

Small Movement Expansion Joints: Performance and State of Practice in the North East

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Objective

- Determine the current state of practice of joint design and maintenance of the states in the NEBPP
- Determine commonly used expansion joints in the North East
- Collect information on the historical performance of joints in the North East

Background

- Varied design and maintenance practices among NEBPP agencies
- Varied experiences with joints among NEBPP agencies
- Concerns about long term bridge maintenance related to small movement expansion joints
- Failure of bridge joints leads to deterioration of structural members
- Failure of bridge joints affects ride quality and life of decking surface

Research Method

- Literature Search
 - DOT manuals and design specifications
 - Prior studies
 - Manufacturer specifications
- Web survey of NEBPP DOT Engineers
 - Quality of performance
 - Causes of failure
 - Maintenance practices
- Follow-up interviews/emails
- Synthesis of data/information
- Final Report

Prior Research

- Simplifying Bridge Expansion Joint Design and Maintenance
 - University of South Carolina
- Sealing of Small Movement Bridge Expansion Joints
 - The New England Transportation Consortium
- Evaluation and Policy for Bridge Deck Expansion Joints
 - Purdue University

Common Joint Types in Use*

- Asphaltic Plug (APJ)
- Closed Cell Foam (CCF)
- Poured Silicone (PS)
- Open Cell Foam (OCF)
- Preformed Silicone (PFS)
- Strip Seal (SS)
- Compression Seal (CS)

*Determined by DOT Bridge Manuals and Surveys

Online Survey

- Types of Joints Used
- Expected Lifespan of a Joint
- Common Failure Modes
- Causes of Common Failures
- Avoided Joint Types
- Routine Maintenance
- Sizing Method
- Inspection Reports
- Repair Methods
- Unique Procedures

Online Survey (continued)

- Surveys Issued – 27
 - Sent to Design and Maintenance personnel if available
 - Differing numbers provided per state
- Responses Received – 22
 - All 12 member agencies with at least one response

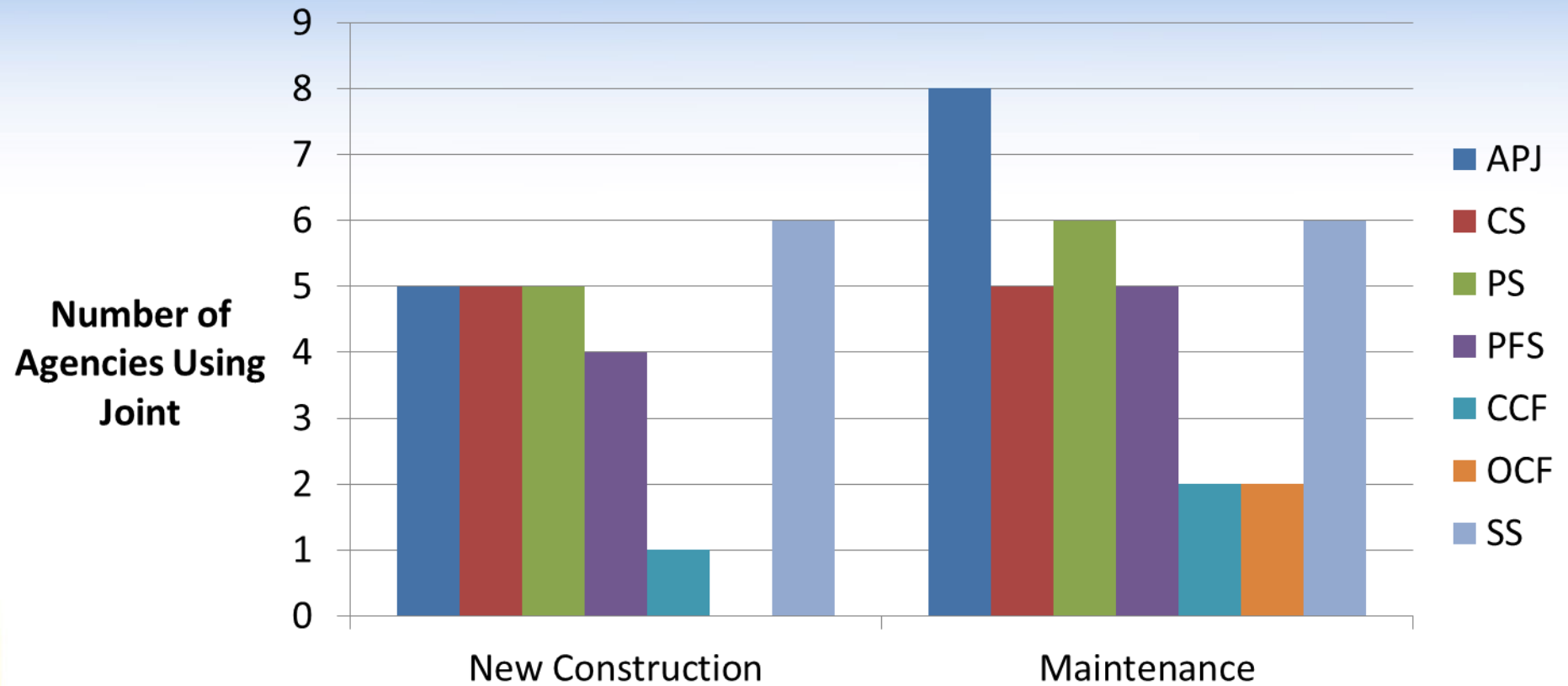
Follow-up Interview

- Follow Up Questions Answered – 13
 - Represents 5 states
- States with Sufficient Level of Response – 5
- Work still to be done – in progress
- Will be in contact today, if not already at the meeting!

