



**2013 Virginia Concrete Conference
Joint Maintenance and Best Practices in Deck Joint
Replacement**

Jeff Milton

Bridge Preservation Specialist

Structure and Bridge Division

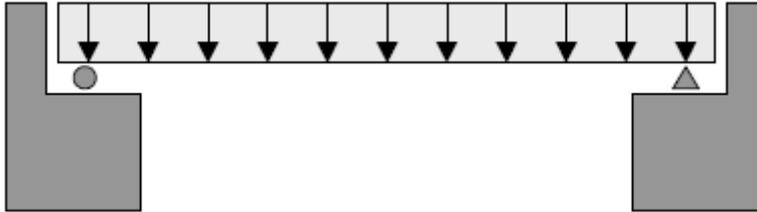
March 8, 2013

Presentation Outline

- **Why Joints?**
- **Purpose of Joints**
- **Typical Joint Systems Used in Virginia**
- **Leaking Joints**
- **Virginia Bridge Program**
- **Joint Maintenance Procedures**

Why Joints?

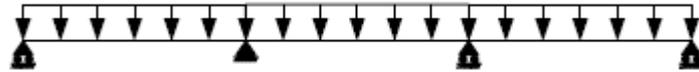
- **Beam and girder bridge superstructures may be constructed as simply supported spans or as continuously supported spans.**
- **Simply supported spans have only two supports, each located at or very near the ends. A simple span bridge can have a single span supported by two abutments, or multiple spans that have independent superstructures supported by two abutments and one or more piers.**



- **Deck joints will typically be required at both ends of a simply supported span.**

Why Joints?

- **Continuously supported spans have one or more intermediate supports. Continuously supported superstructures are somewhat more complicated for engineers to analyze. But, when they are designed and constructed properly, they are easier to maintain since they have fewer components.**



- **Deck joints will typically be required only at ends of beam or girder sections in continuously supported spans.**
- **By the nature of their construction, bridges with simply support spans will have more joints than bridges with continuously supported spans.**

Purpose of Joints

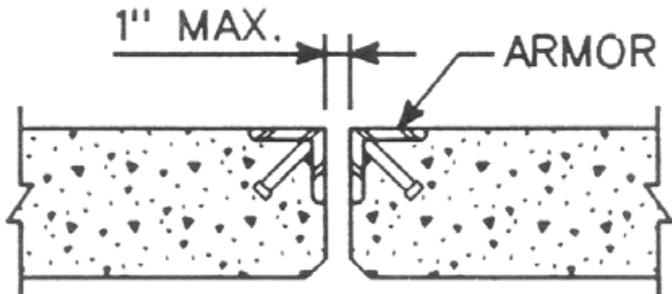
- **The purpose of bridge deck expansion joints is to accommodate movement of the superstructure. Superstructure movement is caused by the following :**
 - **Expansion and contraction caused by temperature variation**
 - **Concrete shrinkage and creep**
 - **Live load deflection**
 - **Wind and seismic loads**
 - **Settlement**

Typical Joint Systems Used in Virginia

- **The following types of joint systems may be found on existing bridges in Virginia:**
 - **Armored Joints – Open or Sealed**
 - **Hot Poured Sealer /Expansion Material**
 - **Preformed Elastomeric Compression Seals**
 - **Poured (Silicone) Seals**
 - **Asphalt Plug Joints (limited number)**
 - **Strip Seals**
 - **Sliding Plate Joints**
 - **Finger Joints**
 - **Cushion Seal (previously denoted as elastomeric expansion dam – limited number remaining)**

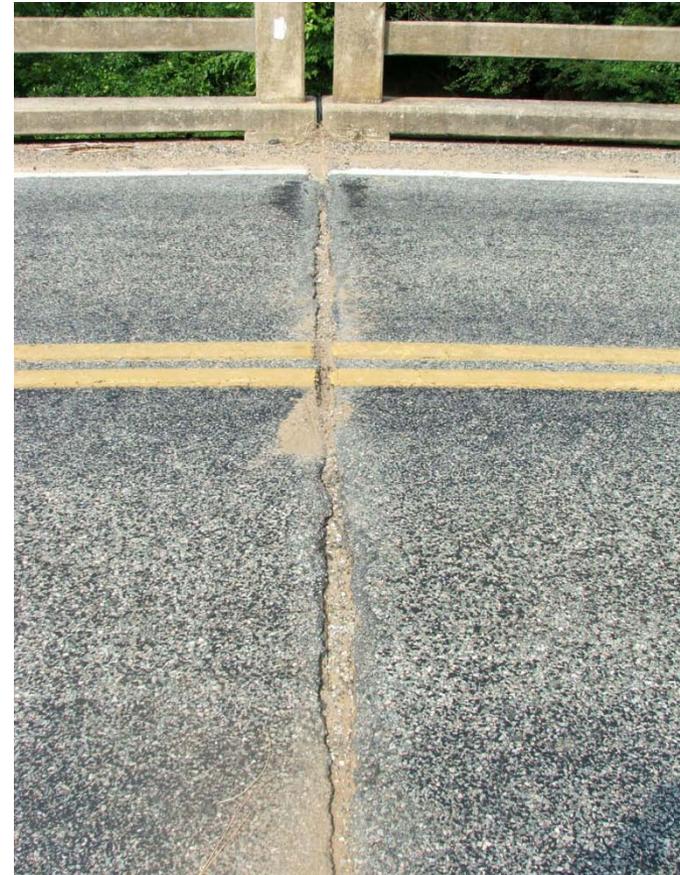
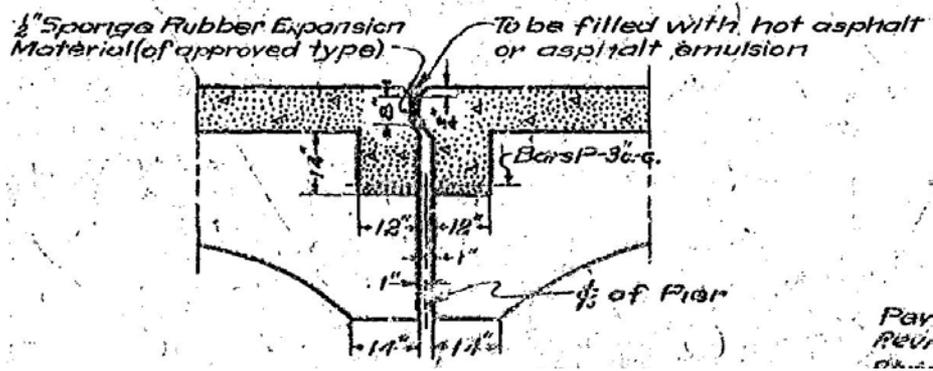
Typical Joint Systems Used in Virginia

