

Bridge Paving Design, Construction, and Management



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Bridge Paving Outline

- Bridge Paving Introduction
- Bridge Paving Design
- Asphalt Removal on Bridges
- Bridge Membranes
- Paving Construction
- Bridge Paving Joints
- Paving Equipment Loads to Bridge

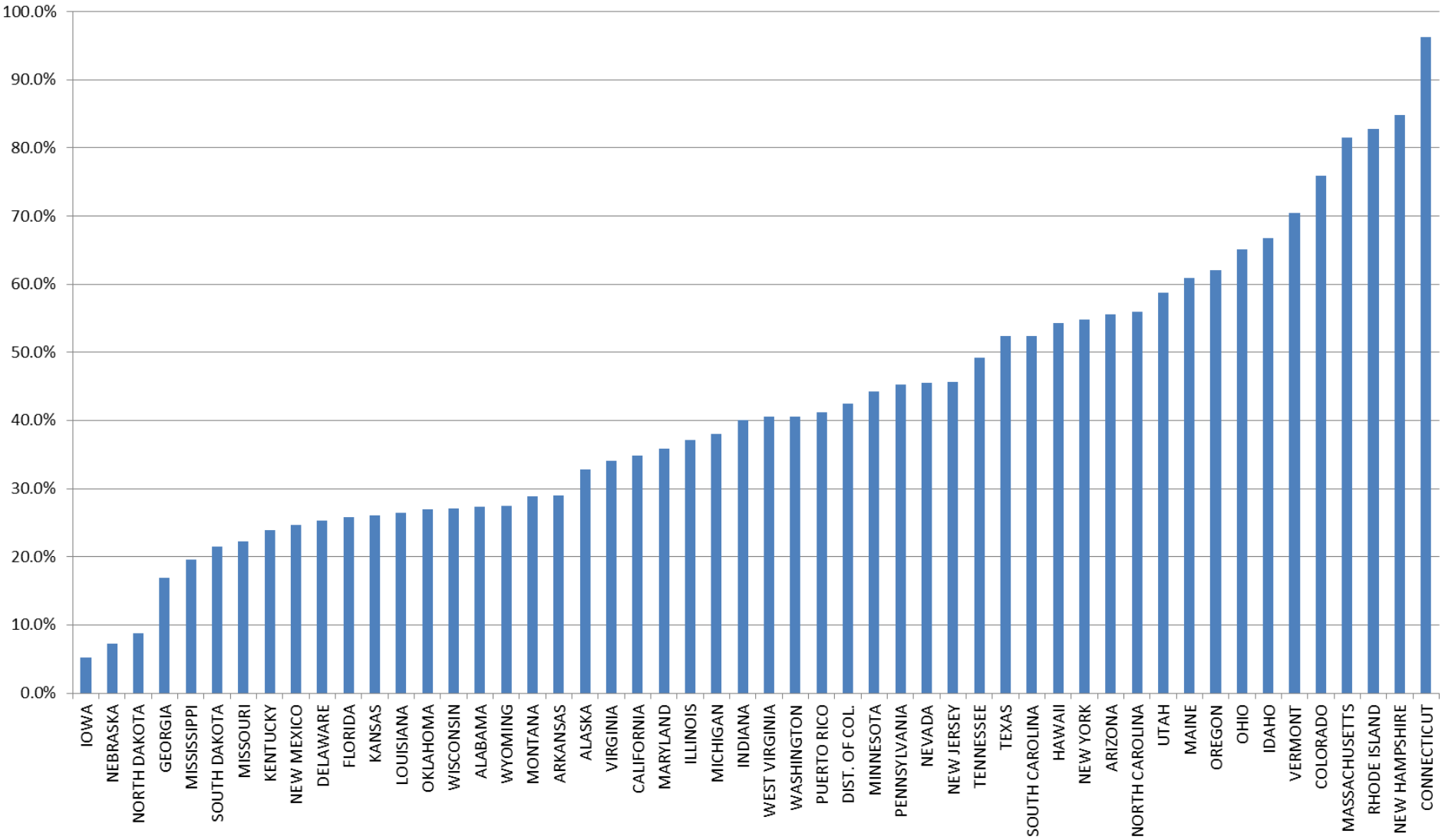
Bridge Paving

- Criteria changes with each structure.

