A Basic Approach to the Installation of Small Movement Expansion Joints

Peter Weykamp, P.E.

OBJECTIVE

Avoid failures

Share practices

Simplify

Guide

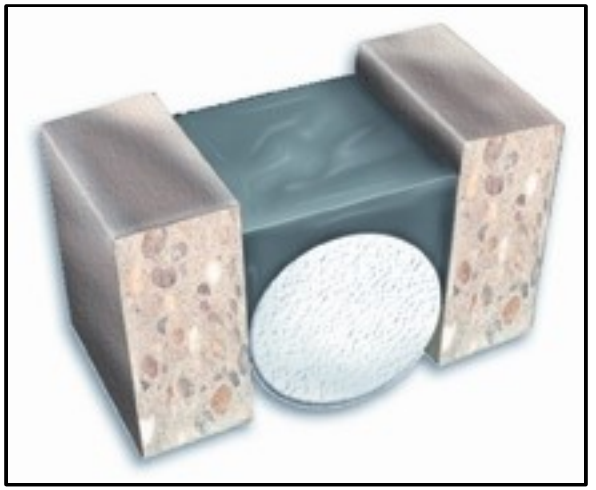
Dialog

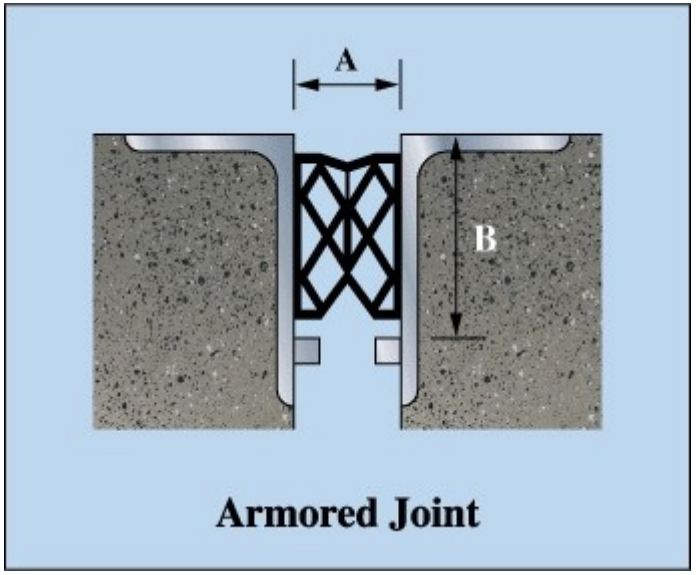
NYSDOT TRANSITION

- Armor to Elastomeric Systems
- Elastomeric Systems to Headers & Seals
- Seal sizing tables to Joint Calculator

SOME TYPES OF SMALL MOVEMENT JOINTS

SOME TYPES OF SEALS





PRE-FORMED SEALS

Other Materials

Can accommodate wider openings

Expensive ($35/ft)

Available

Flexible

Light

Not splice-able

UV protected

Closed-cell Foams

Most common for movement 2 ½” or less

Inexpensive ($5.00/ft)

Available

Flexible

Light

Splice-able

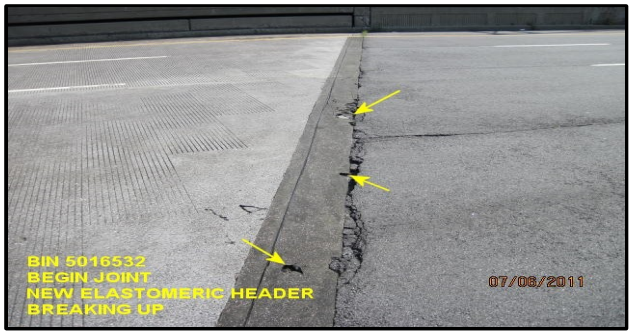
UV protected

FAILURE MODES

- **HEADER**
  - Plows
    - Catch metal
      - Weld risers
  - Debonding
    - No tie to existing
      - Add rebar
  - Cracking
    - Unsound concrete
      - Sound concrete

- **SEAL**
  - Open at edges
    - Compression set
      - Limit compression
  - Debonding
    - Tension
      - Limit tension

FAILURES in the HEADER



FAILURES in the SEAL

FAILURES in TENSION

In tension, the bond between the header and the seal becomes critical. Proper surface preparation and mixing of the bonding agent is important

Joint seal manufacturers allow the seal to be in tension up to 30% greater than the seal width.

