RE: Concrete Surface Degradation

To whom it may concern,

There have been reports of concrete applications in the Midwest region (South Dakota, Iowa and Minnesota) with surface degradation. The purpose of this letter is an effort to understand and explain the variables that may have an affect on concrete surfaces.

The Midwest region experienced a very harsh winter with large amounts of snow and multiple cycles of freezing and thawing. The weather is definitely a factor but not the only one to consider with respect to concrete surface degradation. Concrete has many variables that can affect the overall performance and it's important to understand that such an issue is not the result of just one variable.

The National Ready-Mix Concrete Association (NRMCA) has a series of one-page information sheets on important technical topics called "Concrete in Practice (CIP)" written in a non-technical format of what, why & how. CIP #2: Scaling Concrete Surfaces defines scaling as a local flaking or peeling of a finished surface of hardened concrete as a result of exposure to freezing and thawing. CIP #2 explains the following:

Why do concrete surfaces scale?

- ***The use of non-air-entrained concrete or too little entrained air.***
  - Air entrainment is recommended to help prevent freezing and thawing damage. However, even air-entrained concrete can scale if other precautions are not observed.
- ***Application of excessive amounts of deicing salts/chemicals on concrete with inadequate strength, air entrainment, or curing.***
  - Common residential deicers can be detrimental to concrete as well as the deicing chemicals used on roadways.
  - These deicing salts/chemicals can be present and tracked in by vehicle residue to foot traffic.
- ***Overworking the surface or finishing water into the surface can make the concrete susceptible to scaling in freezing conditions.***
  - Water worked back into the surface creates a high water-cement ratio and, therefore, a low-strength surface layer.
  - Overworking the surface could reduce the air content in the surface layer.
- ***Insufficient Curing***
  - This omission often results in a weak surface skin, which could scale if exposed to freezing and thawing in the presence of moisture and/or deicing salts/chemicals.
  - Proper finishing and curing of concrete can have the most impact on the overall performance.

The degradation of a concrete surface is likely the result of repeated freezing and thawing while saturated, especially in the presence of deicing chemicals. For example, areas where snow has been piled up can create a concentrated solution of moisture and deicing chemical. Poor drainage, or areas where moisture and deicing salts stand on concrete surfaces for an extended period of time, will increase the potential for critical saturation and may lead to scaling. Concrete can exhibit surface degradation at any age of time. Even though the surface has been affected, typically, the structural performance of the concrete has not been compromised. The NRMCA has the following recommendations to prevent scaling:

- ***Properly cure the concrete to help protect it from the environment during its infancy***
    - Consider using a curing product for that application to enhance the curing process
    - ASTM C1315 (AASHTO M148)
    - ASTM D260 (AASHTO M233)
- ***Practice correct finishing techniques and avoid steel trowels for exterior concrete slabs***
- ***Use air-entrained concrete of medium slump (3-5 inches) for moderate to severe exposure climates***
- ***Do not use deicers in the first few years of service after concrete placement***
- ***Seal the surface***
    - After proper curing, use a breathable sealer or water repellent designed for concrete slabs

The surface degradation found in the region may be due to any of these factors or a combination of them. To mitigate these issues in the future, it is suggested to take note and apply these recommendations to help prevent surface degradation issues. Concrete has many variables but good practices in the construction chain can help avoid these issues in the future.