Learning from Other States’ Options for Bridge Expansion Joints

What Was the Need?
Recent changes in Minnesota bridge construction have created a challenge for maintaining expansion joints. While Minnesota’s bridges traditionally utilized parapet-type abutments, where the beams rest on bearings that sit on the abutment, an increasing number of less costly integral and semi-integral abutment bridges are being built with a total length less than 300 feet.

Both types of bridges have expansion joints to enable them to expand and contract with temperature changes, but while the previous design featured a joint at the abutment, the new bridges instead have an E8 expansion joint with high-density foam filler between the approach panel and the pavement off the end of the bridge.

This new E8 joint has not performed well. With Minnesota’s extreme temperature swings, the adhesive holding the foam filler can fail prematurely—sometimes after a single winter season. These joint failures require costly maintenance to repair.

What Was Our Goal?
This project sought to find alternatives for bridge approach panel joints that have performed well in other states and identify them for testing under Minnesota’s climate conditions.

What Did We Do?
After performing a literature review, researchers worked with the project technical advisory panel to identify other departments of transportation to survey and then performed phone interviews with follow-up emails to staff in Iowa, Kansas, Michigan, Ohio, South Dakota, Wisconsin and Ontario. These agencies were selected because of their proximity to Minnesota or because members of the technical advisory panel were familiar with the agency. The project also involved installing four sensors on three semi-integral abutment bridges in Minnesota to collect data about exactly how much movement takes place at an expansion joint.

What Did We Learn?
NCHRP Synthesis 319 surveyed all U.S. states and Canadian provinces and found a wide range of joint types in use, none of which was universally acclaimed by the states that had tried it.

This project’s survey found significant variety in joint procedures, even among states with similar climates to Minnesota’s. Several promising alternatives to the E8 joint emerged:

• Four of the seven agencies surveyed—Michigan, South Dakota, Wisconsin and Ontario—use strip seals in some fashion. South Dakota bridges do not need to carry water runoff from the bridge over the joint as they do in Minnesota. That would necessitate...
a strip seal kick-up at the gutter line. Michigan requires a barrier or sidewalk extended beyond the end of the approach panel to allow the strip seal to kick up. Ontario uses strip seal expansion joints for bridges with expected movements of greater than 2 inches, and Wisconsin uses strip seals only for parapet abutment bridges.

- Kansas has had success using Sealtite 50N (also known as Polytite), a precompressed, high-density polyurethane foam joint sealant from Schul International.
- South Dakota uses webbed neoprene compression seals from D.S. Brown Company.
- Iowa uses dowelled expansion joints with a filler of compressible foam sandwiched by plywood with a 0.5-inch joint sealant on top.
- Iowa, Kansas and Michigan reported having tried compression seals with poor results.

Bridge monitoring revealed movement of up to 1.4137 inches; in two instances, joint movements exceeded the theoretical movements calculated using the coefficient of thermal expansion. Additionally, in-person measurements of joint movement consistently revealed significantly larger movements than the gauge readings indicated. This kind of movement will stress any adhesive- or filler-type joint.

What’s Next?
Given the relatively wide success of strip seals among surveyed agencies and on Minnesota’s parapet abutment bridges, researchers recommend considering them for use in new semi-integral and integral abutment bridges. MnDOT already successfully uses strip seals on parapet-type bridges between the abutment end block and the deck. The downside to using strip seals is that to accommodate the kick-up required to carry water past the joint, concrete barriers must also extend past the joint. Extending the length of concrete barriers at the four corners of a bridge can add significantly to the cost.

As this survey was being conducted, MnDOT experimented with D.S. Brown’s compression seals on nine bridges on US 14 near Waseca, Minnesota. The seals performed adequately in most cases, but MnDOT inspectors found brittle failure of the neoprene material on five out of 18 installations with an effective service life of one to two years. Sealtite may be a viable option, but it must be tested in Minnesota’s climate. In fall 2012, MnDOT started trials of Sealtite and other options on six bridges on I-35 near Faribault, Minnesota. Each bridge had new E8 joints installed in 2009, but approximately two-thirds have failed. These bridges will allow the evaluation of 12 different expansion joint configurations in a small area. While no future work is currently planned, assessment of the performance of those joints may suggest options that require further testing.