



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

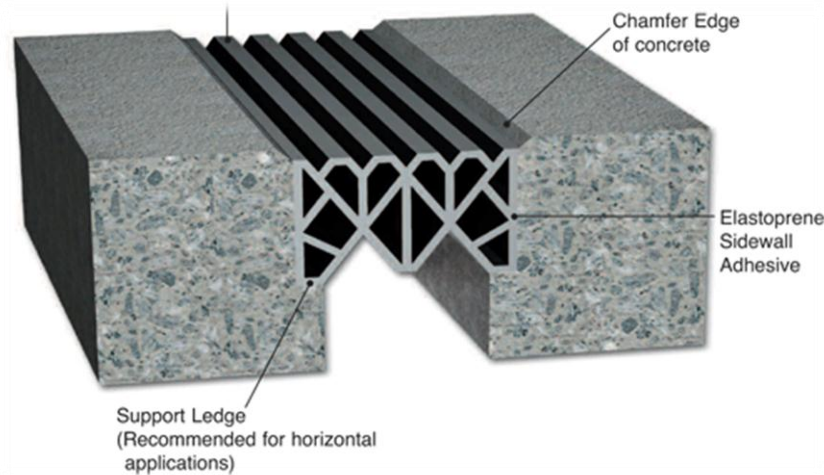
Joint Classification	Movement range
Small movement Joint	~ 0.5" – 2"
Medium movement Joint	~ 2" – 4"
Large movement Joint	~ > 4"

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

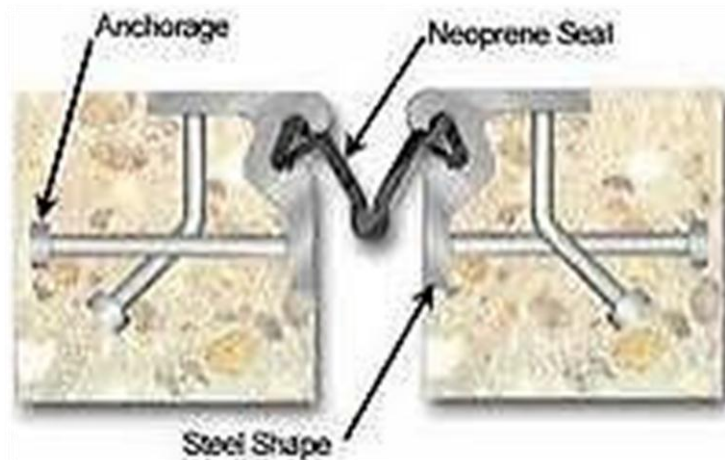


Medium Movement Joints

- 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 steel strips
- Because of its location, the gland is usually protected from vehicular wear



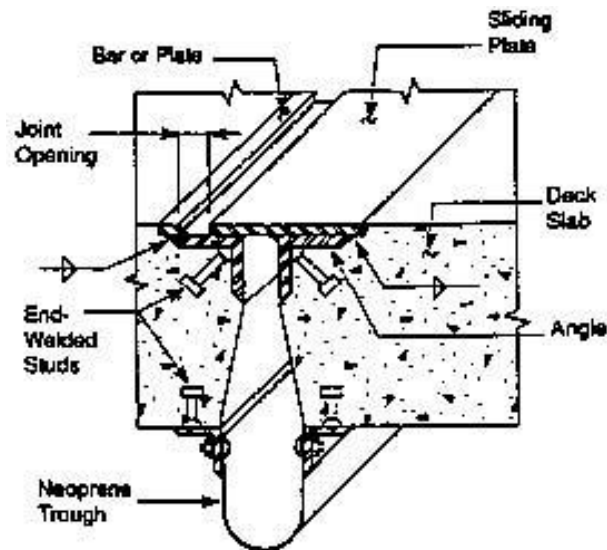
Finger Joints

- 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

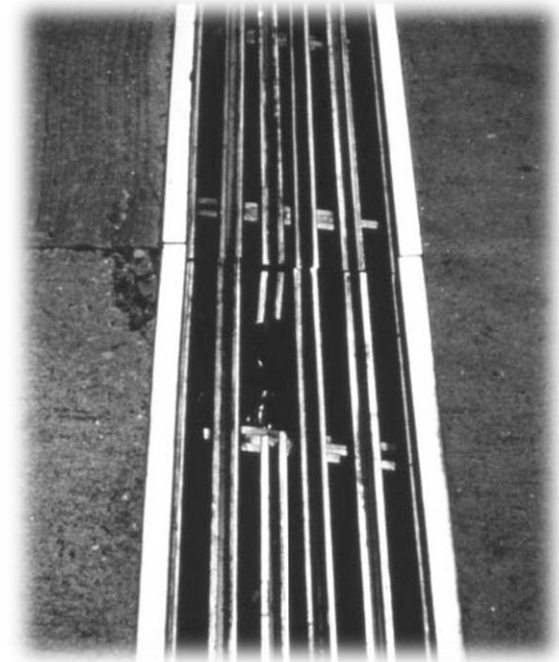
- Not watertight; surrounding concrete decline
- Plates loosen over time; become noisy
- Plates detach
- Debris dislodges plates



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. Tonnias, P.E.
- Concrete Bridges – V.K. Raina
- <http://www.bridgeforum.org/bof/meetings/bof34/Inspection%20Guidance%20for%20Expansion%20Joints%20Vol%201%20v01a.pdf>
- <http://itd.idaho.gov/bridge/manual/14%20Joints%20and%20Bearings/14.5%20Bridge%20Joints.pdf>
- <http://www.dsbrown.com/resources/articles/masterbuilder.pdf>
- <http://www.bridgejoints.org.uk/introduction.htm>
- <http://www.azdot.gov/Highways/bridge/Guidelines/DesignGuidelines/PDF/Section14-JointsAndBearings.pdf>
- http://www.concreteconstruction.net/images/Flashing%20for%20Bridge-Deck%20Joints_tcm45-343336.pdf
- <http://www.emseal.com/Products/Infrastructure/BridgeJointSeals/BEJSBridgeInFailedBoltDowns.htm>