C5.8.3 Expansion joints

See the Office of Bridges and Structures web site for archived Methods Memos listed under articles in this section.

The Methods Memos for which policies have been partially revised and/or for which document references have been updated are noted as partially revised. Any obsolete Methods Memos that apply to this section are listed at the end.

C5.8.3.1 General

C5.8.3.1.1 Policy overview

Methods Memo No. 86: New Policy for Bridge Approach Slabs
23 October 2003

C5.8.3.1.2 Design information

Iowa State University research on strip seal performance [BDM 5.8.3.1.5] has indicated that the AASHTO Procedure A cold climate temperature range [AASHTO-LRFD 3.12.2.1] generally is correct for steel but unconservative for concrete superstructures. The research also showed that the thermal coefficient for steel superstructures (0.0000065/ ºF) in the AASHTO Standard Specifications [10.2.2] generally is correct, the office shrinkage coefficient for concrete superstructures (0.0002 in/in) is reasonable but difficult to verify, and the thermal coefficient for concrete superstructures (0.000006/ ºF) in the AASHTO Standard Specifications [8.5.3] is conservative. Based on the research and long-term experience with expansion joints, the office policy is to use the temperature ranges and coefficients in Table 5.8.3.1.2 to determine movements for deck expansion joints.

C5.8.3.1.3 Definitions

C5.8.3.1.4 Abbreviations and notation

C5.8.3.1.5 References

C5.8.3.2 Strip seals

C5.8.3.2.1 Analysis and design

These two examples illustrate how to select and specify strip seals. Example 1 is for a steel bridge with characteristics that permit use of only one manufacturer's seal. Example 2 is for a concrete bridge with characteristics that permit use of alternate seals, as preferred by the office.

Example 1

Given: steel bridge, 420 feet long, 210-foot expansion length, 30-degree skew

Make preliminary selection.
For 30-degree skew, Table 5.8.3.2.1-1 lists maximum expansion length of 260 feet for Wabo SE-300 and 345 feet for Wabo SE-400. D.S. Brown A2R-400 is not acceptable. Try Wabo SE-300.

Check allowable movement capacity parallel with centerline of roadway for Wabo SE-300.
$(\Delta L)_{thermal} = \alpha\ L\ \Delta T = (0.0000065)(210)(12)(150) = 2.46$ inches
$(\Delta L)_{shrink} = k\ L = (0)(210)(12) = 0$ inches
$(\Delta L)_{total} = 2.46 + 0 = 2.46$ inches [< 3.5 inches from Table 5.8.3.2.1-2, OK]

Check long-term maximum joint opening. [Numerical subscripts refer to temperatures in degrees Fahrenheit. Shrinkage is zero and not shown.]

Try 1.5 inch at 90 °F joint setting for best installation options.
$Width_{-25} = Setting_{90} + (\Delta L)_{115} = 1.5 + (0.0000065)(210)(12)(115)(\cos 30) = 3.13$ inches [> 3 inches {minimum of seal size and (3.5)(cos 30) = 3.03 inches, Table 5.8.3.2.1-2}, NG]

Try 1.5 inch at 80 °F joint setting.
$Width_{-25} = Setting_{80} + (\Delta L)_{105} = 1.5 + (0.0000065)(210)(12)(105)(\cos 30) = 2.99$ inches [< 3 inches {minimum of seal size and (3.5)(cos 30) = 3.03 inches, Table 5.8.3.2.1-2}, OK]

Check short-term minimum joint opening.
$Width_{125} = Setting_{80} – (\Delta L)_{45} = 1.5 – (0.0000065)(210)(12)(45)(\cos 30) = 0.86$ inches [> 0 inches, Table 5.8.3.2.1-2, OK]

Determine joint settings for plans.
$Setting_{50} = Setting_{80} + (\Delta L)_{30} = 1.5 + (0.0000065)(210)(12)(30)(\cos 30) = 1.93$ inches
$(\Delta L)_{40} = \alpha\ L\ \Delta T = (0.0000065)(210)(12)(40)(\cos 30) = 0.57$ inches
$Setting_{10} = Setting_{50} + (\Delta L)_{40} = 1.93 + 0.57 = 2.50$ inches
$Setting_{90} = Setting_{50} – (\Delta L)_{40} = 1.93 – 0.57 = 1.36$ inches

Determine maximum gland installation temperature.
Maximum installation temperature is 80 °F from joint setting trial above.