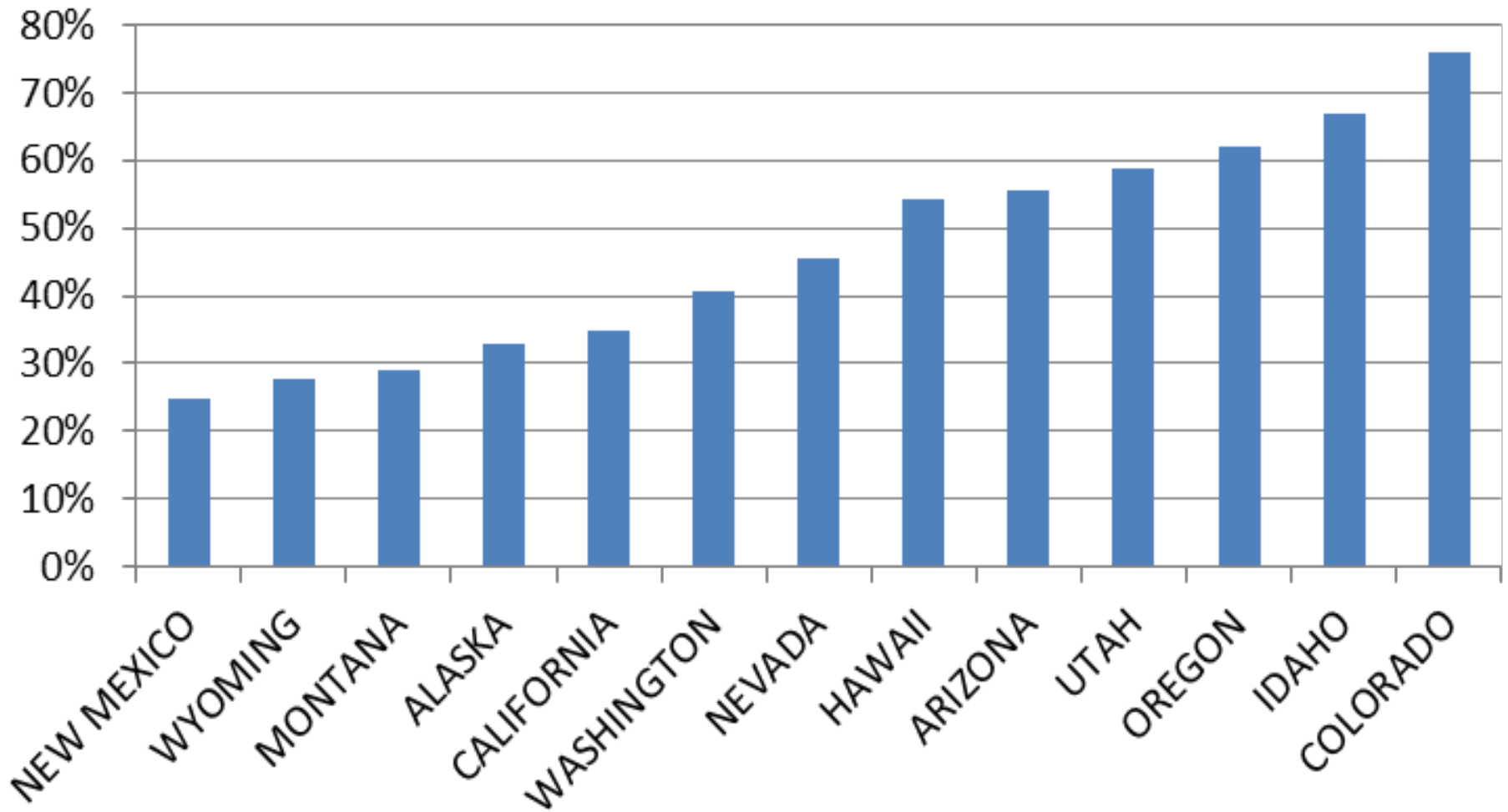


Bridge Paving National Trend

2012 NBI - % of Bridges with Asphalt

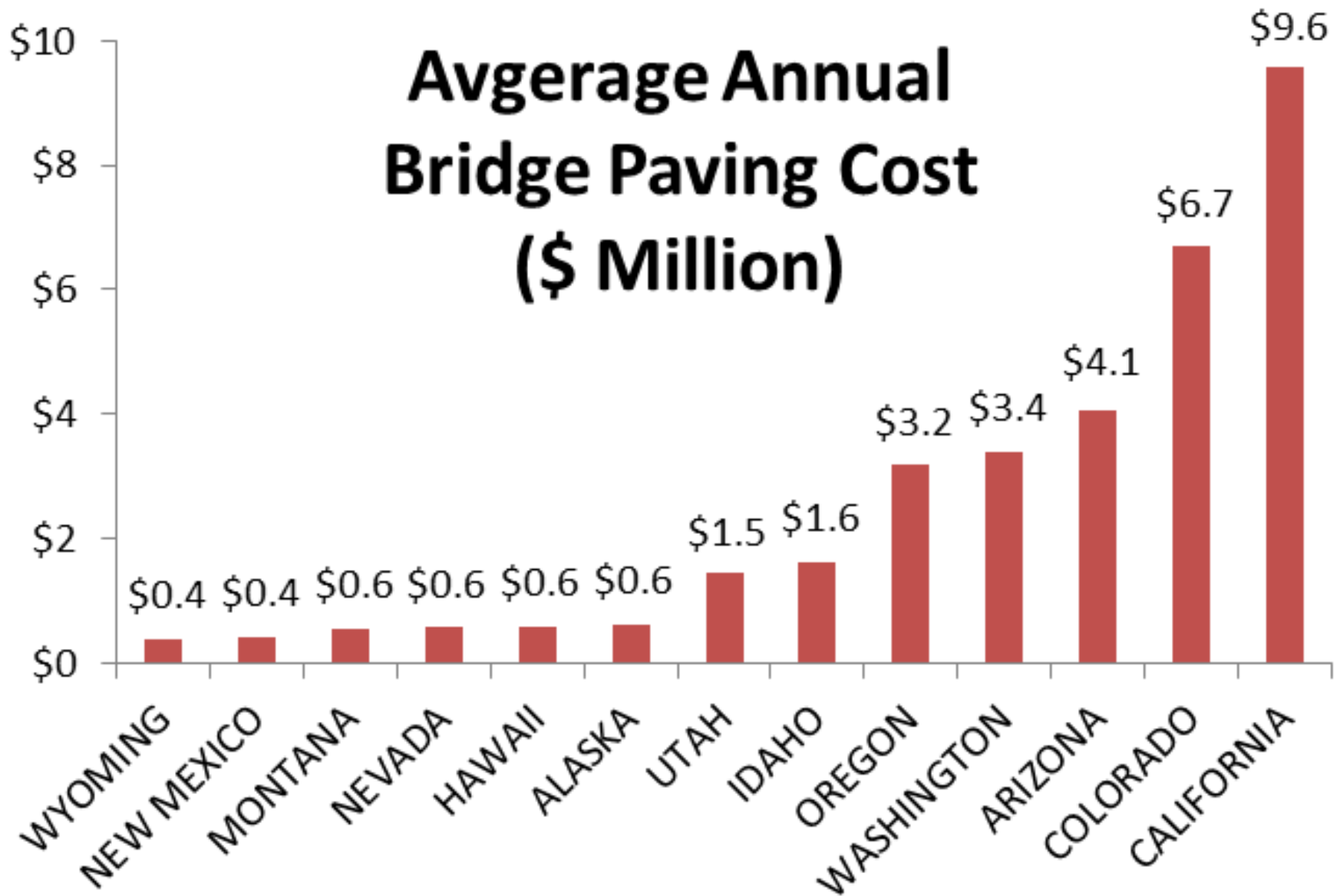


2012 NBI - % of Bridges with Asphalt



Western Bridge States at 25% to 75%

Average Annual Bridge Paving Cost (\$ Million)



Project Cost: \$4.00/SF - 20 yr. life - 2" Mill/Fill
Total = \$33M per year for Western Bridge States

Bridge Paving...



Why Pave the Bridges?

- Removes tires from concrete surface.
 - Also traps water next to concrete.
- Reasonable solution to rutting.
- Improved Construction for short bridges.
- Delay bridge/deck replacement.

Deck Candidate for Delay or Replacement



Bridge Paving Design



Bridge Paving Design

- Maximum Asphalt Depth:
 - Required for Load Rating
 - Limited by height of Joints/Headers
 - Limited by Bridge Rail Height
 - Optimum depth for bridge paving is 3" or more.
 - Provides 2" Mill/Fill with a 1" buffer to concrete deck
 - Bituminous Surface Treatment: 1/2" Chip Seal = 3/8"
 - Eventually will require grade correction by planing
- Membrane Required when using asphalt
- Planing may damage concrete

Depth Determines Paving Design

- Existing depth of asphalt must be known
- Partial Removal - leaves a layer of asphalt
- Full Removal - to deck without damage



Existing Depth

- May not match Plans/Records
- Plans show 3" of asphalt, but measures 5".



Hidden Existing Construction



Asphalt Removal on Bridges



Preferred Full Removal Method

- Scraping with Loader, Grader, Bob Cat
- Backhoe with a welded bar on the bucket



Unacceptable Methods for Full Removal on a Bridge

- Planing requires accurate asphalt depths.
- Other?



