The Critical Few of Sustainable Expansion Joints

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Expansion Joints are a Critical Link to the Sustainability of a Bridge Structure

- Improved installation methods – simpler, quicker, more effective
- Durability through increased product and structure lifespan
- Overall cost savings

Emissions | Energy | Water | Materials | Labor | Health/Safety
---|---|---|---|---|---
CO₂ |  |  |  |  |  

NATIONAL BRIDGE PRESERVATION PARTNERSHIP CONFERENCE 2014
Critical Few

- Deck Prep
- Expansion Joint Headers
- Joint Selection
- Preservation Practices
Deck/Surface Preparation – Find out what is Going on!

- Determine the problem/existing conditions
- Evaluate the cause/ issues
- Engineer the appropriate solution
- Complete the preparation (No Shortcuts)
- Complete long term repair or placement
Deck/Surface Preparation

Proper preparation is everything in extending the life expectancy of an expansion joint!
Definition:
The mechanical or chemical treatment of any surface prior to the application of a repair material / coating, overlay, joint sealant, flooring system or other construction material, that will provide the optimum conditions for ensuring adhesion between the surface (often called the substrate) and the material to be applied.
Why is Surface Preparation important?

- Is the most critical operation of any successful refurbishment project
- Achieving a permanent, strong bond is essential for a successful result
- Failure to perform the **appropriate** preparation to an **adequate** level will undermine the whole repair process
Surface Profile: ICRI CSP Standards

- Surface profile is the *texture or contour* of the substrate surface left after preparation.
- Thinner applied systems require lower surface profile finishes.
- Even power washing and light grinding may be sufficient for some thin aesthetic coatings.
- Heavy duty systems may require more intense profiles to provide sufficient mechanical key.

ICRI define 10 standard profiles for concrete, making specification easier. Each profile rated on a scale from 1 to 10:

- **1** = least profiled with a texture of very fine sandpaper
- **10** = greatest degree of profile with surface amplitude of 5mm (1/4″)
The Profile is All-important for Mechanical Adhesion

- A properly prepared, roughened surface provides a far greater surface area to which a repair material can be adhered.
- A good, clean, profile allows the material to flow into the pore structure of the concrete and ensure a positive bond once it cures.

Illustration showing increase in surface area available for bonding after surface preparation:

Unprepared surface profile: ____________________________________________

Prepared surface profile: ____________________________________________

Prepared surface profile stretched flat to show comparative actual surface available for bonding: ____________________________________________
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Why are Expansion Joint Headers Needed?

because...Concrete Cracks
How do Expansion Joint Headers work?

Bridge joints operate in a unique environment resulting in additional performance considerations for the expansion joint header.

Exposure to:
- Structural dynamics
- Higher traffic loading
- Extreme environments

Demands for
- Opening traffic sooner
- Night time constraints
- Faster-setting materials
- Simpler, quicker installation
What criteria must an Expansion Joint header meet?

Material Composition must:
- Prevent water leakage
- Be durable
- Promote flexibility
- Be impact resistant
- Reduce spalling
- Have superior bonding capabilities

Joint Headers Need to be both Flexible and Energy Absorbing

ex: Elastomeric header (l) and concrete block (r) are subjected to the same force until concrete quickly broke under energy from hammer swing. If a hammer can do this so simply, imagine the effect a car, bus or semi will have...
Constructability of Expansion Joint headers

**Cantilevering of Expansion Joint Headers is NOT recommended**

Crack growth is of particular concern on the expansion joint header side upon which the vehicle tire is impacting. It is established that 3 conditions contribute to a cantilever cracking mode:

- *Cantilever stress concentration at edge of deck*
- *Low temperature*
- *Dynamic impact loading*

Not only are forces amplified due to impact, but the crack growth mechanism will be less ductile.
Constructability of Expansion Joint headers

Patch / Repair Materials
- Choosing the proper repair is just as important as choosing the right header material
  i.e. Magnesium based cementious based materials can gas up to 30 days

Substrate
- Sound concrete
- Avoid Slant shear bond lines
- Know if cracks are static vs dynamic

Equipment
- Use proper removal equipment and techniques so concrete fractures do not occur
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Upon Selection of Expansion Joints

Joint Selection Considerations:

- Movement rating + deck joint opening
- Temperature + time of installation
- Proper positioning and placement

All 3 must be considered!
Temperature + Time of Installation

- Plans specified 3” opening at 68°F mean temperature
- Installation @ 40 degrees
  - MR = ¼” per 10 degree change
  - 3.75” opening
- Installation @ 90 degrees
  - MR = ¼” per 10 degree change
  - 2.25” opening

Installation time can affect joint seal performance:
Over-compress, extend beyond their limits, or cut down on movement capacity
Proper Setting of Joints

Joint seal positioning and placement (groove depth) is as important as sizing the seal based on movement and joint opening.
Versatility of the seal type to accommodate the configuration of field conditions

Understand there is a joint system for every application, but there is no one joint system for all applications!
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Preservation Practices: Proactive vs. Reactive Approaches

Key Preservation Practices:

- Understand Expansion joint limitations
- Debris removal vs debris build-up
- Scheduled Routine Inspections – implementing an expansion joint maintenance program
Preservation Practices: Proactive vs. Reactive Approaches

Key Preservation Practices:
- Resealing or Spot replacement
- Monitoring movements
  - Bearings, joints, approach settlement
Recommendations

- Training of Field engineers on various expansion joints and technologies
- Correct seal size and placement of joints during temperature ranges
- Understanding the requirements of the service condition and attributes as well as limitations of the various systems considered for use
- Flexibility in actual field conditions vs “standards”
- Properly address large joint openings. Cantilevering is NOT the answer
- Understand there is a joint system for every application, but there is no one system for all applications!

Sustain the life of your bridges with more thought and consideration toward bridge expansion joints

- Temperatures below 40 F
- Deck moisture / Rain
- Resist corrosion
- Corrosion
Thank You!

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