials ratios at the surface and may lead to scaling and/or blistering.

09 **PROPER CURING** procedures must be followed immediately after finishing is completed. This includes maintaining proper moisture and temperature conditions.

10 **MONITOR CONCRETE TEMPERATURES** at concrete corners and edges. They are vulnerable to freezing as temperatures are usually more difficult to maintain in these locations.

WHY YOU NEED A COLD WEATHER PLAN

The American Concrete Institute (ACI) 306R-16, “Guide to Cold Weather Concreting” states that cold weather concreting exists when the air temperature has fallen to or is expected to **fall below 40ºF** during the protection period. This document also defines the protection period as the amount of time recommended to **prevent concrete from being adversely affected by exposure to cold weather** during construction.

The objectives of a cold weather protection plan are to:

- Prevent damage to concrete due to early-age freezing. Concrete can withstand a **single cycle** of freezing when it has obtained a compressive strength of **500 psi** in a dry condition. At 50°F, most well-proportioned concrete mixtures reach this strength within **48 hours.**
- Ensure that the concrete develops the required strength for safe removal of formwork and for safe loading of the structure.
- Maintain curing conditions without using water curing. During cold weather, water curing may reduce the resistance to freezing and thawing when protection is removed.
- Limit rapid temperature changes, particularly before the concrete has developed sufficient strength to withstand induced thermal stresses. Rapid cooling of concrete surfaces or large temperature differences between the exterior and interior can cause cracking and reduce the strength or durability of the concrete member.
- Provide protection consistent with the durability of the structure during its design life. Surfaces and corners must be protected from freezing, dehydration, and cracking from overheating due to inadequate protection, improper curing, or careless workmanship.

For more information on cold weather concreting practices, a copy of ACI 306R-16 is available for purchase at **concrete.org**. If you have questions or concerns about a mix design for your project, coarse aggregate selection or admixture packages, please contact your Cemstone Account Representative.

DEVELOPING A COLD WEATHER CONCRETING PLAN FOR STRUCTURAL CONCRETE

A cold weather plan is a team effort between Cemstone and our customer. We each have responsibilities for executing the plan. Below are some items to consider in the plan.

- All formwork and subgrade should be free and clear of snow and ice. The temperature difference of the subgrade and fresh concrete should not be greater than 20°F.
- When temperatures are below 10°F, metallic embeds should be warmed prior to placement. Embeds with a cross-section 4 in^2 or greater should be warmed to at least 32°F. A heated enclosure or insulated concrete curing blankets may need to be used before the concrete is placed.
- The air temperature on the placement day must be determined. Table 1 below provides recommended concrete temperatures, based on the air temperature and member size

TABLE 1: RECOMMENDED CONCRETE TEMPERATURES

		Section size, minimum dimension	
		<12"	12 to 36"
Line	**Air temperature**	**Minimum concrete temperature as placed and maintained**	
1	—	55°F	50°F
Line	**Air temperature**	**Minimum concrete temperature as mixed for the indicated air temperature***	
2	Above 30°F	60°F	55°F
3	0 to 30°F	65°F	60°F
4	Below 0°F	70°F	65°F
Line	**Air temperature**	**Maximum allowable gradual temperature drop in first 24 hours after end of protection**	
5	-	50°F	40°F

*The contractor is responsible for informing Cemstone dispatch if higher concrete delivery temperatures are needed. Additional costs may apply. For colder weather, a greater margin in temperature is provided between concrete as mixed and required minimum temperature of fresh concrete in place.

Note 1: For Line 1, maximum placement temperature is minimum temperature in the table plus 20°F.
Note 2: For Lines 2-4, maximum temperature is minimum temperature in the table plus 15°F.
Note 3: For larger section sizes, consult Table 5.1 of ACI 306R-16.
Ref. Table 5.1 ACI 306R-16

- The concrete must be protected using a heated enclosure or insulating blankets. Table 2 below provides the recommended length of the protection period based on the use and exposure condition of the concrete member.
  - Heated enclosures should be waterproof and strong enough to withstand anticipated wind and snow loads.
  - Ensure corners and edges are sealed.
  - Combustion heaters should be vented to avoid exposing surfaces to carbon dioxide (CO_2). Concrete that is exposed to CO_2 early during the curing process can exhibit carbonation, crazing or dusting.
  - The concrete surface temperature should be monitored during the protection period to ensure that adequate protection is being provided.
  - Consider using concrete maturity to determine the in-situ compressive strength and to aid in removing the protection.