Common Planer Head

Planer Head Moving



Planer Head Still



Planer Tooth Tolerances

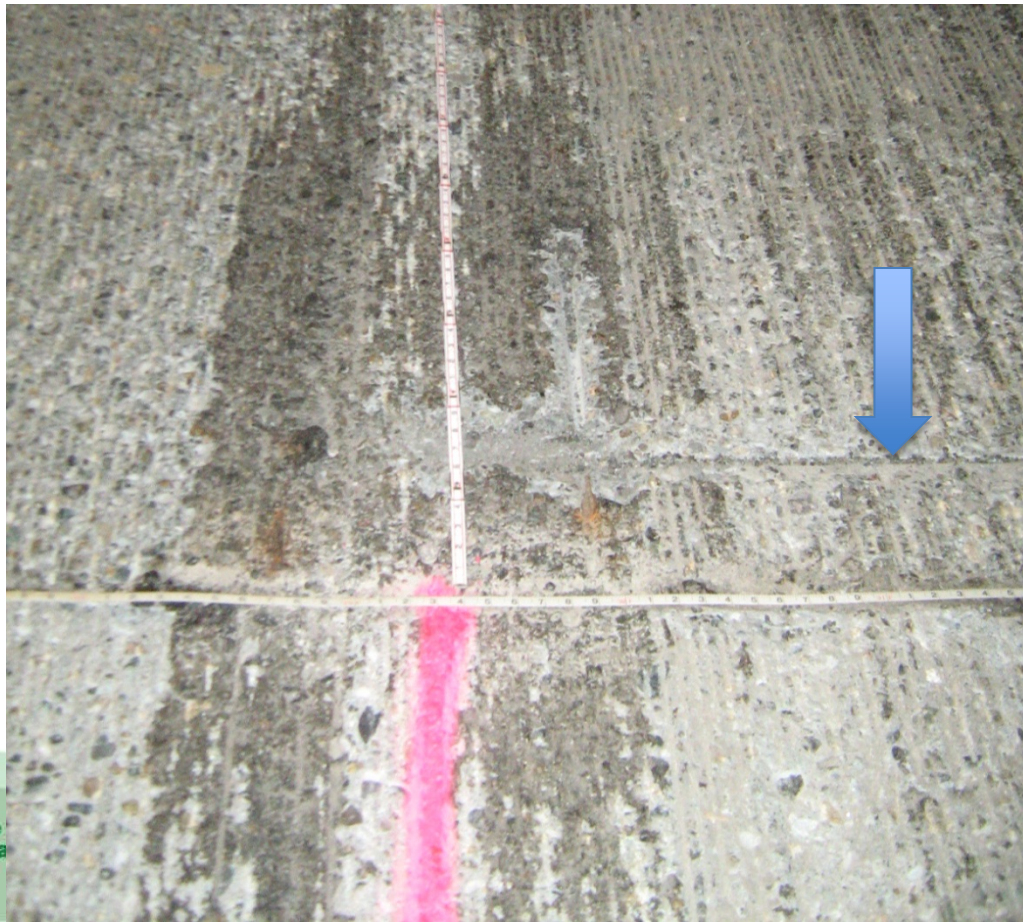
- Length of longest to shortest tooth < 3/8"
- 1/4" max. tooth spacing for membranes



Planer Damage to #5 bar
Showing 5/8" tooth spacing

Planing Removal & Some Cover

- 100% removal will eventually expose rebar.



Damage Can be Structural

- Structural problem for deck girders/slabs
 - Asphalt depth based on plans = 2 1/8"
 - Existing depth of 1" confirmed by planer



Bridge Membranes



Why use membranes?

- Asphalt passes water.
- Water & salts will penetrate the cracks and soak into the concrete with time.



Wet Asphalt After a Rain

Wet at Centerline



Membrane working



Sheet Membrane Specifications

- Families of Sheet Membranes
 - Non-woven or Woven
 - Cotton or Polymer fibers
 - Asphaltic, Rubber, or Polymer
- Durable membranes should specified
 - Tensile strength 50 lbs./in min.
 - Permeability 0.1 perm max.
 - Puncture Resistance 200 lbs min.
- Membrane repair in Construction Spec.

Placing a Sheet Membrane



High Performance Membrane



Membrane Placement @ Curb



Membranes Vulnerable to Construction Methods

- Planing operations
- Concrete surface that is too rough
 - Stray Rocks when placed
- Turning movements of asphalt equipment
- Asphalt repairs

