Curing Concrete

CONCRETE ONTARIO
Ready Mixed Concrete Association of Ontario

Curing is defined as **"maintenance of a satisfactory moisture content and temperature in the concrete for a period of time immediately following placing and finishing so that the desired properties may develop."** Early curing is critical when the concrete will be exposed to harsh Canadian weather conditions since it dramatically affects the permeability and durability of the concrete. In some instances, curing must be initiated even before the finishing operations are complete to provide the necessary concrete properties.

Since the strength and durability properties of concrete are set by the chemical reactions of the various components during the hydration process, there are three key factors to proper curing.

- **Moisture** – Having sufficient moisture to ensure the hydration process continues.
- **Temperature** – Maintaining a sufficient temperature (≥10°C) to ensure that the chemical reaction continues.
- **Time** – Maintaining both the moisture and temperature requirements for a minimum period of time (3 – 7 days – See CSA A23.1 – Table 19) to ensure that the durability properties fully develop. Curing needs to be initiated as soon as the finishing operations are complete, and the surface will not be damaged by the curing operation.

General Notes Regarding Concrete Curing:

1. Alternating cycles of wetting and drying during the curing process is extremely harmful to the concrete surface and may result in surface crazing and cracking. **This should be avoided at all costs.**
2. A 28-day air drying period is recommended immediately following the curing period to provide the necessary freeze/thaw resistance for the concrete. Curing methods that result in fully saturated concrete, which will be exposed to freeze/thaw cycles once the curing period is over, may result in premature deterioration of the concrete (even if the concrete is properly air entrained).
3. Concrete with low W/CM ratios (≤ 0.40) may not have sufficient free moisture in the mix to allow for the use of **"moisture loss prevention"** curing methods. This situation should be reviewed prior to the start of the project.

Curing of concrete can be completed by two basic methods:

- Preventing the loss of moisture from the concrete
- Keeping the exposed surface continuously wet

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Possible curing methods are outlined in the following table:

Moisture Loss Prevention	Supplying Supplemental Moisture
Curing Compounds • Form a membrane over the top surface of the concrete preventing moisture loss • Must be applied at the manufacturer's suggested application rate • Should be applied in two applications with the second being at right angles to the first to ensure uniform coverage • Should be applied as soon as the concrete surface is finished and when there is no free water on the surface • Curing compounds can affect the "bond" of some floor coverings • Confirm that this curing method is suitable for the final floor covering application	**Water Ponding** • Water curing should start without causing damage to the slab immediately after finishing • Flooding of the concrete surface to provide both moisture and a uniform curing temperature • Curing water should not be more than 12°C cooler than the concrete temperature to avoid the possibility of thermal cracking • The water must cover the entire concrete surface
	Water Sprinkling • Spraying water over the concrete surface. The entire concrete surface must be wet for this method to be effective • The concrete surface must have sufficient strength to avoid damaging the surface • Excess water will run off the concrete and must be drained away • This protection method can be adversely affected by high winds which prevent proper curing on the "upwind" side
Plastic Sheeting • Ensure that the plastic sheeting covers 100% of the concrete surface and that it is adequately sealed at the edges to prevent moisture loss • Select the appropriate colour (white, black, or clear) of the plastic based upon the ambient air conditions • If uniform colour is a requirement for the project, ensure that the plastic is not placed directly on the concrete surface • Ensure that plastic sheeting is not damaged by subsequent construction activities and stays in place during the curing period	**Wet Burlap** • Pre-soaked burlap is applied to the concrete surface and is covered with plastic to prevent moisture loss or water is reapplied as necessary to prevent the material from drying out • Burlap should be rinsed prior to its first use to avoid possible staining • Materials utilizing both geotextile fabric and plastic top coatings can be reused throughout the project
Leaving Formwork In Place • This system is most effective for vertical elements (walls, columns, beams, etc). Care must be taken to also protect the top surface of the concrete appropriately • "Breaking" or "Releasing" the formwork dramatically reduces the effectiveness of this curing method since air flow is now possible between the concrete and the formwork • If uniform colour is an issue, then a uniform curing time and temperature must also be maintained and form removal scheduled accordingly	**Wet Sand** • Wet loose material such as sand can be used to cure concrete slabs and footings • The sand thickness must be sufficient to prevent moisture loss at the concrete surface or the sand must be wetted throughout the curing period

CSA A23.1:19 TABLE 19

Allowable curing regimes

(see Clause 4.1.1.1.1, 7.1.2.2, 7.8.1, 7.8.2.1, 7.9.9, and Table 2)

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.

** When using silica fume concrete, additional curing procedures shall be used. See Annex I, Clause 1.3.13.*

Notes:

(1) *Curing of plant production of precast concrete shall be as set out in CSA A23.4.*

(2) *It is recommended that concrete be allowed to air-dry for a period of at least one month after the end of the curing period, before exposure to de-icing chemicals.*

(3) *The rate of compressive strength gain in concrete is significantly reduced below 10 °C.*

Sources:

1 Table 19, **CSA A23.1:19/CSA A23.2:19 Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.** © 2019 Canadian Standards Association

2 Ontario Building Code – 2012, Ontario Ministry of Municipal Affairs and Housing – Housing Development and Buildings Branch

3 RMCAO Concrete Digest, Second Edition

4 Concrete in Practice #11 – Curing In-Place Concrete, National Ready Mixed Concrete Association

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