

# **FREEZE-THAW CONCRETE POP-OUTS (PHYSICAL)**

## **Introduction**

Concrete is a mixture of natural sand and stone that is glued together with portland cement, supplementary cementitious materials, water, and admixtures. You can expect some variations in surface and performance because concrete is mostly made of natural materials. Concrete can provide long-term durability and value when you use quality materials, and place, cure and maintain it properly. This document addresses a specific concrete issue and provides guidance on how to prevent it.

## **What is a pop-out?**

Many aggregate sources with high-quality sand and rocks that are used for concrete include bits of softer, porous material like shale, iron oxides, unsound chert, and more. It is practically impossible to remove every undesirable particle in the aggregates.

When these particles absorb water and freeze, they can fracture, separate from the concrete, and “pop-out.” In a pop-out; either the mortar, the particle or both may consequently fracture.

## **Is my concrete OK?**

Yes. Pop-outs do not harm the concrete structurally or shorten its life. The processes that cause pop-outs only affect the surface, not beneath it, and only in the few areas where the particles are located. After one or two winters, pop-outs rarely appear again.

In fact, the following agencies all recognize that pop-outs are naturally occurring, and allow some deleterious particles, causing pop-outs, to be acceptable in the final concrete product (see Table 1 and Table 2 at the end of this article):

- American Society for Testing and Materials (ASTM)
- American Concrete Institute (ACI)
- Minnesota Department of Transportation (MnDOT)
- Local Building Codes

## **What can be done to minimize pop-outs?**

- Define your expectations about pop-outs with your contractor or concrete producer and how to minimize the number of them. Higher-grade aggregates are available from the concrete producer, but they might be more expensive and have other issues, so make sure they’re right for your project.
- Properly cure the concrete to ensure it has enough surface strength, and then seal the concrete to protect it from moisture and deicing chemicals.

## Can a pop-out be patched?

Yes. A small patch can be made by filling the void with dry-pack mortar, epoxy mortar, or other appropriate patch material. However, patches can be a different color than the surrounding concrete. After patching, a pigmented sealer may even out color variations. Consult with your contractor and concrete producer to determine if patching is right for your project.

## Limits for deleterious particles in aggregate for concrete

**TABLE 1. COARSE AGGREGATE**

Coarse Particles	ASTM C33-03 CLASS 4S* (Max Limits) (Good)	MnDOT #3137 2.D.1 (Max Limits) (Better)	MnDOT #3137 2.D.2 (Max Limits) (Best)
Total Spall (MnDOT)	5% *	1%	0.5%
Potential density of pop outs per sq.yd. with maximum deleterious limits**	20-30	15-20	5-10

## FINE AGGREGATE

FINE PARTICLES	ASTM C33-03 (Max Limits)	MnDOT #3126 General Use (Max Limits)
Clay lumps&friable particles	3%	N/A
Coal and lignite	0.5% (for exposed concrete)	0.3%
Other deleterious substances (shale, mica, soft & flaky particles)	N/A	2.5%

\*For ASTM C33 Class 3S aggregates the maximum limit for sum of Clay Lumps, Friable Particles, and Chert (includes shales) is higher (7%) and for 1S and 2S class aggregates there is no limit for the sum. So, more pop outs can be expected for these Classes.

\*\*Due to unusual circumstances or weather conditions during placing, finishing, or curing, the number of pop outs may vary from those predicted at right

For more information, call your local concrete contractor, ready mix producer or

[www.chooseconcrete.com](http://www.chooseconcrete.com).

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