



Ten Steps to Durable Exterior Flatwork



Exterior concrete flatwork is both beautiful and durable when it is properly placed, finished and protected. In order to ensure that your project is a complete success we strongly suggest you follow these ten steps:

1. Use the right concrete.

The Ontario Building Code requires that all exterior concrete shall have a minimum 28-day compressive strength of **32 MPa** and a maximum water/cementing materials ratio (W/CM) of 0.45 (C-2 Concrete as per CSA A23.1) and 5-8% air for freeze-thaw durability. **25 MPa concrete should never be used!** Concrete should only be ordered from an RMCAO member company.

2. Use the right contractor.

Use a contractor who has been trained to an industry certification program such as ACI Concrete Flatwork Finisher/Technician (or similar). Ask for past examples of their work and references. Call the references and visit projects that have gone through at least two winters.

3. Avoid placing concrete late in the season.

The concrete must have sufficient time to both cure properly (28 days) and to dry out (additional 28 days) before being exposed to freeze-thaw cycles. Early in its life, concrete contains excess moisture in order to provide the contractor with the slump necessary to place the material. If the concrete is allowed to freeze when this excess moisture is still present, the effects of air entrainment are dramatically reduced due to the fact that the concrete is completely saturated with water. Because of this, concrete placements from October on should be considered very carefully or avoided.



Photo courtesy of CAC

4. Avoid placing in hot or cold temperature extremes.

Concrete placed in hot weather and low humidity conditions can dry prematurely at the surface adding to finishing problems. Cold weather can also greatly reduce durability if the concrete is not placed, finished, protected and cured properly.

5. Ensure that the subgrade is properly prepared.

The subgrade must be properly graded and compacted in order to provide uniform support to the concrete slab. Subgrade settlement after concrete placement will lead to uncontrolled cracking.

6. Do not finish the concrete while the bleed water is still present.

This creates two significant problems. First, the excess water is physically worked back into the concrete paste on the surface dramatically increasing the W/CM and decreasing the concrete's strength and durability. Secondly, this action tends to seal the surface of the concrete causing all of the remaining bleed water to be trapped a few millimeters below the concrete surface. Once the concrete is exposed to its first winter, scaling will occur in this weak layer.

7. Do not overfinish or overwork the concrete surface.

Repeated troweling or finishing operations continue to bring additional cement paste to the surface, which weakens it. This paste layer then scales or mortar flakes very easily. The best procedure for all exposed concrete is to strike-off the surface, bullfloat the concrete before the bleed water appears and apply a broom texture to the surface once the concrete has gained sufficient stiffness. The use of **power trowels is not recommended** for exterior flatwork. If further finishing is performed (not recommended) ensure that a magnesium float is used on all air-entrained concrete! Steel trowels should never be used on exterior concrete.



Photo courtesy of CAC

9. Cure the concrete immediately after finishing.

Proper concrete curing addresses many defects that can be found in slab-on-grade concrete construction. Curing is required for a minimum of 7 days (as per CSA A23.1) on exposed concrete. Be sure that the curing compound is not watered down and that care is taken to apply the correct amount. **This is the most commonly overlooked part of the finishing process.** *The only caution regarding curing relates to work that is completed late in the fall since care must be taken to avoid having a fully saturated concrete when freezing can occur.*



Photo courtesy of CAC

8. Install proper control joints to prevent uncontrolled cracking.

All joints should be cut or formed to at least one-quarter ($\frac{1}{4}$) of the slab thickness. Layout the locations of all control joints before the concrete placement starts! This advanced planning will ensure that there is no confusion when it is time to install the control joints and it may also indicate that the slab size should be modified in order to optimize the joint layout. Ensure that you avoid "T-Joints" and "re-entrant corners" at all times. The spacing between joints should be between 24 to 36 times the slab thickness and should be $\frac{1}{4}$ depth minimum. Sawcutting should be completed **as soon as the concrete can be cut** (4 to 12h) without causing raveling.

10. Did We Mention Curing?

This point can not be overstated. All concrete must be properly cured in order to develop the necessary durability properties required to resist Canadian weather conditions. Owners may also wish to consider the use of concrete sealers to prevent the ingress of chlorides, oils and water into the concrete. These materials, when properly applied, can significantly lengthen the life of exterior concrete.

References:

- 1 CSA A23.1-09 – Concrete Materials and Methods of Concrete Construction, Canadian Standards Association International
- 2 Design and Control of Concrete Mixtures – 7th Canadian Edition, Cement Association of Canada
- 3 Doing Driveways Right the First Time, Concrete Construction, July 1998
- 4 De-icers and Concrete Scaling, Concrete Construction, November, 1965

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