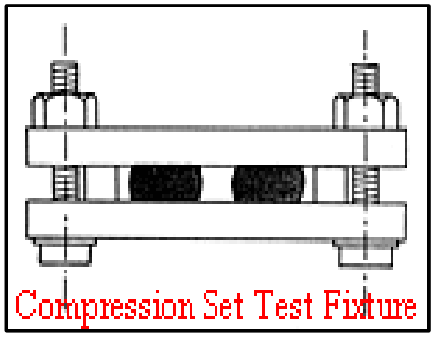
Installation occurs during the summer months when the gap is narrow. Selecting the seal with maximum tension allows for easier installation.

COMPRESSION SET

- Manufacturer provides maximum allowable compression
- Compression set
  - ASTM 3575 Suffix B

Compression Set 50% compression for 22 hours @ 73 F 2 hour recovery

- WBA
  - 9% set @ 24 hr recovery
  - 10% set @ 2 hr recovery
- RJ Watson
  - 9% @ 24 hr recovery
  - 13% @ 2 hr recovery



THEORY OF BRIDGE MOVEMENT

How do we calculate the movement in a bridge joint ?

MOVEMENT = □ □ΔT x □

Coefficient of Thermal Expansion "□".

Change in Temperature "□T". Use AASHTO tables for Max & Min temperatures.

Length "L" of bridge beams/members that contribute to the movement of the joint. Check the "fixity".

COEFFICIENT of THERMAL EXPANSION "□"

Concrete:

Φ = 6.0 x 10^{-6} in./in./□F

Steel:

Φ = 6.5 x 10^{-6} in./in./□F

CHANGE in TEMPERTURE "ΔT"