Joint Type vs. State

State	Joints Used for New Construction							Joints Used for Maintenance						General Movement Range	
	APJ	CS	PS	PFS	CCF	OCF	SS	APJ	CS	PS	PFS	CCF	OCF		SS
CT	●		●	●				●		●	●				APJ <1.5", PS <1.5", PFS <3"
DC							●							●	
DE		●	●				●	●	●	●	●	●		●	CS fixed, PS fixed, SS < 4"
MA	●		●				●	●		●				●	PS <.5", APJ <2", SS <2" if skew>30°
MD			●	●							●				PS <1", PFS <3"
ME		●		●				●	●	●	●		●		CS <3", PFS <3", APJ < 1.5", PS < 1.5"
NH	●	●					●	●	●					●	APJ <.75", CS <2", SS <4"
NJ		●					●		●					●	
NY			●	●	●					●	●	●			PFS <3"
PA		●					●	●	●	●			●	●	SS <5"
RI	●						●	●						●	APJ <1", SS <5"
VT	●							●							APJ <1"

Frequency of Joint Type



Joint Types Avoided

State	Joints Avoided	Reason
CT	Compression Seals Elastomeric Concrete with Armoring	Frequent failures Rutting
DC	Compression Seals	Frequent pushing out of seal
DE	N/A	
MA	N/A	
MD	Compression Seals Closed Cell Foam	Difficult maintenance Compression set
ME	Compression Seals	Poor performance on larger movements
NH	Compression Seals	Tension failures
NJ	Preformed Silicone Asphaltic Plug	Pushing out of seal Failure under heavy traffic
NY	Any armored joints	Plow damage Difficult to install
PA	Poured Silicone Compression Seals	Inconsistent installation Frequent failures
RI	Compression Seals	Frequent pushing out of seal
VT	N/A	

Design Methods for Sizing

- AASHTO LRFD Bridge Design Manual: Thermal Expansion
- Standardized Expansion per Length of Bridge
 - Based on material types
- Previous Experience
- Excel Calculator

State	Sizing Method
CT	AASHTO
DC	AASHTO
DE	AASHTO
MA	AASHTO
MD	AASHTO
ME	Movement / Length
NH	AASHTO / started using Calculator
NJ	AASHTO
NY	AASHTO / moving towards Calculator
PA	AASHTO
RI	AASHTO
VT	AASHTO

General Failure Modes

- Debonding from deck or header material
 - APJ, PS, PFS, CS, CCF
- Rupture of seal
 - PS, PFS, SS
- Pushing out of seal
 - CS, CCF, OCF
- Material failure
- Snow plow damage
 - Armored joints



Average Expected Lifespan

Joint	New Construction	Replacement / Rehabilitation
Asphaltic Plug Joint	10 yrs	4 yrs
Compression Seals	15 yrs	6 yrs
Poured Silicone	7 yrs	3 yrs
Preformed Silicone	7 yrs	3 yrs
Closed Cell Foam	5 yrs	2 yrs
Open Cell Foam	Test joints in place, performing well after 1 yr	unknown
Strip Seals	15 yrs	10 yrs

- Shown lifespans assume no installation problems and some maintenance
- Lifespans varied considerably between states
- Armored joints may fail prematurely due to snow plows

Common Maintenance Issues

- Inconsistent material properties
 - APJ, PS, and CCF
- Lack of preventative maintenance or washing
- Improper installation
- General lack of funding and manpower for proper maintenance



Maintenance and Repair

- Installation Crews
 - State bridge maintenance
 - Private contractor
 - Installation Procedure
 - Ideal Conditions vs. Reality
 - Material Quality
 - Inconsistent from manufacturer
 - On-site issues
- Is the crew experienced?
 - Do they follow manufacturer procedures?
 - Is it realistic to expect a perfect installation?
 - Are preformed materials consistent?
 - Do materials mixed on site meet requirements?

Evaluation of New Products

Typical procedure as described in follow-up interviews by 5 states:

1. Materials Testing Department
2. Presentation/Data from Manufacturer
3. Testing
 - a. Laboratory
 - b. Field Installation
4. Evaluation and Approval

New Developments

- Open Cell Foam – EMSEAL BEJS System
 - Similar to compression seal
 - Lighter and more flexible
- Slab over back wall
 - May require joint
 - Runoff does not affect structural members
- Joint Calculator
 - Avoids all tension

Schedule Moving Forward

- Finish Gathering Information – October
- Summarize Data – November
- Draft Report – December
- Submit Final Report – December/January

Acknowledgments

- North East Bridge Preservation Partnership
- Survey Participants and DOT contacts
- University of Delaware

Thank You!

Questions?