➤ Armored Joints



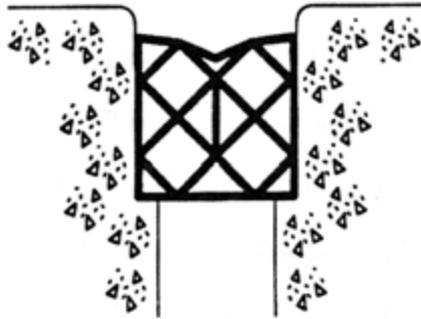
Typical Joint Systems Used in Virginia

➤ Hot Poured Sealer /Expansion Material



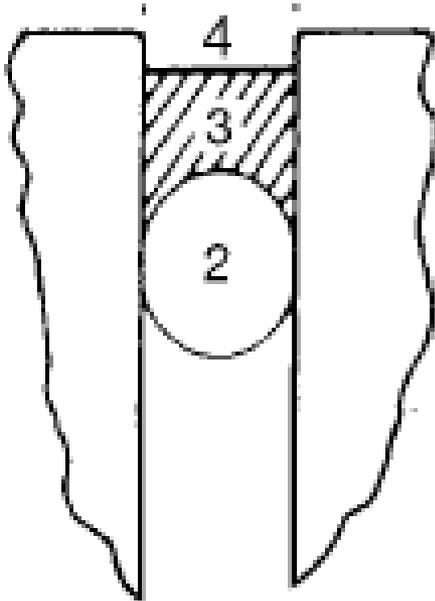
Typical Joint Systems Used in Virginia

➤ Preformed Elastomeric Compression Seals



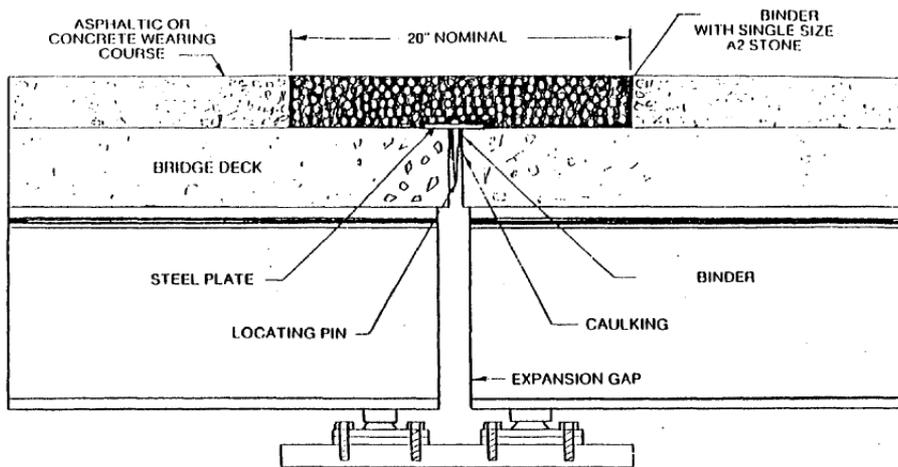
Typical Joint Systems Used in Virginia

➤ Poured (Silicone) Seals



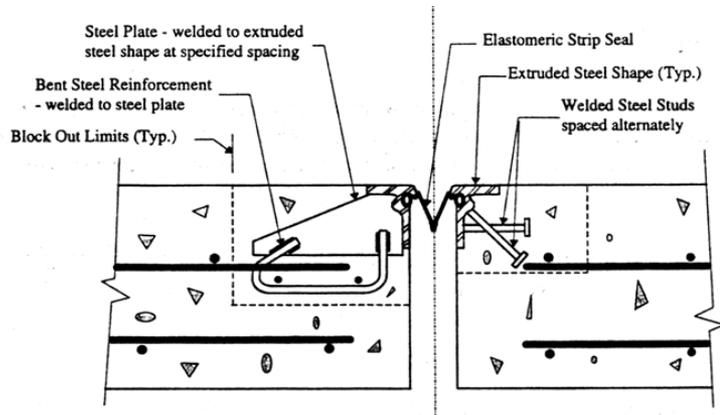
Typical Joint Systems Used in Virginia

➤ Asphalt Plug Joints (limited number)



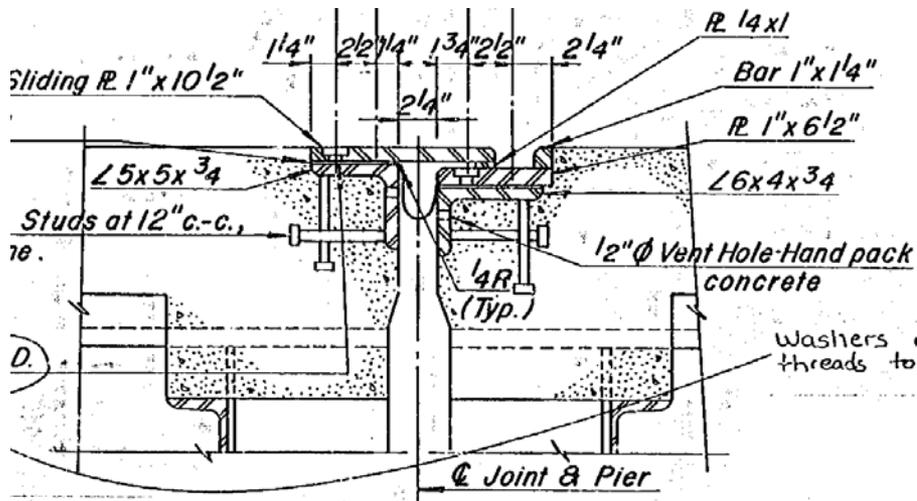
Typical Joint Systems Used in Virginia

➤ Strip Seals



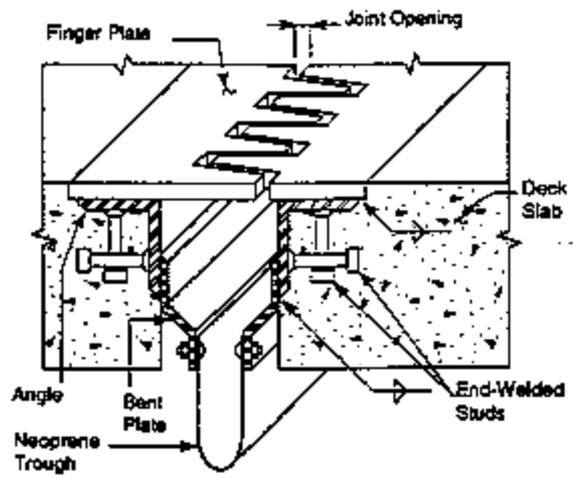
Typical Joint Systems Used in Virginia

➤ Sliding Plate Joints



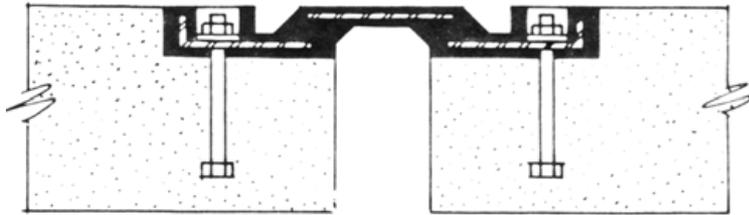
Typical Joint Systems Used in Virginia

➤ Finger Joints



Typical Joint Systems Used in Virginia

➤ Cushion Seal (Elastomeric Expansion Dam)



