CONCRETE ONTARIO
Ready Mixed Concrete Association of Ontario

CONCRETE ZERO

TECHNICAL SPECIFICATION
Cold Weather Concreting

Environmental factors such as low ambient temperatures, freezing conditions, and exposure to ice or snow during cold weather significantly affect concrete properties and the processes of mixing, transporting, placing, and curing.

As per CSA A23.1, cold weather is when there is a probability of the air temperature falling below 5 °C within 24 h of placing (as forecast by the nearest official meteorological office). These conditions pose significant risks to both fresh and early-stage hardened concrete, requiring appropriate measures to ensure the structural integrity and durability of the final product.

Official weather sources can be found at the Canada Weather Website.

Preparation

A pre-concrete placement meeting should be conducted at least 30 days prior to the commencement of cold weather concrete construction. This meeting is essential for reviewing the proposed concrete mix designs and discussing the methods and procedures needed to comply with project specifications.

Concrete must be protected against cold temperatures, and preparations for cold weather concreting involve:

- Ensure materials and equipment for protection and curing are ready before placement.
- Remove all snow and ice from surfaces before placing concrete.
- Avoid using calcium chloride or de-icing salts as de-icing agents in forms.
- Do not place concrete on surfaces that would lower its temperature below the limits in Table 14.

Table 14
Permissible concrete temperatures at placing

	Temperatures, °C	
Thickness of section, m	**Minimum**	**Maximum**
< 0.3	10	32
≥ 0.3 - < 1	10	30
≥ 1 - < 2	5	25
≥ 2	5	20

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Temperature Control During Curing

During cold weather, adequate protection must be provided that will maintain the concrete temperature at a **minimum of 10 °C for the duration of the curing period** as defined by Tables 2 and 19. Protection information is as follows:

- Protection shall be provided by means of heated enclosures, coverings, insulation, or a suitable combination of these methods.
- The type and amount of insulation required depend on air temperature, wind velocity, structure size, and the amount of cementitious material in the mix.
- Corners, edges, and thin sections are most vulnerable to cold and require extra protection.
- Concrete must achieve a minimum strength of 7 MPa to withstand early frost damage effectively.

Temperature Differentials Must be Avoided

When placing slabs on ground, large temperature differentials between the ground and the concrete being placed can lead to blisters during troweling, and delamination may occur if sufficient bleed water is entrapped.

- Pre-heating the granular base and surroundings and using non-chloride accelerators can reduce or eliminate this problem.

Considerations when Removing Protection

Sudden temperature changes can lead to cracking in concrete, and care must be taken when removing thermal protection to avoid large temperature differential, maintaining temperature variations within the limits of Table 20.

Testing Cylinders Care

Special care must be taken when casting concrete cylinders during cold weather. Due to the small size of cylinders, these specimens are extremely susceptible to colder temperatures.

- According to CSA A23.1/.2, **the temperature during initial curing of cylinders must be kept between 15 °C and 25 °C.**
- This often requires heated curing boxes at the jobsite to maintain compliant cylinder temperatures during the first 24 hours.
- Field-cured cylinders are highly vulnerable to cold weather and must accurately represent the structures they reflect.
- ACI 306R-16 provides guidelines that field-cured cylinders are inappropriate during cold weather and should be replaced with in-place testing and maturity testing to assess the in-situ strength development.

Possible Consequences of not following these requirements might include:

- Delayed or incomplete strength development.
- Reduced durability and weather resistance.
- Cracking, superficial or internal, due to plastic shrinkage or thermal gradient.
- Strength test reports that do not accurately represent the in-place concrete structure.
- Increased construction delays and costs.

Table 19
Allowable curing regimes

Curing type	Name	Description
1	Basic curing	3 d at ≥ 10 °C or for the time necessary to attain 40% of the specified strength.
2	Additional curing	7 d total at ≥ 10 °C and for the time necessary to attain 70% of the specified strength.
3	Extended wet curing	A wet-curing period of 7 d at ≥ 10 °C and for the time necessary to attain 70% of the specified strength. The curing types allowed are ponding, continuous sprinkling, absorptive mat, or fabric kept continuously wet.

Sources:
1. Table 14 & 19, CSA A23.1:24/CSA A23.2:24 Concrete materials and methods of concrete construction/Test methods and standard practices for concrete. © 2024 Canadian Standards Association
2. ACI 306R-16 Guide to Cold Weather Concreting