Max & Min temps are obtained from - AASHTO

Procedure B

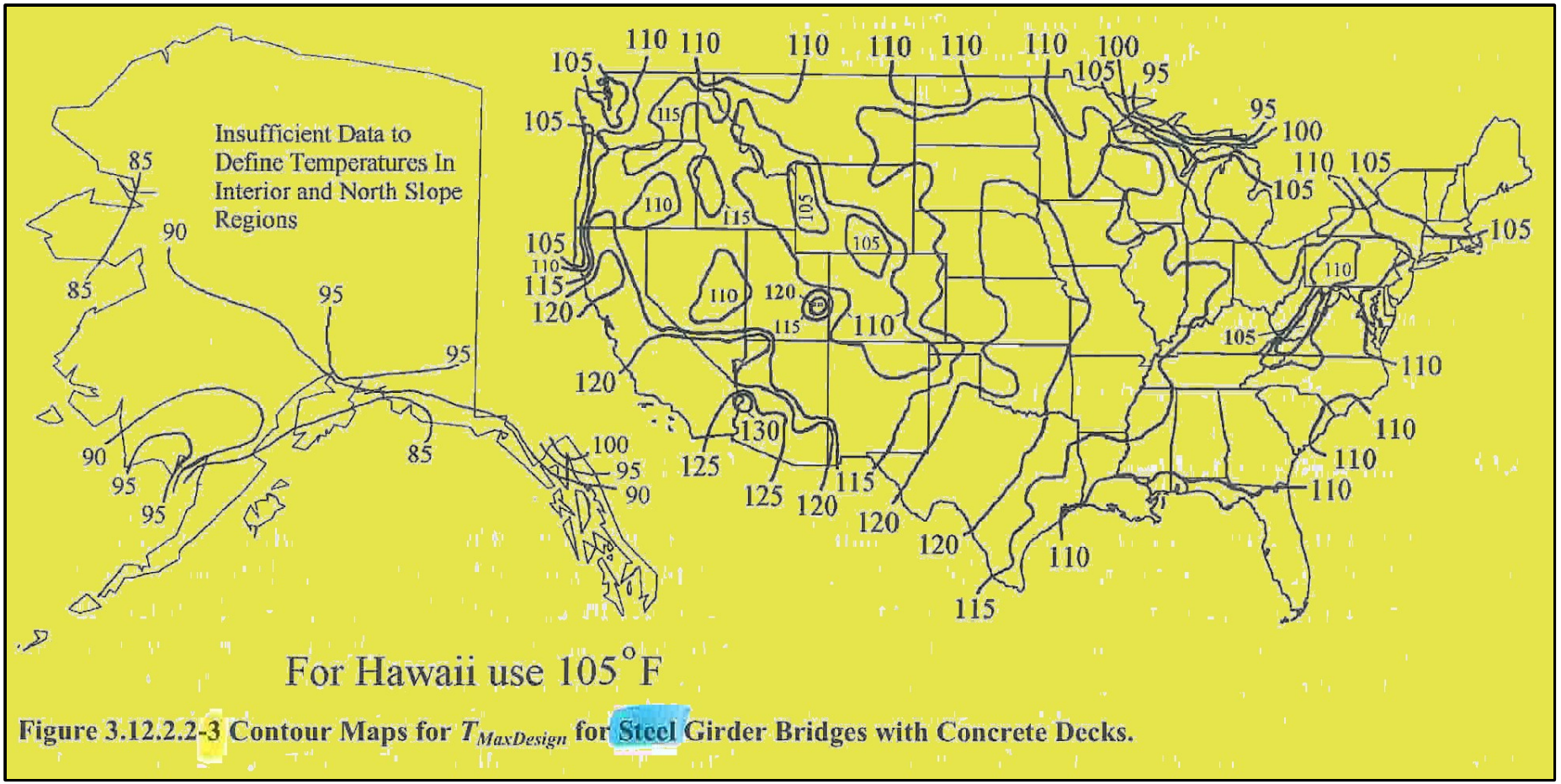
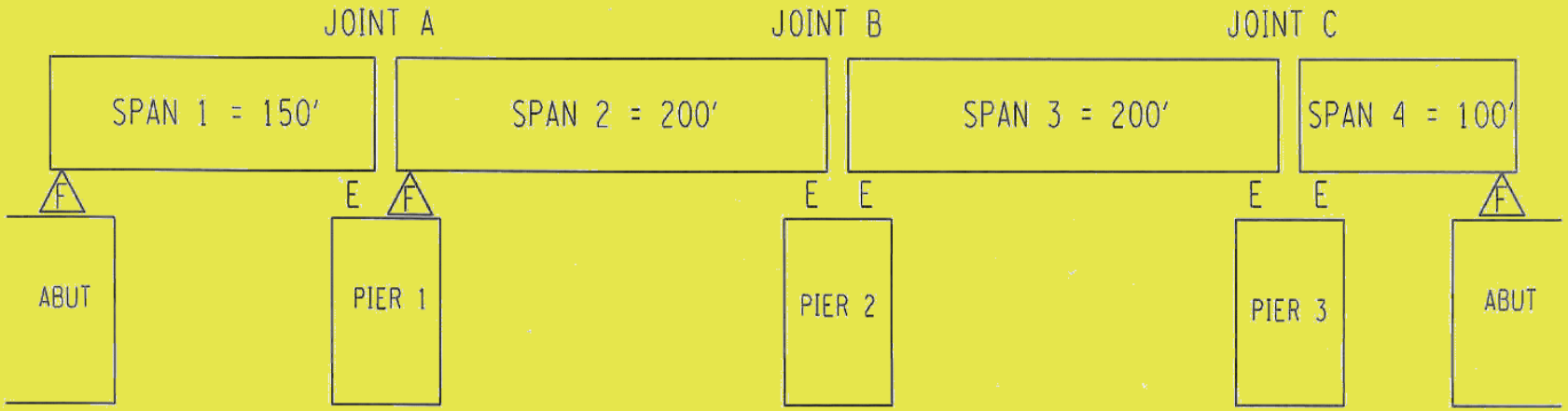


Figure 3.12.2.2-3 Contour Maps for $T_{MaxDesign}$ for Steel Girder Bridges with Concrete Decks.