Specify only one strip seal: Wabo SE-300 with joint settings of 1 3/8 inches at 90 °F, 1 15/16 inches at 50 °F, and 2 1/2 inches at 10 °F. Specify that maximum gland installation temperature is 80 °F.

(It would be conservative in this example to specify Wabo SE-400.)

Example 2

Given: Concrete bridge, 600 feet long, 300-foot expansion length, 10-degree skew

Make preliminary selection.
For 10-degree skew, Table 5.8.3.2.1-1 lists maximum expansion length of 375 feet for Wabo SE-400 and 300 feet for D.S. Brown A2R-400. Try Wabo SE-400, and then try D.S. Brown A2R-400.

Check allowable movement capacity parallel with centerline of roadway for Wabo SE-400.
$(\Delta L)_{thermal} = \alpha\ L\ \Delta T = (0.000006)(300)(12)(100) = 2.16$ inches
$(\Delta L)_{shrink} = k\ L = (0.0002)(300)(12) = 0.72$ inches
$(\Delta L)_{total} = 2.16 + 0.72 = 2.88$ inches [< 4.1 inches from Table 5.8.3.2.1-2, OK]

Check long-term maximum joint opening. [Numerical subscripts refer to temperatures in degrees Fahrenheit.]
Try 1.5 inch at 90 °F joint setting as best installation option.
$Width_0 = Setting_{90} + (\Delta L)_{90} + (\Delta L)_{shrink} = 1.5 + (0.000006)(300)(12)(90)(\cos 10) + (0.72)(\cos 10) = 4.12$ inches [> 4 inches {minimum of seal size and (4.1)(cos 10) = 4.04 inches, Table 5.8.3.2.1-2}, NG]

Try 1.5 inch at 80 °F joint setting.
$Width_0 = Setting_{80} + (\Delta L)_{80} + (\Delta L)_{shrink} = 1.5 + (0.000006)(300)(12)(80)(\cos 10) + (0.72)(\cos 10) = 3.91$ inches [< 4 inches {minimum of seal size and (4.1)(cos 10) = 4.04 inches, Table 5.8.3.2.1-2}, OK]

Check short-term minimum joint opening.
$Width_{100} = Setting_{80} – (\Delta L)_{20} = 1.5 – (0.000006)(300)(12)(20)(\cos 10) = 1.07$ inches [> 0 inches, Table 5.8.3.2.1-2, OK]

Determine joint settings for plans.

$Setting_{50} = Setting_{80} + (\Delta L)_{30} = 1.5 + (0.000006)(300)(12)(30)(\cos 10) = 2.14$ inches
$(\Delta L)_{40} = \alpha\ L\ \Delta T = (0.000006)(300)(12)(40)(\cos 10) = 0.85$ inches
$Setting_{10} = Setting_{50} + (\Delta L)_{40} = 2.14 + 0.85 = 2.99$ inches
$Setting_{90} = Setting_{50} – (\Delta L)_{40} = 2.14 – 0.85 = 1.29$ inches

Determine maximum gland installation temperature.
Maximum installation temperature is 80 °F from joint setting trial above.

Try D.S. Brown A2R-400.

Allowable movement capacity check will be the same as for the Wabo SE-400 seal.