- Membrane repair method should be included in specifications

Planer Damage Requires Membrane Repair



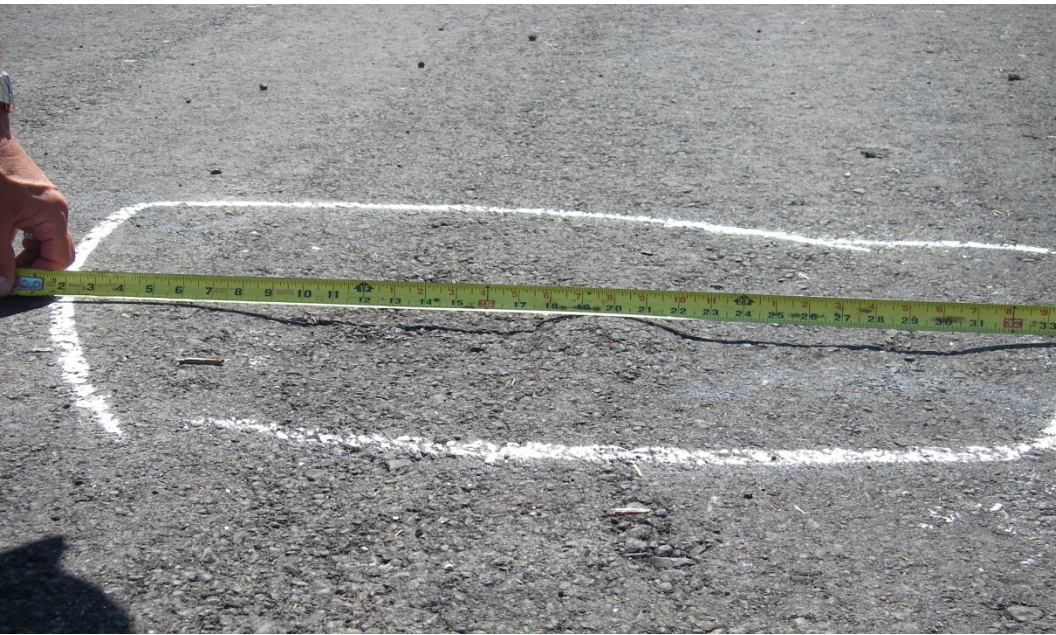
Rough Surface with Rock



Turning Movements



Asphalt Repairs Potential for Membrane Damage



Bridge Paving Construction



Checking Asphalt Depth



Grade Control may be required

- Paving Tolerance different than the roadway
- Critical for next resurfacing cycle



Longitudinal



Transverse

Grade Control Required at Joints



Asphalt $\frac{1}{4}$ " Higher than Steel/Conc.

- Allows for compaction at asphalt butt joint
- Allows for minor rutting
- Helps keep snow plows off the joint



Full Compaction Possible @ Edge



Asphalt 1/4" Higher than Steel/Conc



Grade Control for Transition Zone



Grade Control for Transition Zone



Snow Plow Removed the High Spot



Paving Tolerances may be Different for Bridges

- WSDOT Standard Specification for Roadway:
 - Must be smooth
 - No more than $\pm 1/8$ " in 10 feet (1" in 80 feet).
- WSDOT Bridge Paving
 - Must be a consistent depth
 - Within $\pm 1/4$ " of design asphalt depth

Bridge Compaction is Different

- Vibratory Compactors not allowed
 - Extra Effort required
- Specifications and Acceptance testing may not address bridge paving appropriately.
- Compaction critical within 6" of joints



Compaction Restrictions Can Vary

No Restriction



Restriction?



Restrictions Apply



Within 6" of Asphalt Butt Joints

Additional Extra Effort



Failure Within 6"

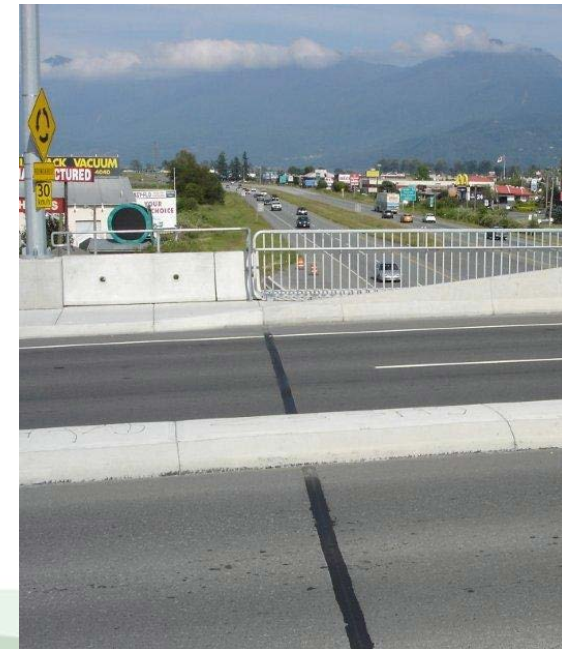


Bridge Paving Joints

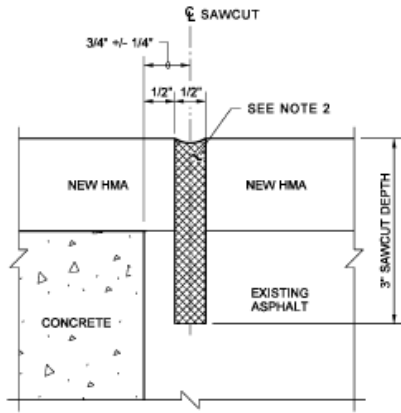


Asphalt Joints

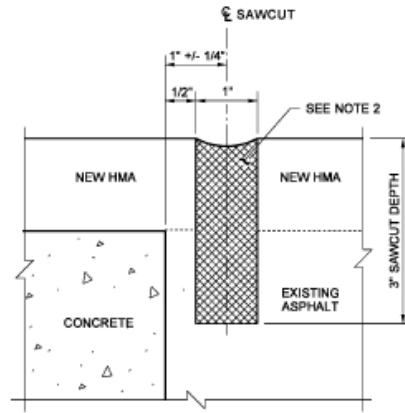
- Sawcut in HMA paving and filled w/sealer
 - Relieve cracking
 - Improved Wear
 - Mitigate water and settlements
 - Width is usually ½” or 1”
 - Sealed with Hot Poured Rubber
- Std. Plan A-40.20
 - Bridge Transverse Joint Seals