Leaking Joints

- **Leaking bridge deck expansion joints allow run-off water and deicing chemicals to pass through the joints and onto superstructure and substructure members.**

- **The following bridge components are adversely affected by leaking joints:**
 - **End Diaphragms**
 - **Beam/Girder Ends**
 - **Bearings**
 - **Substructure Seat Areas**
 - **Other Substructure Areas**

- **Leaking joints cause significant deterioration and damage to bridge components and are a nationwide bridge maintenance problem. Many millions of dollars are spent each year repairing the damage caused by leaking joints.**

Leaking Joints



Leaking Joints



Leaking Joints

- Deterioration and damage – steel End Diaphragms



Leaking Joints

- **Deterioration and damage – steel End Diaphragms**



Leaking Joints

- **Deterioration and damage – concrete End Diaphragms**



Leaking Joints

- **Deterioration and damage – steel beam ends**



Leaking Joints

- Deterioration and damage – concrete beam ends



Leaking Joints

- Deterioration and damage – bearings



Leaking Joints

- Deterioration and damage – bearings



Leaking Joints

- Deterioration and damage – pier seats and cap



Leaking Joints

- **Deterioration and damage – pier cap**



Leaking Joints

- **Deterioration and damage – overall**



Virginia's Bridge Program

- **The Virginia Bridge Program consists of the following four work actions:**
 - Preventive Maintenance
 - Restorative Maintenance
 - Rehabilitation
 - Replacement

- **Preventive Maintenance and Restorative Maintenance are the components of Virginia's Bridge Preservation Program.**

- **Viewed from a high level –**
 - Preventive maintenance candidates are structures in Good Condition (a low General Condition Rating of 6 or greater)
 - Restorative maintenance candidates are structures in Fair Condition (a low General Condition Rating equal to 5)
 - Rehabilitation and replacement candidates are structures in Poor Condition (a low General Condition Rating of 4 or less)

Virginia's Bridge Program

- **Preventive maintenance can be condition based or non-condition based. Non-condition based preventive maintenance is typically referred to as Planned Preventive Maintenance.**
 - **Condition based Preventive Maintenance includes sealing leaking deck joints on bridges that are in overall good condition**
 - **Planned Preventive Maintenance includes Scheduled Replacement of Compression Seal Joints in good condition (10 year cycle) and Scheduled Replacement of Pourable Joints in good condition (6 year cycle)**
- **Restorative Maintenance includes Reconstructing/Closing Joints on bridges that are in fair condition**
- **There are approximately 19,400 state maintained structures in the inventory - approximately 11,850 of the structures are bridges**
- **The current overall condition for the statewide inventory is shown below:**
 - 70% of the structures are in Good condition
 - 23% of the structure are in Fair condition
 - 7% of the structures are in Poor condition

Joint Maintenance

- **Joint Maintenance activities include:**
 - **Cleaning and Flushing Troughs under open and finger joints**
 - **Replacing existing joint material with new material – where the surfaces adjacent to the joint are in good condition – this activity may require saw cutting when the new material is a preformed elastomeric compression sealer**
 - **Reconstructing concrete slabs and/or back-walls adjacent to joints and installing new joint material**
 - **Constructing Asphalt Plug Joints on decks having asphalt overlays**
 - **Eliminating joints by constructing joint closures and slab extensions**