TABLE 2: LENGTH OF PROTECTION PERIOD FOR CONCRETE PLACED DURING COLD WEATHER

Protection period at a minimum temperature indicated in Line 1 of Table 1, days*		
Service condition	**Normal set condition**	**Accelerated set concrete**
No load, not exposed	2	1
No load, exposed	3	2
Partial load, exposed	6	4
Full load	Refer to Chapter 8 of ACI 306R-16	

RECOMMENDATIONS FOR PLACING CONCRETE IN COLD WEATHER CONDITIONS

CONCRETE MIXTURES

- The water-cementitious materials ratio (w/cm) should not exceed the recommendations within ACI 201.2R-16. All concrete that is subjected to freeze-thaw cycles while saturated in service should have a w/cm ratio no greater than 0.45.
- Use accelerating admixtures to increase the rate of hydration. Do not use calcium chloride ($CaCl_2$) accelerators or admixtures containing $CaCl_2$ for concrete with reinforcing steel as this can lead to corrosion. In addition, $CaCl_2$ admixtures can darken the concrete color.
- Accelerating admixtures are not anti-freezing agents.
- Limit the use of supplementary cementing materials (SCM's), such as fly ash and slag, when early strength development is required.

SLAB FINISHING

- It is recommended to use air-entrained concrete for saturated members that will be exposed to freeze-thaw cycles during construction, even if the member is not expected to be exposed to freeze-thaw cycles while in service.
- Avoid hard-trowel finishing air-entrained concrete greater than 3% as this can lead to surface blistering or other surface defects. Air-entrained concrete should not be specified for hard-trowel slab construction.

CURING

- Upon completion of finishing, concrete should be protected from drying, i.e. evaporation of moisture should be prevented. Subsequently, since fresh concrete is critically saturated, a drying period must occur after curing and before the concrete is exposed to freezing temperatures.
- Additional curing is generally not needed after protection is removed so long as the air temperature remains below 50°F and the relative humidity is above 40%.

Reference: American Concrete Institute (ACI) 306-16 Guide to Cold Weather Concreting.

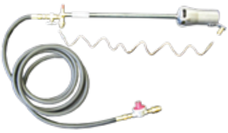
FIND COLD WEATHER PRODUCTS AT CEMSTONE SUPPLY

CEMSTONESUPPLY.COM

HEATING SOLUTIONS

Premium Winter Curing Blanket
Item# 9329832

R Series Nu-Way Torch
Item# 9329272



AC Series NU-WAY Torch
Item# 9329270

Norseman™ 250 Heater
Item# 9333540

Tradesman® 170 Ultra Heater
Item# 9367430

Tradesman 400 Ultra
Item# 9333539

6 mil Reinforced Poly Sheeting
Stocked in sizes 10, 12, 16, 20, 24, 32, 40 and 60' wide by 100' long.

COLD WEATHER PROTECTION

MaxiFlex® Ultimate™ Gloves
Size M-3XL

PowerGrab™ Thermo W Gloves
Size M-2XL

ZXT BUCKLE OVERSHOE
Size 6-17. Available at Eagan location only.

A. FULL ZIP BLACK BOTTOM RIPSTOP SOFT SHELL Size M-4XL
B. ZIP FRONT BLACK BOTTOM HOODIE Size S-5XL

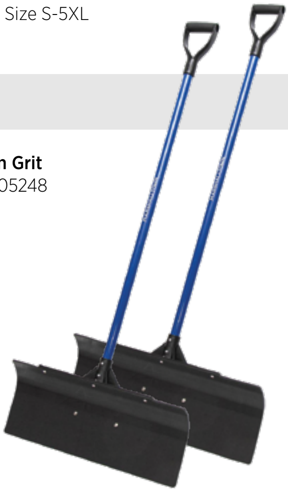
SLIP PREVENTION

Mel-Rol® LT
Item# 9344506
Mel-Rol® XLT
Item# 9380101

Tube Sand
Item# 106610

Traction Grit
Item# 105248

Chapin® Spreader
Item# 9370520



Polar Pusher Shovel
24" Item# SNOWP24
36" Item# SNOWP36

COLD WEATHER APPLICATION

Set Accelerator
Item# 120376

Concrete Patching Mix AE 3U58M
Item# 126199

Commercial DOT Repair
Item# 126173

AT-XP® Acrylic Adhesive
Item# 9372424

Concrete & Masonry Dissolver
5 gal Item# 120912
1 gal Item# 120911
28 oz Item# 121006