# BIM Advisory Bulletin #6 – May, 2017

In 2012, Alberta Transportation was informed of 6 SC girder bridges that were showing signs of accelerated freeze thaw deterioration on exterior girders. Further investigations revealed that the deterioration was due to the use of substandard aggregates in the concrete mixes used in some girders fabricated between 2003 and 2007.

88 SC girder bridges were built between 2003 and 2007. 36 of these 88 bridges are now showing signs of deterioration with various degrees of severity. 16 bridges are exhibiting significant premature deterioration and 20 more bridges are showing signs that deterioration may soon become severe.

The most severe deterioration has typically been found on the exterior girders, especially those exposed to direct sunlight, but interior girders have also been affected. To date, the deterioration of interior girders has been limited to top surfaces that have no wearing surface.

Immediate issues include significant reduction of bridgerail capacity due to deterioration of concrete surrounding bridgerail posts anchorages of exterior girders and structural capacity of the exterior girders due to loss of concrete and reinforcing steel embedment. In addition, there are signs that damage to the tops of girders may soon become a concern for sites with no wearing surfaces.

Guidelines for BIM Ratings and Maintenance Recommendations for SC girder bridges showing signs of premature freeze thaw deterioration are presented in the following sections of this bulletin.

## BIM Rating Guidelines

The current guidelines for rating prestressed concrete girders do not address the freeze thaw issues that are occurring with the SC girder bridges. The following recommendations are intended to supplement the BIM Inspection Manual guidelines to address specific concerns with these SC girder bridges and to assist with using the Management Strategy Flow Chart presented in the following section. The rating entered on the BIM form should be the lowest for all girders. In the comments section, provide separate ratings for interior and exterior girders.

BIM rating guidelines are presented in Table 1. Photographs showing typical deterioration are provided in the Appendix.

**Table 1: Level 1 BIM Rating for SC Girders**

| Element | Rating | Defects |
|---|---|---|
| **Interior and exterior girders** | 4 | • Aggregate popouts, minor scaling and other signs of freeze thaw damage with no visible signs of concrete section loss. |
| | 3 | • Concrete section loss of the side face of the girder that does not extend more than 50 mm from the top or bottom edges of girder.<br>• Concrete section loss of the side and/or end face of the girder that does not extend more than 50 mm from the vertical edge of the girder ends.<br>• Concrete section loss of the girder top surface less than 35 mm in depth. |
| | 2 | • Concrete section loss on the side face of the girder that extends more than 50 mm from the top or bottom edges of girder.<br>• Concrete section loss of the side and/or end face of the girder that extends more than 50 mm from the vertical edge of the girder ends.<br>• Concrete section loss of the girder top surface more than 35 mm in depth.<br>• Exposed steel stirrups.<br>• Exposed prestressing strands. |
| Bridgerail posts | 3 | • Concrete section loss of the exterior girder top or plinth that does not extend to the edge of the bridgerail post base plate. |
| | 2 | • Concrete section loss of the exterior girder top or plinth that extends up to or below the edge of the bridgerail post base plate.<br>• Exposed exterior girder steel stirrups within 500 mm longitudinally of the centreline of a bridgerail post. |

**Maintenance Recommendation Guidelines**

The following Flow Chart (Figure 1) is provided to guide the development of management strategies for SC girder bridges based on BIM Inspections including the rating modifications discussed above. Due to the rapid nature of the concrete deterioration, it is recommended that for all SC girder bridges determined to be affected, the inspection frequency should be increased to a minimum of once every 21 months. This shorter cycle between inspections will help evaluate the rate at which the girders may be deteriorating and allow action to be taken before deterioration proceeds too far.

For affected bridges with concrete deterioration and soundness that cannot be adequately determined and quantified due to access restrictions, level 1.5 or level 2 inspections utilizing specialized vehicle access equipment should be recommended to provide accurate ratings and subsequent development of management strategies.