"L" = LENGTH of BEAM CONTRIBUTING TO MOVEMENT



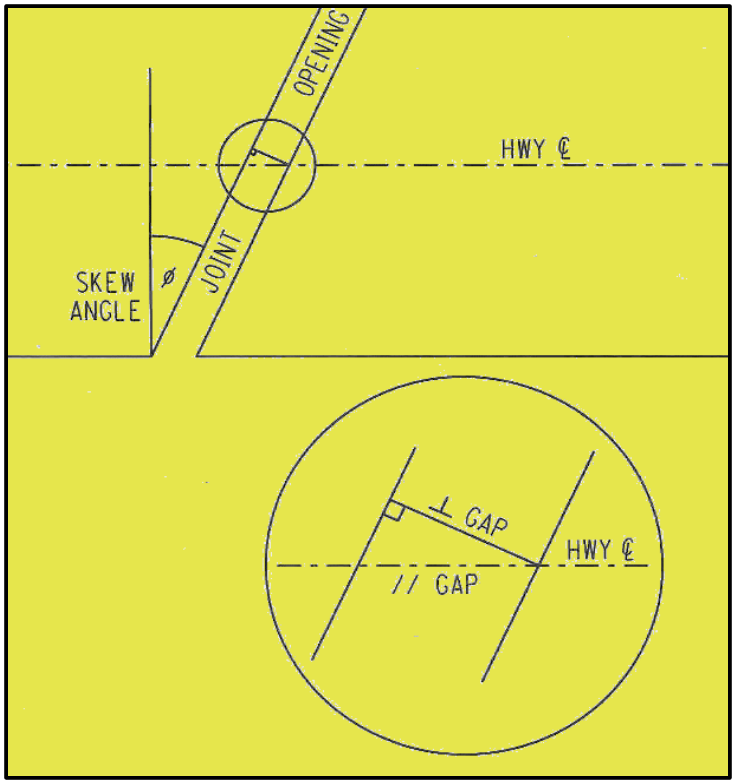
LENGTH OF MEMBER(S) CONTRIBUTING TO MOVEMENT OF JOINT:

JOINT A = 150 LF
JOINT B = 300 LF
JOINT C = 200 LF

F = FIXED BEARING
E = EXPANSION BEARING
ASSUME ALL BEARINGS ARE FUNCTIONAL

MOVEMENT = Φ x ΔT x L

Skew angle



- Bridge moves parallel to highway center line
- Seal is placed parallel with header
- Shear forces develop in seal
-

SIZING TABLES

Joint Design Chart

(Charts based on 60% compression & 30% tension)

Model Number	Jt. Gap (in.) @ 60°F	Rec.* Seal Size (w x d)	Movement Range (in.)
#1.38	1	1 3/8 x 2	0.5 - 1.8
#1.63	1 1/4	1 5/8 x 2	0.6 - 2.1
#2.00	1 1/2	2 x 2	0.8 - 2.6
#2.38	1 3/4	2 3/8 x 2	0.9 - 3.1
#2.75	2	2 3/4 x 2	1.1 - 3.6
#3.00	2 1/4	3 x 2 1/2	1.2 - 3.9
#3.25	2 1/2	3 1/4 x 2 1/2	1.3 - 4.2
#3.50	2 3/4	3 1/2 x 2 1/2	1.4 - 4.5
#4.00	3	4 x 3	1.6 - 5.2
#4.50	3 1/2	4 1/2 x 3	1.8 - 5.8
#5.00	4	5 x 3 1/2	2 - 6.5

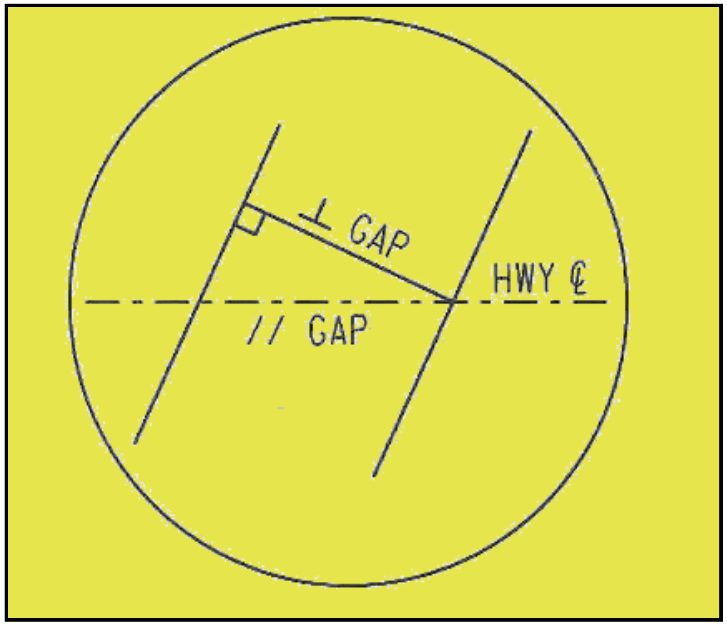
**Please contact us for project specific recommended sizes Many other sizes are available*

- Set for opening at specific temperature
- Accommodates manufacturers compression and tension limits
- Installation issues favor maximizing tension

SIZING by BRIDGE CREWS

“It is what it is” method

MEASURE THE EXISTING OPENING



- Formula provides maximum & minimum change in length.
- Add to existing opening to get max opening (winter).
- Subtract from existing opening to get min opening (summer).