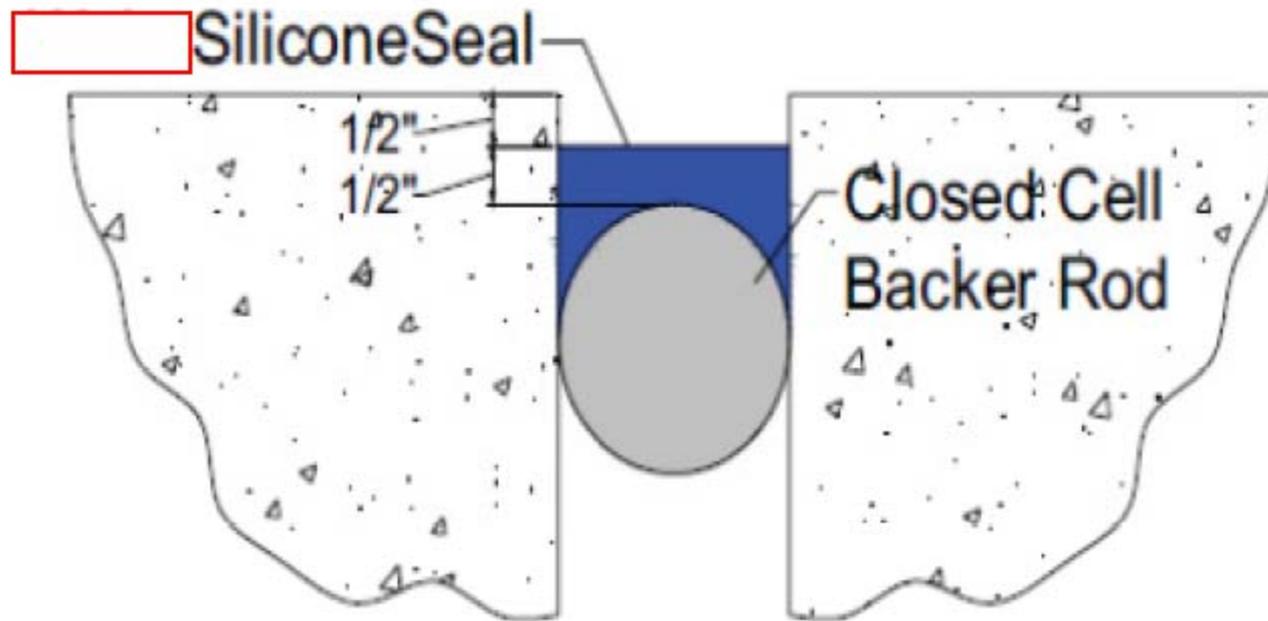
Joint Maintenance

- **Cleaning and Flushing Troughs under open and finger joints**



Joint Maintenance

- Replacing existing joint material with new silicone material



Joint Maintenance

- Replacing existing joint material with new silicone material



Joint Maintenance

- Replacing existing joint material with new silicone material



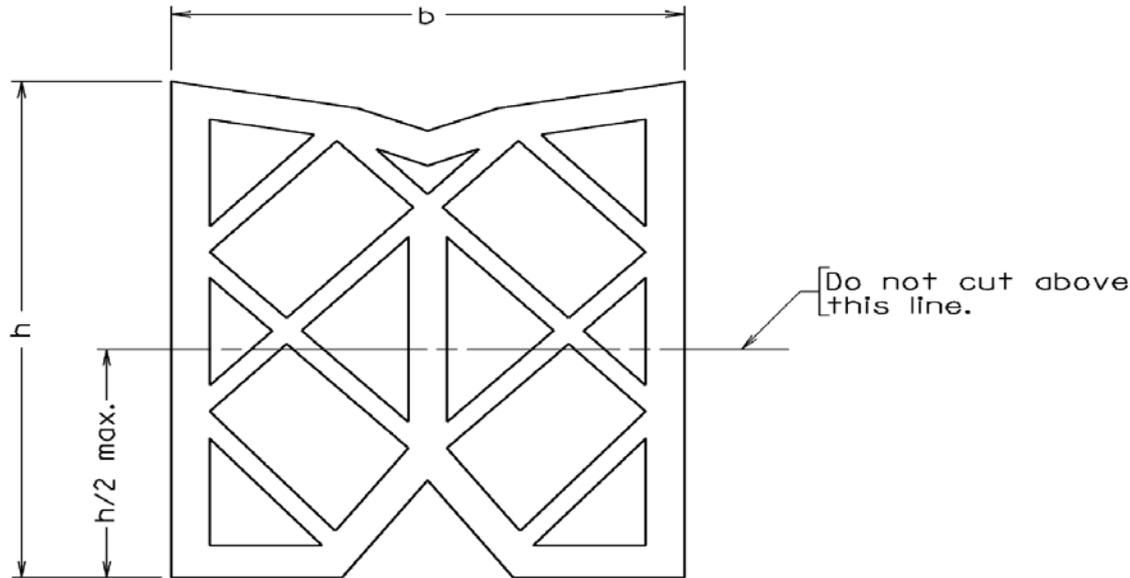
Joint Maintenance

- Replacing existing joint material with new silicone material



Joint Maintenance

- Reconstructing concrete slabs and back-walls adjacent to joints and installing new joint material – **Preformed Elastomeric Compression Seal**

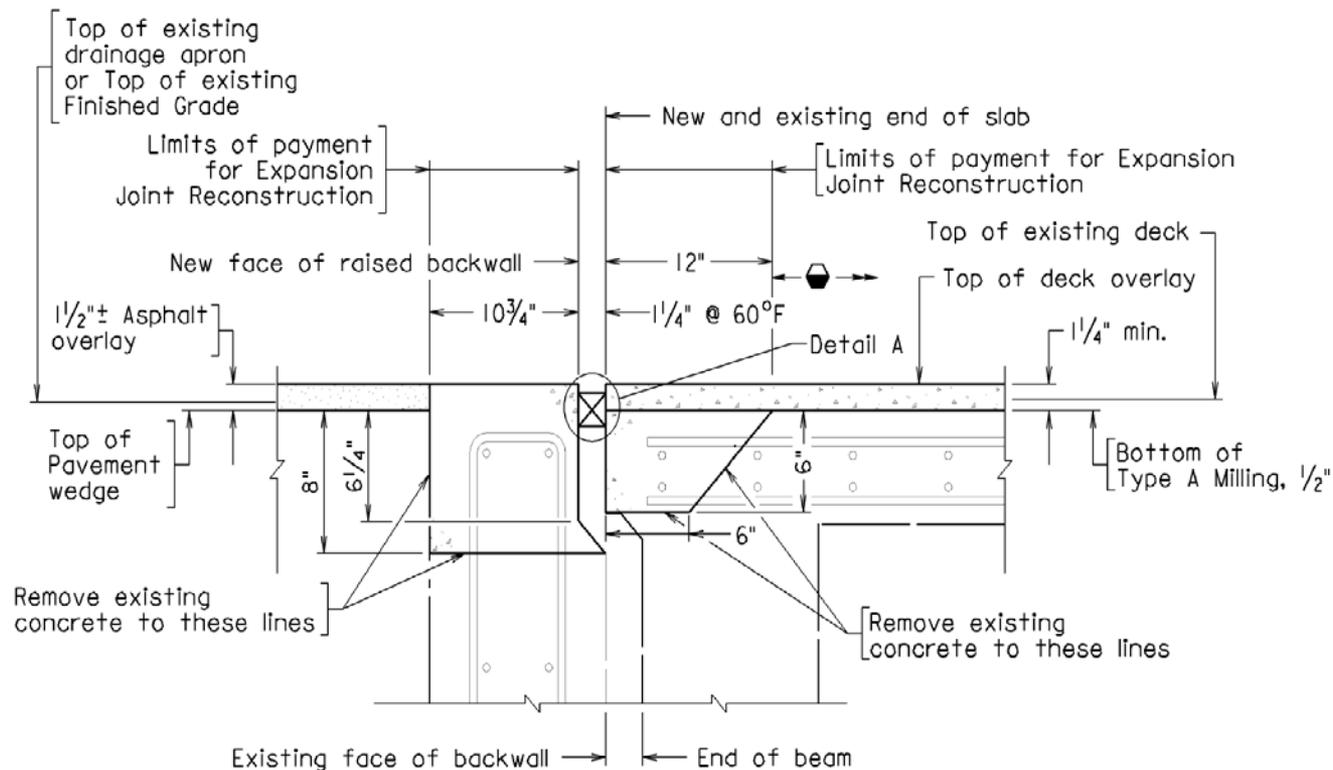


PREFORMED ELASTOMERIC JOINT SEALER

In uncompressed state

Joint Maintenance

- Reconstructing concrete slabs and back-walls adjacent to joints and installing new joint material - Preformed Elastomeric Compression Seal



Joint Maintenance

- **Reconstructing concrete slabs and back-walls adjacent to joints and installing new joint material - Preformed Elastomeric Compression Seal**



