Bridge Expansion Joints
How effective are they?

Infrastructure Project Management Administration (IPMA)
Purpose

- Accommodate deck expansion and contraction caused by ambient temperature
- Mitigate adverse affects of shrinkage, creep, and rotation
- Lessen the chance of bridge decks cracking and buckling due to deck movement
Types of Joints

- Open – allow water and debris to pass through
- Closed – created to block debris and water
- Classified into categories based on movement range

<table>
<thead>
<tr>
<th>Joint Classification</th>
<th>Movement range</th>
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<tbody>
<tr>
<td>Small movement Joint</td>
<td>~ 0.5” – 2”</td>
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<tr>
<td>Medium movement Joint</td>
<td>~ 2” – 4”</td>
</tr>
<tr>
<td>Large movement Joint</td>
<td>~ &gt; 4”</td>
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</table>
Small Movement Joints

- Compression seals
- Silicone sealants
- Asphalt plug joints
Compression Seals

- Utilized for movements 0.25” – 2.5”
- Provides uniform compression without coming out of joint opening
- Enables a smooth ride for vehicles when even with the deck after compression
Silicone Sealants

- These joints are poured in place
- Recommended for repair and rehabilitation projects
- Cures quickly
Asphalt Plug Joints

• Effective for allowing thermal movement

• Constructed to be waterproof, flexible and self-sealing
Medium Movement Joints

• Strip Seal Joints

• Finger Joints – can be used for large movements as well

• Sliding Plate Joints
Strip Seal Joints

- Enables movement by a neoprene seal gland between two steal strips
- Because of its location, the gland is usually protected from vehicular wear
Finger Joints

• Open joint typically anchored to concrete decks

• Metal troughs are usually constructed beneath the joint to redirect runoff
Sliding Plate Joints

- Two overlapping steel plates made to stop water and rubble infiltration
- Allow a smooth joint surface
Large Movement Joints

• Modular Bridge Expansion Joints
  – Finger Joints as well
Modular Expansion Joint

- Designed to prevent water and debris from damaging structures below

- Accommodate large structural movement from several connecting seals

- Seals expand and contract uniformly
Joint Failure

• Common Causes:
  – Improper Installation
  – Poor alignment
  – Deterioration of surrounding deck
  – Excessive water and debris
  – Large amounts of movement
Joint Failure

• Common Causes:

  – Road deicing salts
  – Loose bonds
  – Material failure
  – Creep/Shrinkage
  – Traffic
Protection

- Steel angle armor – protection from snow plows and debris from passing through
- Troughs – constructed under open joints
- Promote 100% water tightness
Repair & Rehab

• Joints are not expected to last through the life of the bridge

• Demand frequent inspection

• Must be repaired and replaced on a regular basis

• Work conducted to minimize traffic interruptions
Compression Seals

• Leaks shortly after installation

• Improper seal sizing and installation

• Debris and snowplows

Repair: usually replace the entire seal, leakage areas filled with adhesive, debris removed
Silicone Sealants

- Lose bonding over time
- Damage from debris
- Material failure (splitting)

Repair: easy to remove the seal and refill
Asphalt Plug Joints

• Softening and cracking due to weather conditions

• Loss of bond between joint-pavement

• Delamination

Repair: Replacement
Strip Seal Joints

- Material tears due to lodged debris
- Rupture/loss of water tightness
- Seals can pull out of the metal facing groove

Repair: debris removal, replacement
Finger Joints

• Ends of fingers bending upwards
• Broken fingers
• Surrounding concrete deterioration
• Debris/water collection in drainage trough

Repair: replacement, trough cleaning, patch deteriorated concrete, smooth plate over missing fingers
Sliding Plate Joints

- Not watertight; surrounding concrete decline
- Plates loosen over time; become noisy
- Plates detach
- Debris dislodges plates

Repair: Replacement, debris removal, re-welding specific locations
Modular Expansion Joints

- Damage to the sealer material
- Fatigue cracking
- Snowplow damage

Repair: Replacement, debris removal
Repair & Rehab

• Be proactive

• Frequent & thorough inspections

• Water-tightness tests

• Repair can soon follow evaluation
Bridge Expansion Joints

• Eliminate expansion joints
  – Integral abutment bridges

• Identify factors that impact joint life span

• Create more resilient materials
Resources

- The Manual for Bridge Evaluation 2nd edition
- Bridge Engineering – Demetrios E. Tonias, P.E.
- Concrete Bridges – V.K. Raina
- [http://www.bridgejoints.org.uk/introduction.htm](http://www.bridgejoints.org.uk/introduction.htm)
- [http://www.concreteconstruction.net/images/Flashing%20for%20Bridge-Deck%20Joints_tcm45-343336.pdf](http://www.concreteconstruction.net/images/Flashing%20for%20Bridge-Deck%20Joints_tcm45-343336.pdf)
- [http://www.emseal.com/Products/Infrastructure/BridgeJointSeals/BEJSBridgeInFailedBoltDowns.htm](http://www.emseal.com/Products/Infrastructure/BridgeJointSeals/BEJSBridgeInFailedBoltDowns.htm)