JOINT CALCULATOR

NYSDOT Expansion Joint Calculator

Make selections for the following categories:

	NYSDOT Region	R7
	Primary Member Type	Steel

Input values for the following categories:

	Exist Temperature of Primary Member	55	F
*	**Length of Member(s) contributing to total movement @ joint**	124	Feet
*	**Exist Joint Opening (perpendicular to header) ⊥**	2	inches
*	**Skew Angle ($0 \leq \theta < 90$)**	18	Degree Skew
	Max. Compression limit % of joint material (from Manufacturer)	60	%

Results: (Perpendicular to header)

Joint Opening at 68 F (⊥)	1.88	inches
Joint Opening at Coldest F (⊥)	2.69	inches

INPUTS

Inputs

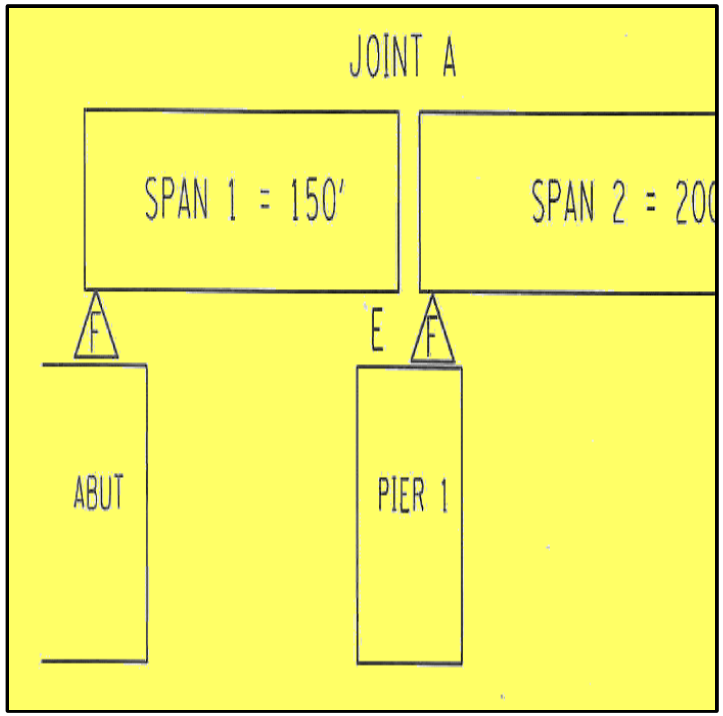
Make selections for the following:		
AASHTO Region	R7	
Primary Member Type	Steel	
Input values for the following:		
Exist Temperature of Primary Member	55	F
Length of Member(s) contributing to total movement @ joint	124	Feet
Exist Joint Opening (⊥ to header)	2.25	Inch
Skew Angle ($0 \leq \Theta \leq 90$)	18	Skew
Max. Compression limit % of joint material (from Manufacturer)	60	%

Notes:

MEASURING THE OPENING: When on the bridge, measure the perpendicular joint opening. rather than the parallel joint opening (can't see through the deck for the orientation of the primary member).

OUTPUTS		
Joint Opening at 68 F (⊥)	1.88	inch
Joint Opening at Coldest (⊥)	2.69	inch
Joint Opening at Warmest (⊥)	1.54	inch
Total movement of Joint (⊥)	1.15	inch
Width of New Closed Cell Foam (use Coldest Temp width (⊥)	2.69	inch
Depth of New Closed Cell Foam (if Manuf. info. not available)	2.50	inch
Acceptability based on Manufacturer's Compression limit	OK	
Compression @ Warmest Temp	42.75%	
Compression @ Exist Temp	25.65%	
Procedure B Temperature Ranges - AASHTO		
Coldest Temp for Primary Member in Region	-20	F
Warmest Temp for Primary Member in Region	+105	F

IMPLEMENTING THE RESULTS



- **Installation**
  - **Cooler weather**
- **Fixed Bearings**
  - **Closed-cell Foams**
    - **Compression set**
  - **Sizing 25% larger**
- **Use more expensive seals where movement occurs**

PROPERLY SIZED?

THANK YOU

Questions?????