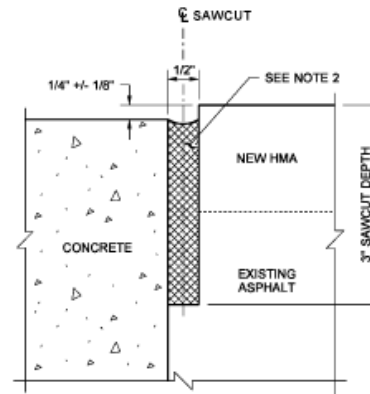
WSDOT Standard Paving Joints



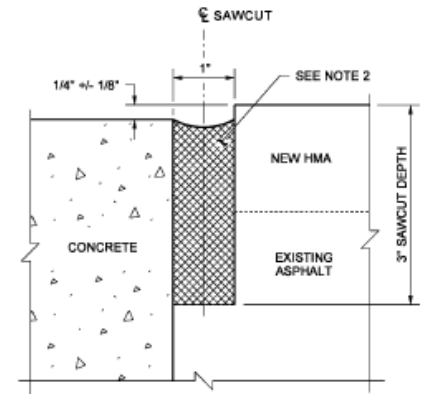
DETAIL 1



DETAIL 2



DETAIL 3



DETAIL 4

Element 401 – Sawcut Asphalt Joint

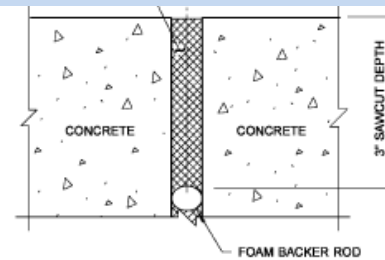
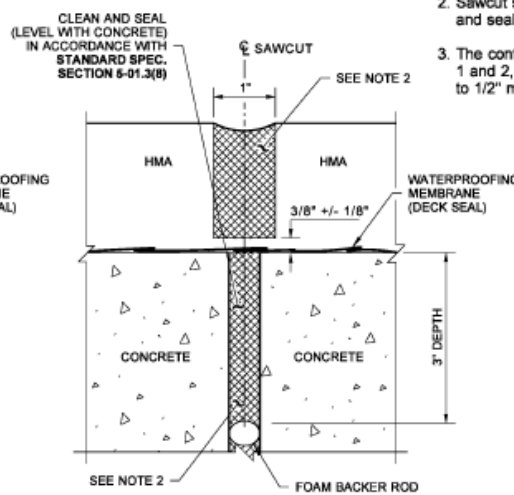
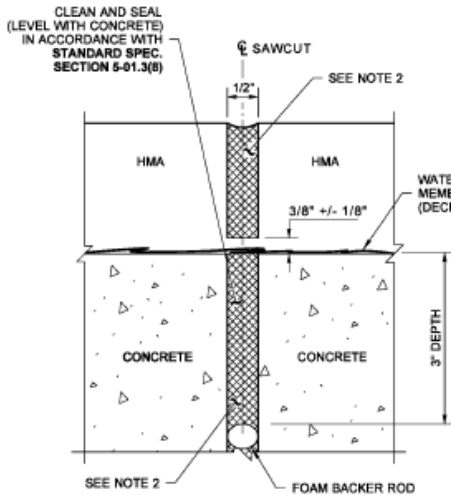
Element 400 – Asphalt Butt Joint

NOTES

1. Use the 1/2" joint details for bridges with expansion length less than 100' and for bridges with L type abutments. Use the 1" joint details for other applications. Use DETAIL 5 on steel trusses and timber bridges with concrete deck panels.
2. Sawcut shall be as described in **Standard Specification 5-05.3(8)** and sealed in accordance with **Standard Specification 5-05.3(8)B**.
3. The contractor shall avoid sawing out concrete at all locations. For details 1 and 2, the construction tolerance to locate the saw cut is 1/4" (0 min. to 1/2" max.) from the concrete.