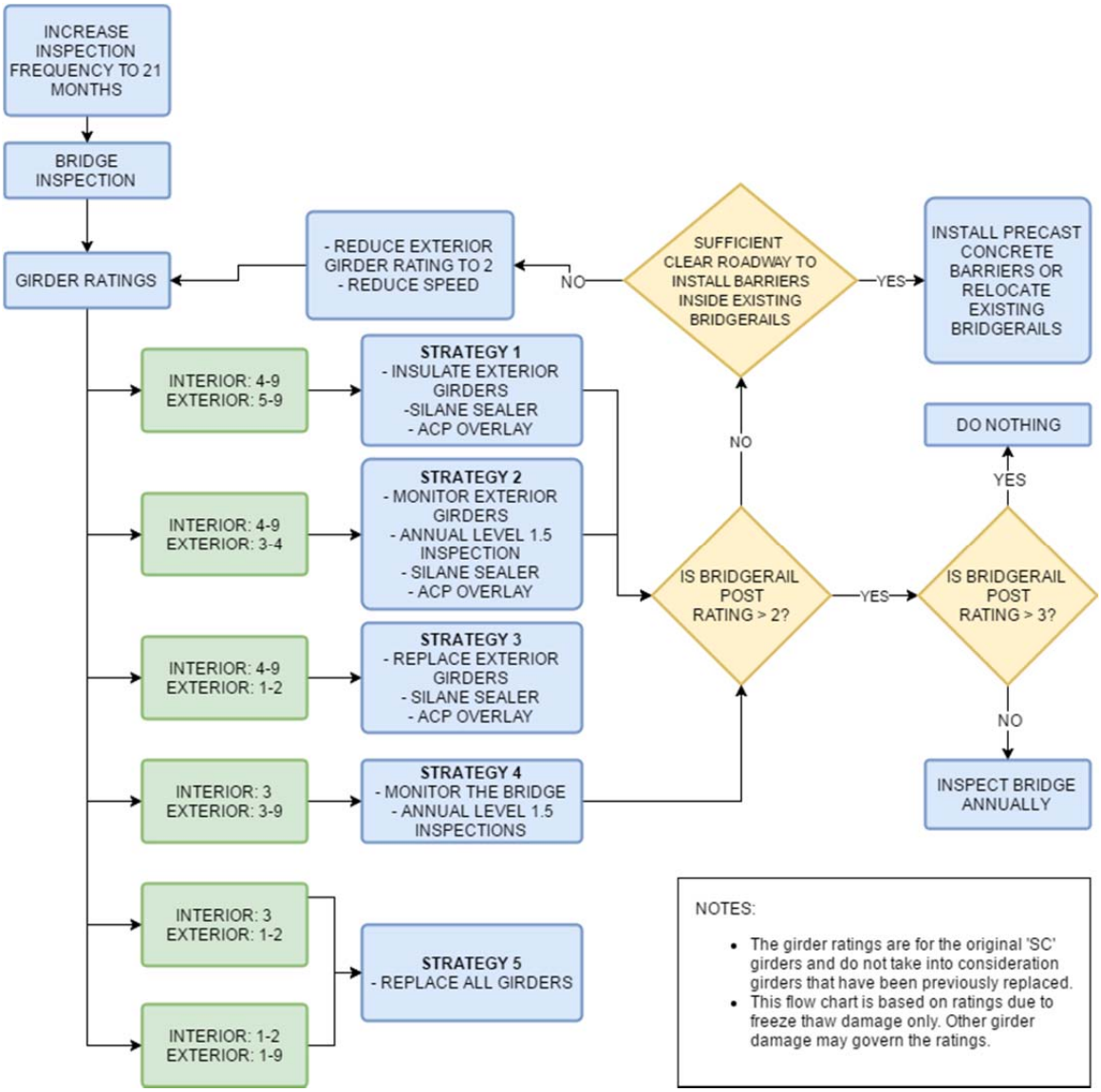


**Figure 1: Management Strategy Flow Chart**

If you have any questions on this matter, please contact the undersigned.

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# Appendix – Example Photographs

**Example 1:** Extensive scaling of exterior girder surfaces with concrete section loss extending more than 50 mm from top, bottom, and end edges of the girder. Exposed strand and stirrups. Concrete section loss of girder top that extends up to the edge of the bridgerail base plate. Girders rated 2. Bridgerail posts rated 2.

**Example 2:** Concrete section loss extending more than 50 mm from top and bottom edges of the girder with no exposed stirrups or strands. Concrete section loss of plinths, extending to bridgerail post base plates. Girder rated 2. Bridgerail posts rated 2.

**Example 3:** Concrete section loss less than 35 mm in depth along top surfaces of interior girders. Interior girders rated 3.

**Example 4:** Significant concrete section loss with exposed steel stirrups. Exterior girder rated 2. Concrete section loss extending below bridgerail post baseplate. Bridgerail posts rated 2.

**Example 5:** Concrete section loss of exterior girder extending less than 50 mm from the top edge of the girder. Girder rated 3. Concrete section loss of bridgerail post plinth not extending to bridgerail post baseplate. Bridgerail post rated 3.

**Example 6:** Concrete section loss of exterior girder extending more than 50 mm from the vertical edge of the girder end. Girder rated 2. Concrete section loss of bridgerail post plinth extending to bridgerail post baseplate. Bridgerail post rated 2.

**Example 7:** Isolated aggregate popouts along interior girder. Girder rated 4.

**Example 8:** Concrete plinth section loss extending below bridgerail base plate. Bridgerail post rated 2.