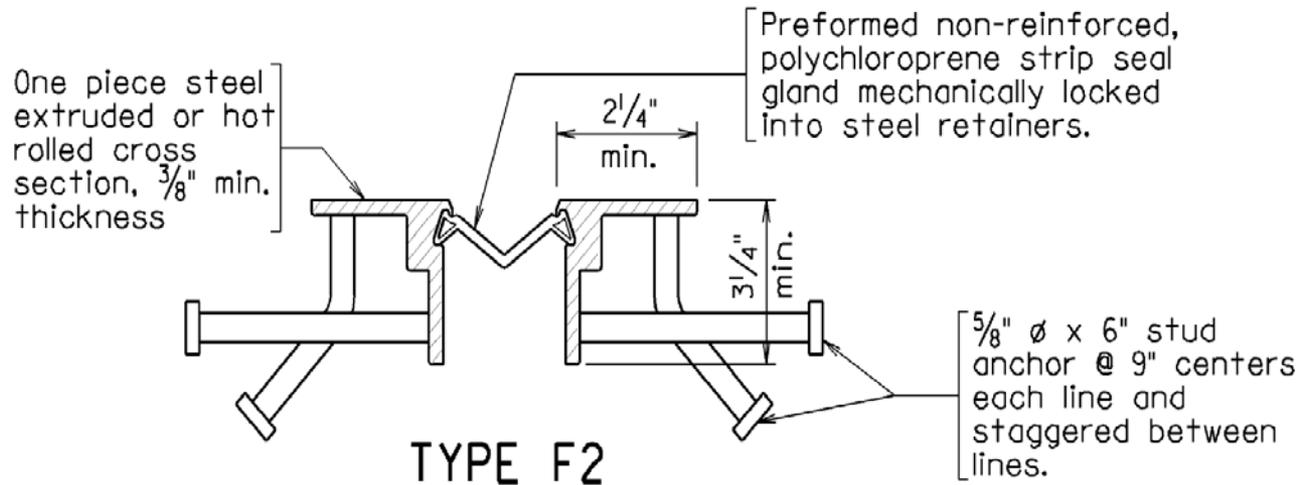
Joint Maintenance

- **Reconstructing concrete slabs and back-walls adjacent to joints and installing new joint material –
Preformed Elastomeric Compression Seal**



Joint Maintenance

- **Reconstructing concrete slabs adjacent to joints and installing new joint material – Strip Seal**

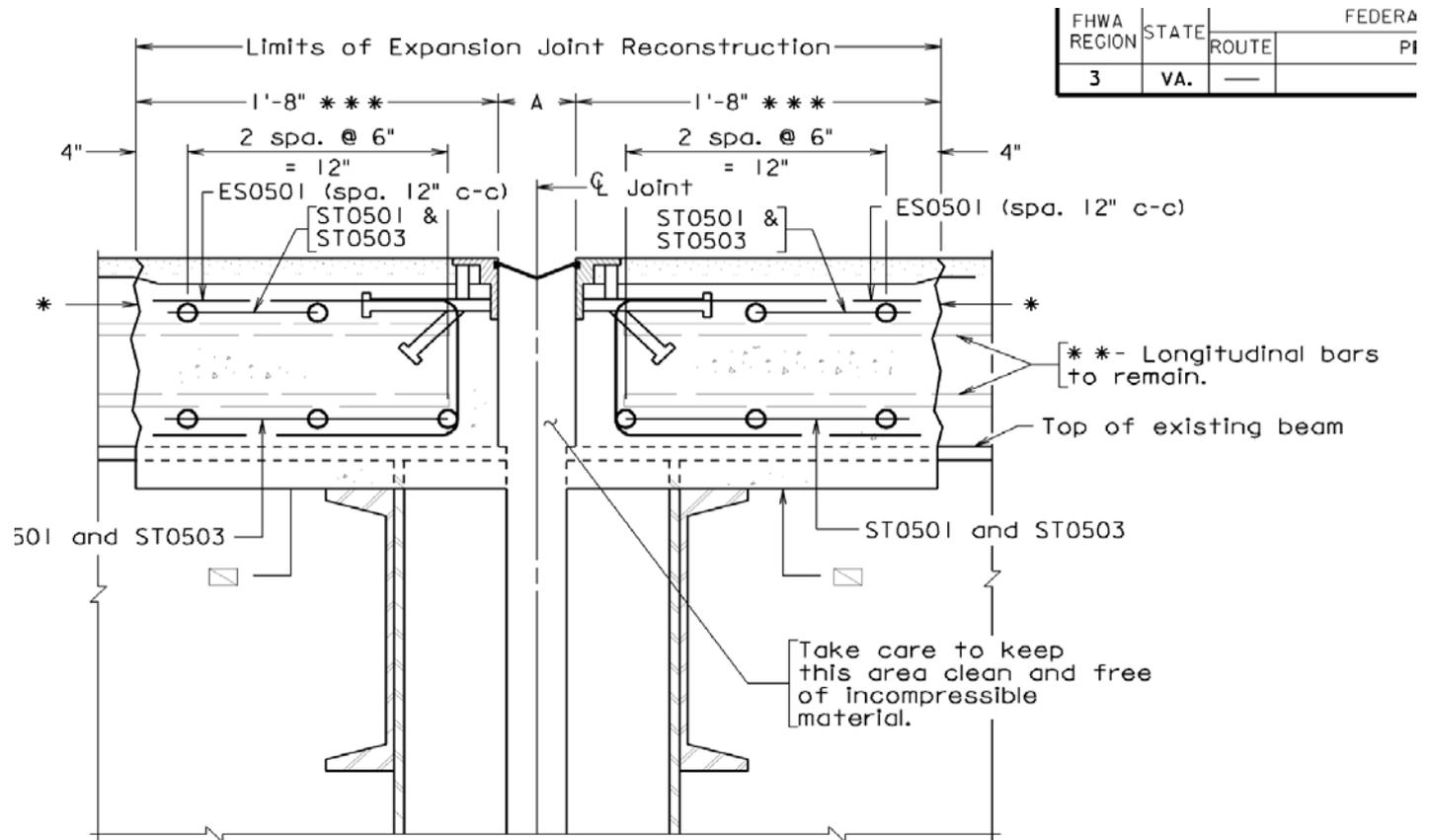


Dam Proprietary Nomenclature:

Type F2 = Wabo Strip Seal, Steelflex SSCM-2 and SSPA (D.S.Brown)

Joint Maintenance

- Reconstructing concrete slabs adjacent to joints and installing new joint material – Strip Seal