Element 402 – Open Concrete Joint

PRELIMINARY



DETAIL 7
CONCRETE OPEN JOINT
1/2" JOINT SEAL

Element 401 – Sawcut Asphalt Joint

BRIDGE TRANSVERSE JOINT SEALS
STANDARD PLAN A-40.20-02

SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION

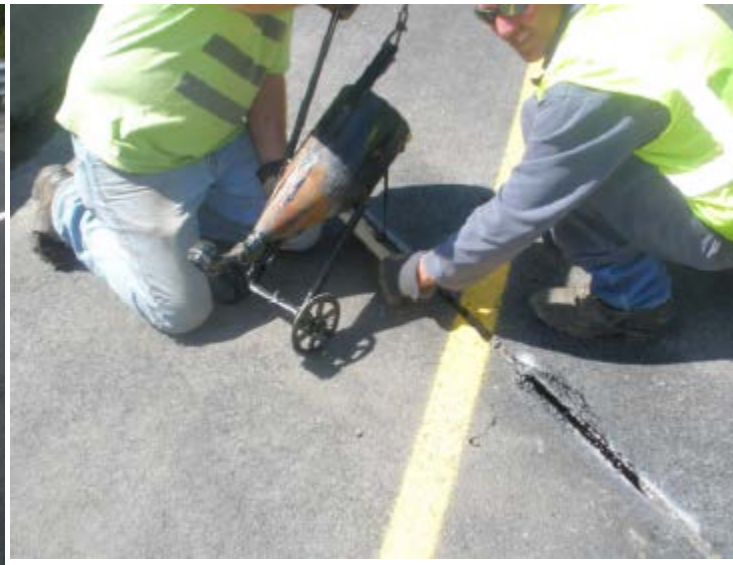
STATE DESIGN ENGINEER _____ DATE _____
Washington State Department of Transportation

