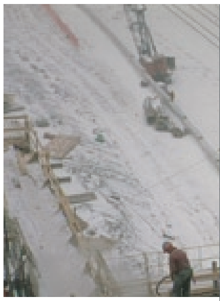
TECHNICAL SPECIFICATIONS



Cold Weather Concreting

RMCAO

THE Power of Concrete

Weather conditions can have a dramatic effect on both the setting time and concrete placing, finishing and protection systems that must be followed for proper concrete placement. Cold weather concreting conditions are typically defined as:

- When the air temperature is ≤ 5°C.
- Or when there is a probability that the temperature may fall below 5°C within 24 hours of placing the concrete.

Because the hydration process is a chemical reaction it is strongly affected by ambient air and subgrade/formwork temperatures. At low temperatures concrete gains strength and sets very slowly and must be adequately protected from freezing and thawing. Concrete that is allowed to freeze while in its plastic state can have its potential strength reduced by more than 50% and its durability properties will be dramatically reduced. Concrete must achieve at least 3.5 MPa before it is frozen and should obtain at least 20 MPa before it is exposed to multiple freeze/thaw cycles.

General procedures for cold weather concreting include:

- Removing all ice and snow from the subgrade or formwork.
- Supplying the necessary supplemental heat required to ensure that forms, subgrades, and reinforcing steel is maintained a minimum temperature of 5°C well prior to the concrete placement.
- Ordering concrete with a temperature between 10°C – 25°C.

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- Concrete should be ordered using the lowest practical water slump since this will reduce bleeding and setting times. Chemical admixture can still be used to improve the workability of the concrete.
- Chemical admixtures and mix design modifications can be used to offset the slower setting times and strength gain of concrete during cold weather conditions. Considerations should be given to ordering concrete that will obtain higher early strengths.
- Concrete temperature must be maintained at a minimum of 10°C for the full curing period.
- The surface of the concrete should not be allowed to dry out while it is still plastic since this may cause plastic shrinkage cracking. The longer set times encountered during cold weather combined with the effects of hot dry air from heaters being blown along the top surface of the concrete significantly increase this risk.
- Wet curing methods are typically not recommended during cold weather conditions since the concrete will not have a sufficient time period to air dry before the first freeze/thaw cycle.
- The possibility of thermal cracking must be considered when the heating supplied during the curing period is going to be suspended. Concrete should not be allowed to cool at a rate outside the limits listed in CSA A23.1 Table 21.

CSA A23.1 – TABLE 21

Maximum permissible temperature differential between concrete surface and ambient (wind up to 25km/h)

(see Clauses 7.4.2.3 and 7.4.2.5.3.4)

	Maximum permissible temperature differential, °C				
	Length to height ratio of structural elements*				
Thickness of concrete, m	0†	3	5	7	20 or more
< 0.3	29	22	19	17	12
0.6	22	18	16	15	12
0.9	18	16	15	14	12
1.2	17	15	14	13	12
> 1.5	16	14	13	13	12

** Length shall be the longer restrained dimension and the height shall be considered the unrestrained dimension.*
† Very high, narrow structural elements such as columns.

Special care should be taken with concrete test specimens used for the acceptance of the concrete. The initial test specimens shall be stored in a controlled environment that maintains the temperature at 20 ± 5°C as per CSA A23.1/.2 requirements.

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Caution regarding the use of portable gas fired heaters:

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Plastic concrete exposed to a carbon dioxide source (CO_2) during the concrete placing, finishing and curing period will develop a soft, chalky, carbonated surface (known as dusting). Carbon Dioxide is an odourless and colourless gas that is heavier than air and is produced by all forms of combustion. Typical sources include: open flame heaters (stacks must be vented to outside), and internal combustion engines (e.g. on trucks, power trowels, concrete buggies, etc.). Precautions **must** therefore be taken to properly vent the placement area.

References:

1 CSA A23.1-04 – Concrete Materials and Methods of Concrete Construction, Canadian Standards Association International
2 Ontario Building Code – 1997, Ontario Ministry of Municipal Affairs and Housing – Housing Development and Buildings Branch
3 Design and Control of Concrete Mixtures – 7th Canadian Edition, Cement Association of Canada
4 Concrete in Practice #27 – Cold Weather Concreting, National Ready Mixed Concrete Association

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