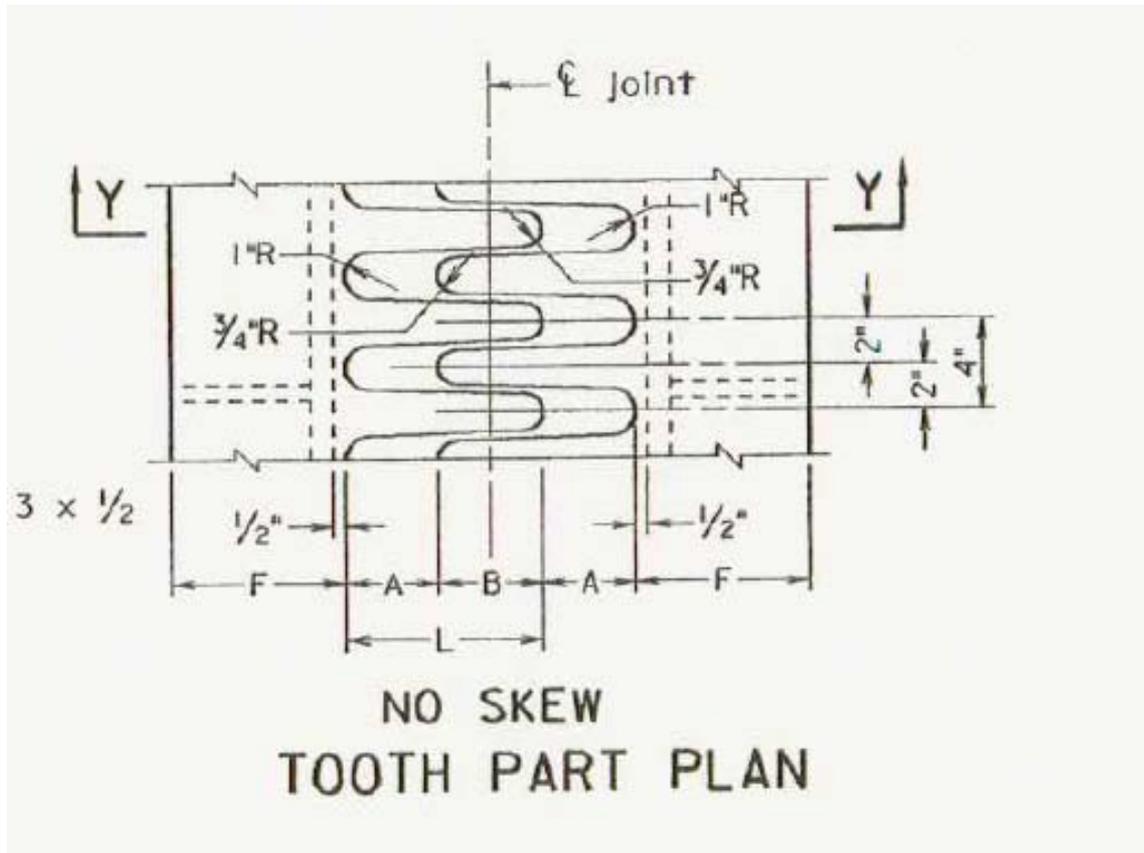
Joint Maintenance

- **Reconstructing concrete slabs adjacent to joints and installing new joint material – Strip Seal**



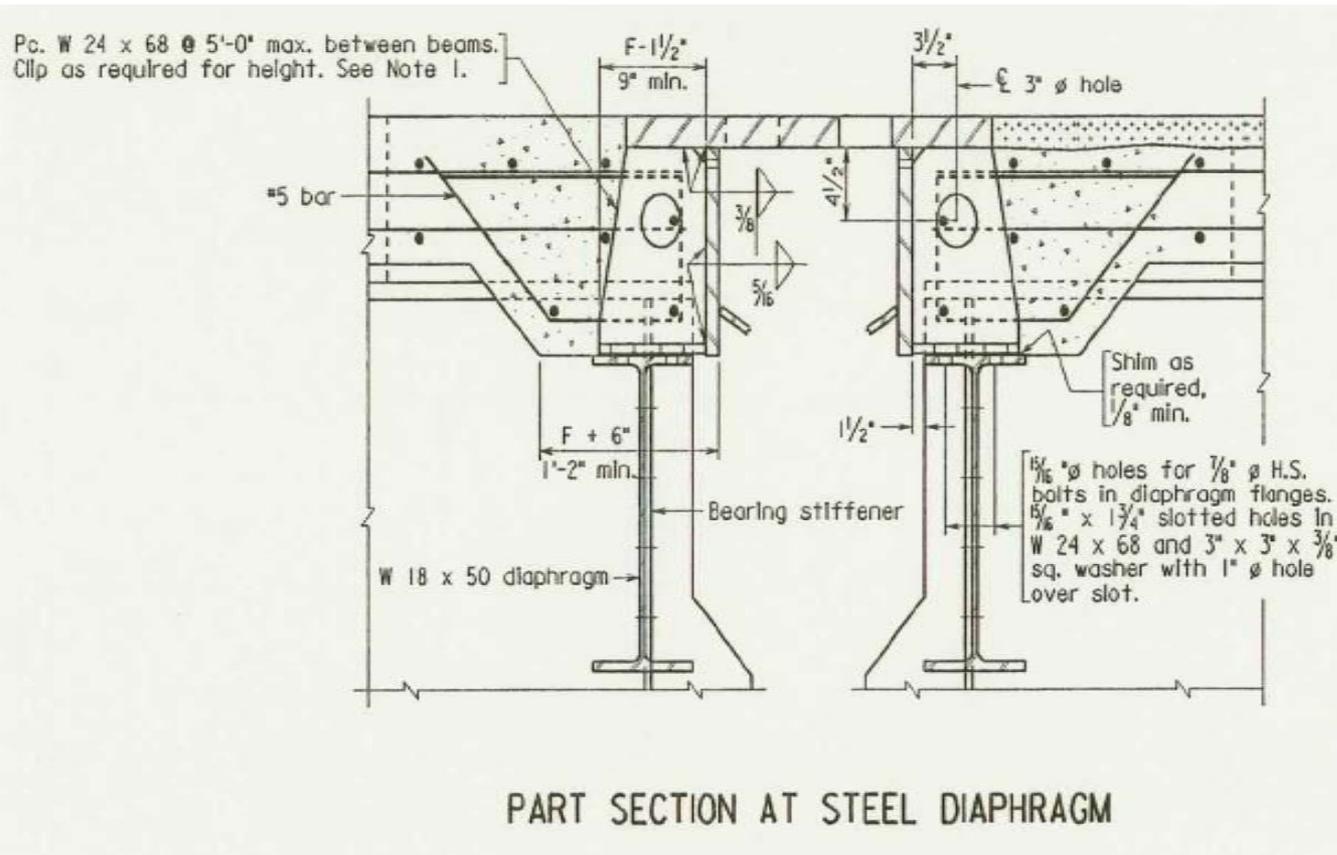
Joint Maintenance

- Reconstructing concrete slabs and back-walls adjacent to joints and installing new joint material – Tooth Joint



