

Cold Weather Concreting

What is Cold Weather Concreting?

Cold weather concreting refers to the placing, finishing, and curing of concrete under low temperature conditions that may adversely affect hydration, setting, strength development, and durability.

CSA A23.1:24 defines cold weather concreting when there is probability the air temperature will fall below 5°C within 24 hours of placing.

Why Consider Cold Weather?

Successful cold weather concreting requires an understanding of the various factors that affect concrete properties.

In its fresh state, concrete freezes if its temperature falls below -4°C. If plastic concrete freezes, its potential strength can be reduced by more than 50% and its durability will be adversely affected. Concrete should be protected from freezing until it attains a minimum compressive strength of 3.5 MPa.

Low concrete temperature has a major effect on the rate of cement hydration, which results in slower setting and rate of strength gain. A good rule of thumb is that a drop in concrete temperature by 10°C will approximately double the setting time. The slower rate of setting and strength gain should be accounted for when scheduling construction operations, such as form removal.

What Precautions Should You Take?

CSA A23.1 requires that specific precautions be implemented when concrete is placed under cold weather conditions to prevent early age freezing and to ensure adequate strength development. The primary objective is to maintain the concrete temperature above the minimum values specified in the standard from the time of placement through the early curing period.

CSA A23.1:24, requires adequate protection of the concrete shall be provided that will maintain the concrete temperature at a minimum of 10°C during the curing duration. Therefore, in cold weather some provision must be in place to ensure that this objective is met.

Before placement, materials should be protected from freezing and excessive cooling. This may include heating mixing water, aggregates, or both, while avoiding temperatures that could cause flash set or excessive evaporation. Formwork, reinforcement, and the subgrade should be free of ice and snow, and should be at a temperature that will not excessively cool the fresh concrete.

During placement and finishing, CSA A23.1 recommends minimizing heat loss by using insulated forms, windbreaks, and temporary enclosures where required. Concrete temperature at discharge should meet the minimum limits specified in the standard, based on member size and exposure conditions.

After placement, concrete must be protected and cured so that it does not freeze before reaching sufficient strength. This typically involves the use of insulated blankets, heated enclosures, or a combination of both. CSA A23.1 also requires that protection be maintained until the concrete has achieved the minimum strength necessary to resist freezing and to support subsequent construction activities.

Cold Weather Guidelines?

1. Use air-entrained concrete when exposure to moisture and freezing and thawing conditions are expected.
2. Keep surfaces in contact with concrete free of ice and snow and at a temperature above freezing prior to placement.
3. Place and maintain concrete at the recommended temperature.
4. Place concrete at the lowest practical slump.
5. Protect plastic concrete from freezing or drying.
6. Protect concrete from early-age freezing and thawing cycles until it has attained adequate strength.
7. Limit rapid temperature changes when protective measures are removed.

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Three Rules to Consider:

1. Keep concrete warm. Protect materials before, during, and after placement using heated water, insulation, or enclosures.
2. Control setting and strength. Account for slower hydration, use air-entrainment for freeze-thaw durability, and prevent early freezing.
3. Plan and coordinate. Schedule operations carefully, maintain temperatures during curing, and gradually remove protection to avoid thermal shock.

References

1. CSA A23.1 A23.2 2024. *Concrete materials and methods of concrete construction Test methods and standard practices for concrete.* CSA Group
2. *Design and Control of Concrete Mixtures. 9th Edition.* Cement Association of Canada

Disclaimer

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