Bridge Paving Joint Construction

Sawcut



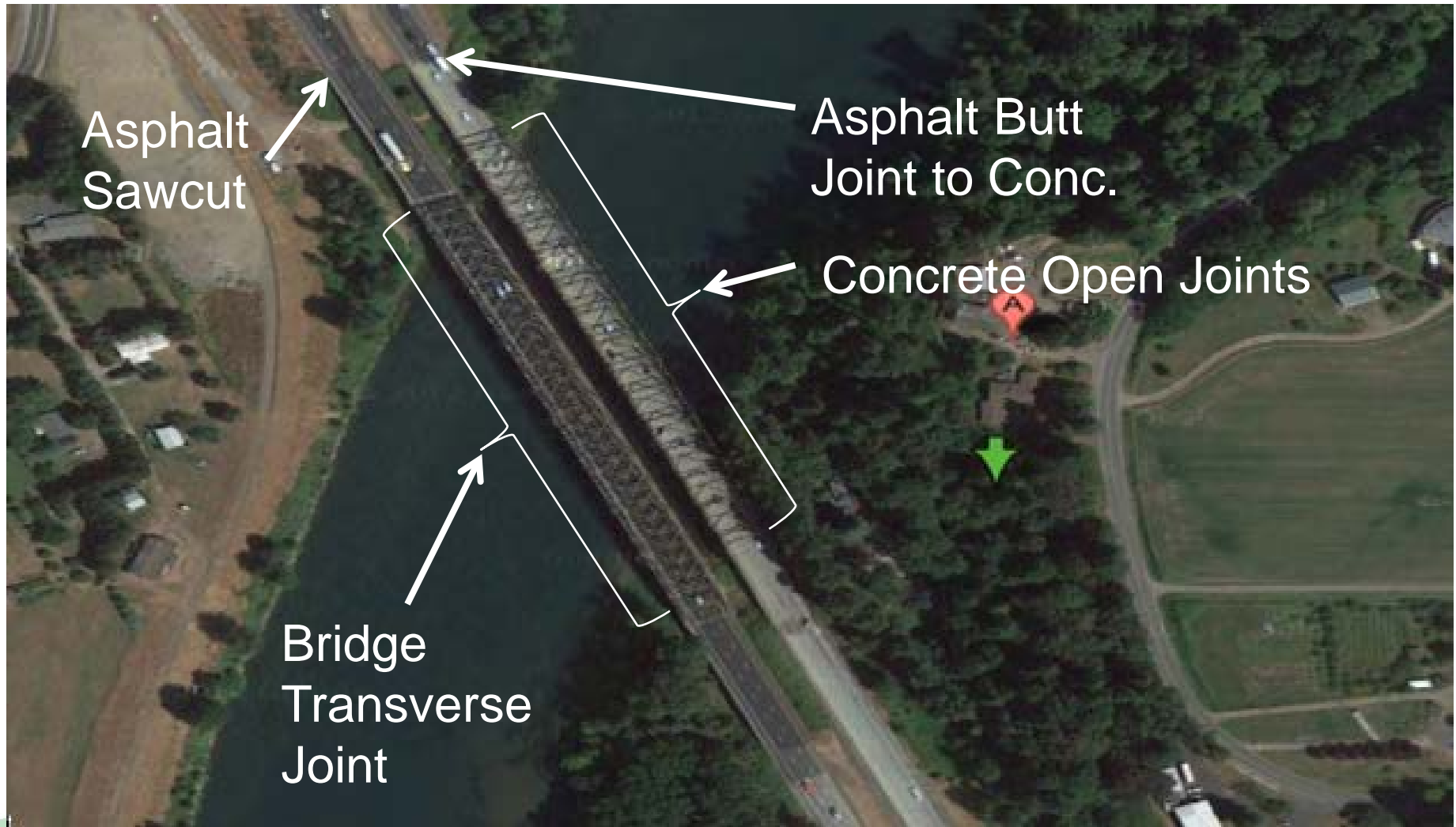
Sealing



Finished Joint



Standard Plan Paving Joints



5/40E & W Lewis River

Deterioration without Sawcut

22 years old – Low Traffic



Deterioration without Sawcut

Year 2000 - 15 years old

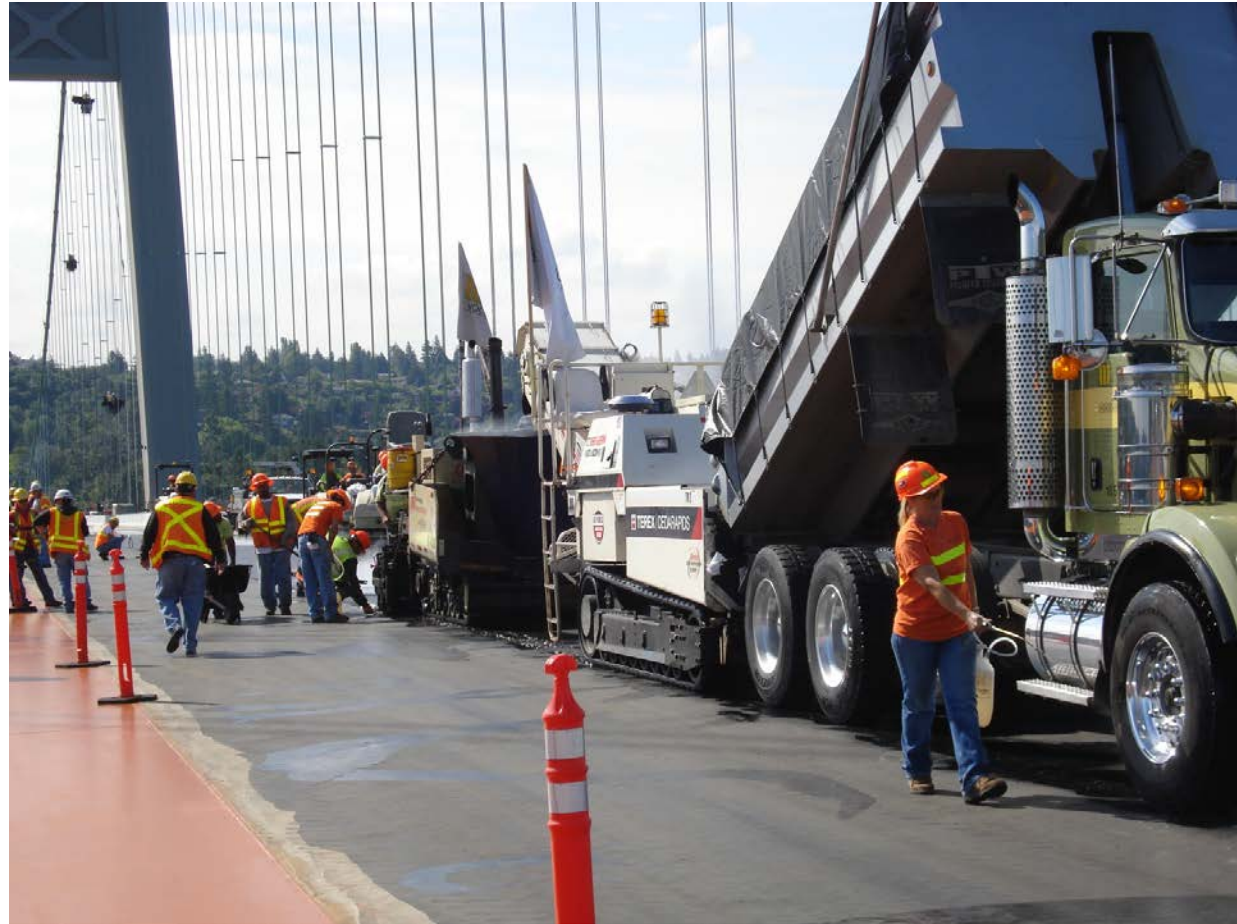


Year 2006 – 6 Years later



Paving Loads

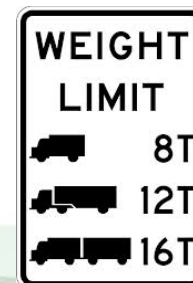
- Dump Truck
- MTV
- Paver
- Compactor



Maximum Equipment Loads

- Dump Truck: 40 Ton 3 axles
- Material Transfer: 70 Ton 2 axles
- Paver: 40 Ton 1 track
- Compactor: 15T+15T Vib. 2 axles

- Planer: 45 Ton 2 tracks



Paving Loads

- Equipment may not have Legal Axles.
- Posted bridges may limit operations.



Bridge Paving Summary

- Asphalt depth is the key criteria.
 - 3” or more is optimum to preserve structure.
 - Depth must be known prior to planing operations.
- Consider Grade Control.
- Membranes can be replaced.
 - Concrete cover can not.
- Posted bridges may limit paving equipment.

New Asphalt is HOT

- The most severe bridge expansion will be during placement of asphalt.
- Temperatures range from 260-350.