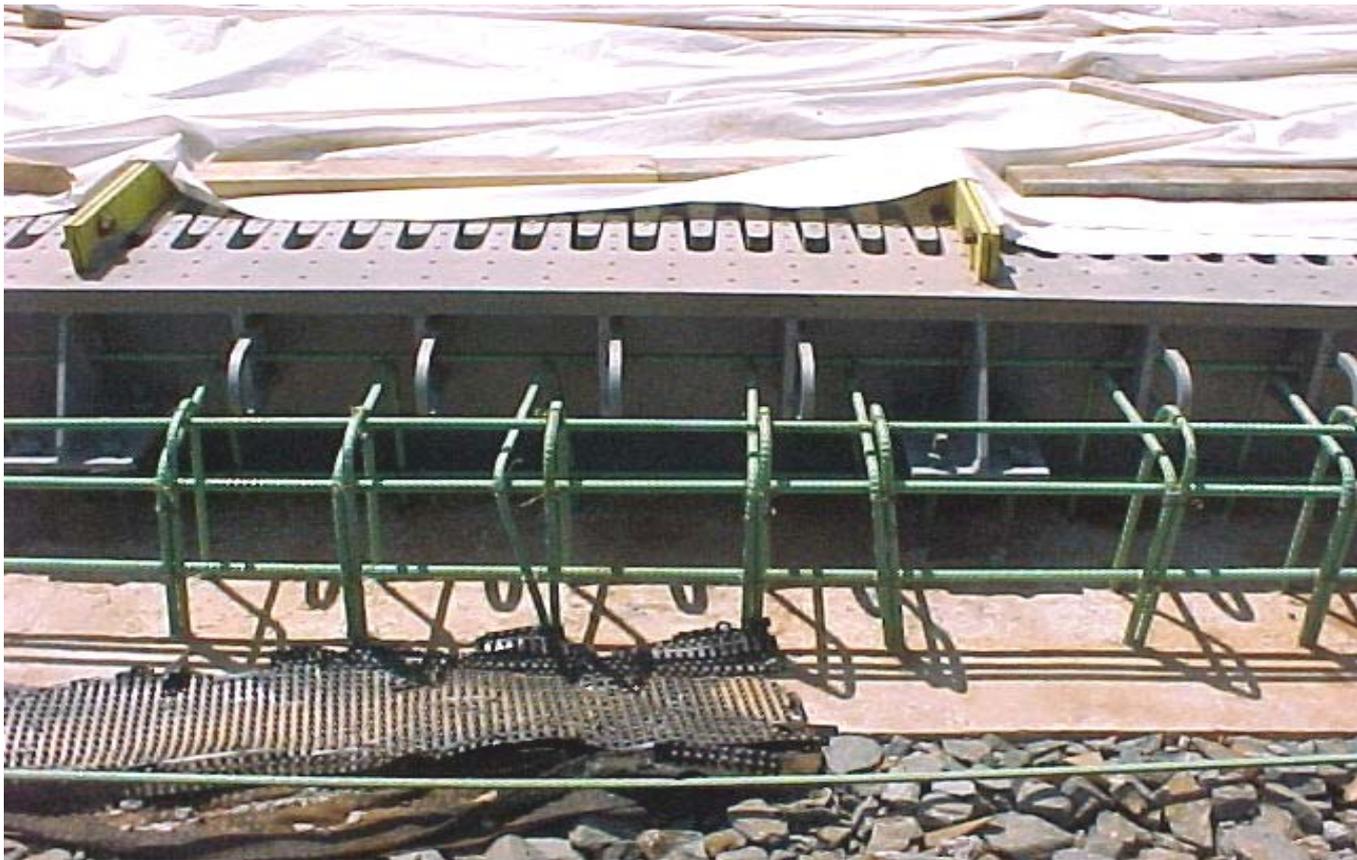
Joint Maintenance

- Reconstructing concrete slabs and back-walls adjacent to joints and installing new joint material – Tooth Joint



Joint Maintenance

- **Reconstructing concrete slabs and back-walls adjacent to joints and installing new joint material – Tooth Joint**



Joint Maintenance

- Reconstructing concrete slabs and back-walls adjacent to joints and installing new joint material – Tooth Joint



Joint Maintenance

- **Check Points for reconstructing concrete slabs and back-walls adjacent to joints:**
 - **Mark area of concrete to be removed as shown on plan details**
 - **Outline area with saw cut to a depth of 1”**
 - **Remove concrete as shown on the plan details using hand tools and pneumatic hammers. Pneumatic hammers should have maximum weight of 30 pounds and should be worked at an angle of 45 to 60 degrees to the plane of the surface being removed**
 - **Set and secure forms for joint – adjusting joint opening as necessary for temperature**
 - **Clean area by abrasive blast cleaning**
 - **Place new reinforcing steel as shown on plan details and check reinforcing steel for section loss – bars that has lost $\frac{1}{4}$ or more of their original cross sectional area shall be lapped with new bars of the same size – lap shall be 30 diameters on each side**
 - **Remove dust and debris from area and ensure that existing concrete is in a saturated-surface dry condition before placing new concrete**
 - **Measure and record dimensions of area before placing new concrete**
 - **Place, consolidate, and cure new concrete**

Joint Maintenance

- **Example of poor construction practice when reconstructing concrete slabs and back-walls adjacent to joints**



Joint Maintenance

- **Example of poor construction practice when reconstructing concrete slabs and back-walls adjacent to joints**