Check long-term maximum joint opening.
Because Table 5.8.3.2.1-1 shows seal type to meet expansion length with no excess, try 2.0 inch at 60 °F joint setting.
$Width_0 = Setting_{60} + (\Delta L)_{60} + (\Delta L)_{shrink} = 2.0 + (0.000006)(300)(12)(60)(\cos 10) + (0.72)(\cos 10) = 3.99$ inches [< 4 inches {minimum of seal size and (4.1)(cos 10) = 4.04 inches, Table 5.8.3.2.1-2, OK]

Check short-term minimum joint opening.
$Width_{100} = Setting_{60} – (\Delta L)_{40} = 2.0 – (0.000006)(300)(12)(40)(\cos 10) = 1.15$ inches [> 0.5 inches, Table 5.8.3.2.1-2, OK]

Determine joint settings for plans.
$Setting_{50} = Setting_{60} + (\Delta L)_{10} = 2.0 + (0.000006)(300)(12)(10)(\cos 10) = 2.21$ inches
$(\Delta L)_{40} = \alpha\ L\ \Delta T = (0.000006)(300)(12)(40)(\cos 10) = 0.85$ inches
$Setting_{10} = Setting_{50} + (\Delta L)_{40} = 2.21 + 0.85 = 3.06$ inches
$Setting_{90} = Setting_{50} – (\Delta L)_{40} = 2.21 – 0.85 = 1.36$ inches

Determine maximum gland installation temperature.
Maximum installation temperature is 60 °F from joint setting trial above.

Specify two, alternate strip seals:

- Wabo SE-400 with joint settings (to nearest 1/16 inch): 1 5/16 inch at 90 °F, 2 1/8 at 50 °F, and 3 inches at 10 °F and maximum gland installation temperature of 80 °F and
- D.S. Brown A2R-400 with joint settings (to nearest 1/16 inch): 1 3/8 inch at 90 °F, 2 3/16 at 50 °F, and 3 1/16 inches at 10 °F and maximum gland installation temperature of 60 °F.

C5.8.3.2.2 Detailing

C5.8.3.3 Finger joints

C5.8.3.3.1 Analysis and design

Partially revised: Methods Memo No. 30: Finger Joints
5 February 2002 (corrected 17 April 2009)

Memo 5.8.3.3.1-2011 ~ Minimum Opening and Temperature Settings for Finger Joints
During the 1990s the office summarized and organized memos and office practice for an Electronic Manual. The minimum finger joint opening of 0.5 inch (13 mm) for the Electronic Manual was taken from page 28-122, Through Highway Spans, Design, in Robert W. Abbett's *American Civil Engineering Practice*. Article 14.5.3.2 in the current AASHTO LRFD Specifications (2010 Interim) requires a minimum transverse deck joint opening of 1.0 inches for steel superstructures designed for the appropriate strength load combination but allows for a reduced opening for concrete superstructures. To more closely align with the AASHTO specifications the office increased the minimum joint opening for steel superstructures but is neglecting the AASHTO load factor or Iowa setting factor because

finger joints are required with this change to be installed with adjustment for the installation temperature. The designer is required to include on the plans the finger joint settings at 90, 50, and 10 degrees Fahrenheit (32, 10, and -12 degrees Celsius).

C5.8.3.3.2 Detailing

Partially revised: Methods Memo No. 30: Finger joints
5 February 2002

Memo 5.8.3.3.2 II-2011 ~ Assembly of Finger Joints
In recent years finger joints have been fabricated with curb plates or barrier plate boxes shop welded to the ends of finger joint assemblies. During construction the attached plates and boxes must be cut loose so that the contractor can properly finish the deck. To improve constructability the curb plates and barrier plate boxes should not be shop attached but should be kept separate. After deck finishing the plates and boxes should be field welded in place and the galvanizing repaired using an approved method.

Memo 5.8.3.3.2-2011 ~ Elevation Adjustment for Finger Joints
The finger joint assembly will require elevation adjustment in the field. The +/- ½-inch (13-mm) minimum adjustment given in the manual may not be sufficient for the design haunch condition and, in that case, the designer will need to allow for more adjustment, either with a larger shim pack or by some other means. In unusual cases all of the design planning for elevation adjustment will not be adequate, and special field details will be necessary.

C5.8.3.4 Tire buffings joints

C5.8.3.4.1 Analysis and design

Methods Memo No. 86: New Policy for Bridge Approach Slabs
23 October 2003

C5.8.3.4.2 Detailing

C5.8.3.5 Other joints