

ARM of Minnesota

POPOUTS

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12300 Dupont Avenue South
Burnsville, MN 55337

Phone: 952-707-1250

Fax: 952-707-1251

E-mail: mmills@armofmn.com

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AGGREGATE & READY MIX
ASSOCIATION OF MINNESOTA

POPOUTS

Popouts are surficial defects which occur in concrete, characterized by a conical failure with an aggregate at the base, while leaving the remainder of the paste in tact. It is not a failure of the paste, but rather the properties of the aggregate that can lead to this occurrence.

Most of the gravels found in Minnesota were deposited during the last period of glaciation.

These materials contain a mixture of rock types from our north and west, which is the rough direction of the glaciers which covered Minnesota some 10,00 to 15,000 years ago.

These materials are for the most part, more than 98% of the particles, hard and durable with respect to freezing and thawing. There are some particles, for examples some limestones, cherts, shales, which are not. These are present in trace quantities in almost all glacial aggregates. Their presence ranges from approximately 0% to approximately 2% of the particles.

As a result, some of the particles contained in concrete are not durable with respect to freezing and thawing. The stresses developed within the aggregate itself by the freezing of water contained in the spaces inside the rock cause it to expand, fracturing the surrounding concrete and resulting in a popout.

The quality of aggregate in Minnesota is set often by the Mn/DOT Specification for coarse aggregate for use in concrete pavements, or the American Society for Testing and Materials C33 specification for concrete coarse aggregate. Both these documents recognize the economic impossibility of removing all of this popout-causing material. For example, ASTM C33 Class 5, Architectural Concrete, Class S Severe Weather Exposure which exposes all of Minnesota, still allows a fraction of the aggregate to contain particles which are not freeze/thaw durable. Similarly, Mn/DOT Specification 3137 allows the same.

When using materials conforming to ASTM C33, it is not uncommon to see dozens of popouts per square yard.

Using Mn/DOT 3137 Aggregate reduces the number of offensive particles, however several popouts per square yard can still be anticipated.

We have all seen concretes that do not contain popouts. This is because during the production of aggregates, the maximum limit is set. In some locations in gravel pits, where the aggregate was deposited by standing or moving water, some sorting may take place, and as a result, there may be very few popout-causing particles in some areas of the pit. Similarly, the freeze/thaw exposure may be different in different areas.

Popouts are a normal part of concrete manufactured with gravel and used in exterior flatwork in Minnesota.

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