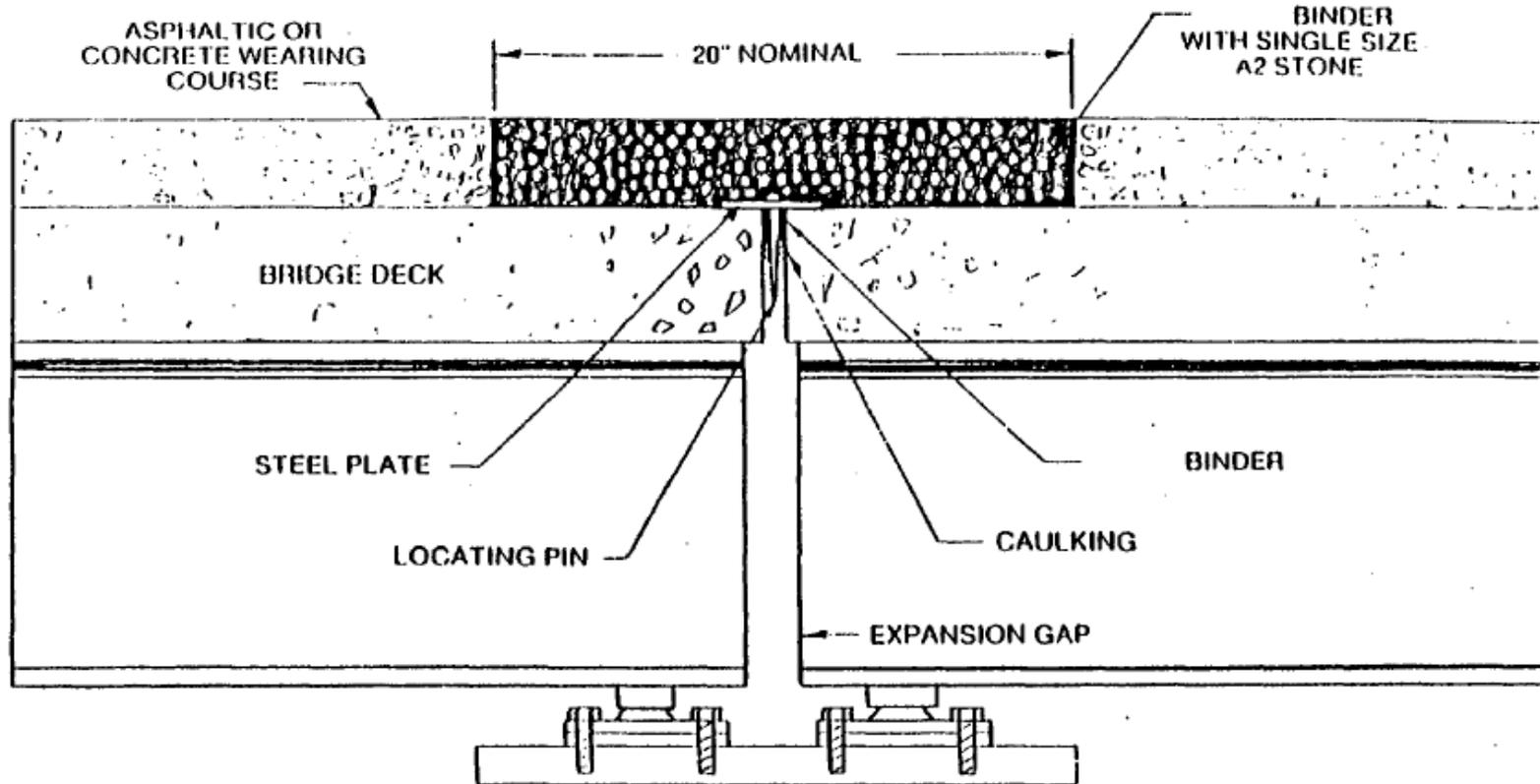
Joint Maintenance

- Example of poor construction practice when reconstructing concrete slabs and back-walls adjacent to joints



Joint Maintenance

- **Constructing Asphalt Plug Joints on decks having asphalt overlays**



Joint Maintenance

- **Constructing Asphalt Plug Joints on decks having asphalt overlays**



Joint Maintenance

- **Constructing Asphalt Plug Joints on decks having asphalt overlays**



Joint Maintenance

- **The best joint maintenance is to eliminate the joint**
- Chapter 32 of the Manual of the Structure and Bridge Division contains the following instructions to designers –
 - The designer shall investigate the feasibility of eliminating all deck expansion joints. Typically, issues requiring examination include, but are not limited to, the nature and condition of the bearings, bearing layout, adequacy of fixed bearings and corresponding piers to handle longitudinal forces, adequacy of fixed and expansion bearings to handle transverse forces, movement capability of expansion bearings that remain active, pier flexibility, structure symmetry with respect to location of fixed pier(s), the size of any remaining joints, bridge length, degree of curvature, span lengths greater than 120, etc.
 - When the elimination of all pier joints is not possible, provide deck continuity over substructure units with potentially higher relative repair costs such as tall column piers in the water as opposed to short piers on land
 - Elimination of the existing abutment joints by using deck extensions is also expected; however, the issues relating to the nature of the bridge and the presence of existing approach slabs to remain in place may inhibit feasibility
 - Justification for any remaining joints shall be provided via email to the Assistant State Structure and Bridge Engineer for Maintenance and posted in IPM.

Joint Maintenance

- **Eliminating joints by constructing joint closures at piers**



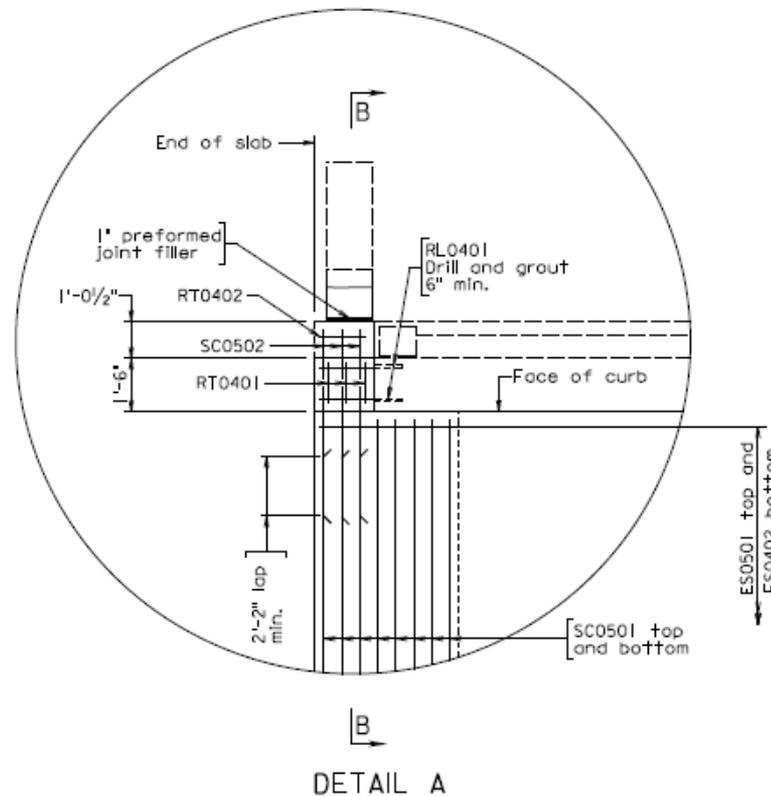
Joint Maintenance

- **Eliminating joints by constructing joint closures at piers**



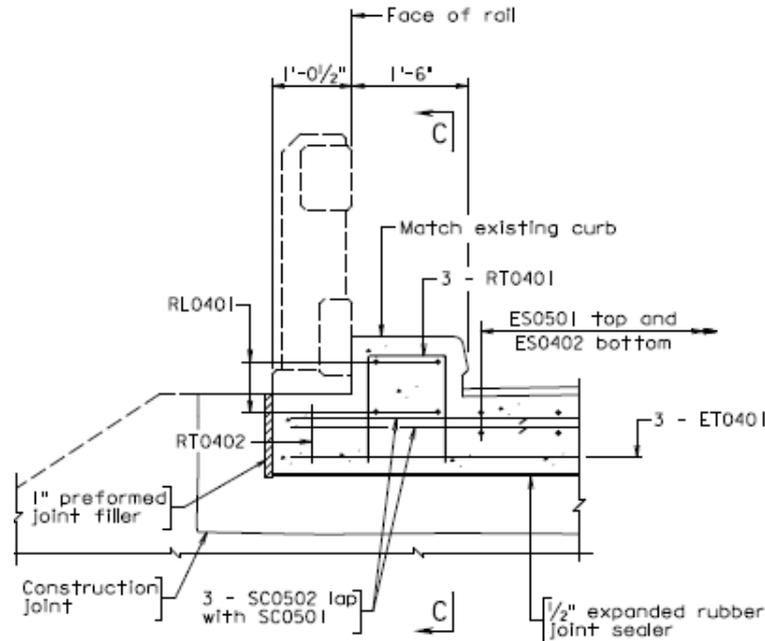
Joint Maintenance

- **Eliminating joints by constructing joint closures (slab extensions) at abutments**



Joint Maintenance

- **Eliminating joints by constructing joint closures (slab extensions) at abutments**



SECTION B-B

Scale: 3/4" = 1'-0"

Joint Maintenance

- **Eliminating joints by constructing joint closures (slab extensions) at abutments**



Joint Maintenance

- **Eliminating joints by constructing joint closures (slab extensions) at abutments**





Thank you for your time and attention

Questions??

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Joint Replacement

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