

# Preserving Tennessee's Bridge Decks and Joints

SEBPP Meeting – Atlanta, GA  
April 23-25, 2012

# Tennessee's Bridge Repair Program

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TN currently doesn't have a FHWA defined maintenance program. TN believes that repairing our bridges preserves the bridges in our inventory.

The Repair Office currently doesn't compete for federal funding with the rest of the Department, we are given our own budget of 100% state funds.

# Tennessee's Bridge Repair Program

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Repair projects generated in our Repair Office are advertised for contract. FHWA defined maintenance activities performed on bridges should be included in these awarded repair contracts. The project should include repairing all bridge deficiencies and, if possible, include details to prevent the same problem.

Our four Regions also have maintenance crews that perform repairs on minor deficiencies that wouldn't necessarily be large enough for a repair project.

# Deck Preservation

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Tennessee uses 4 types of overlays for deck preservation:

1. 3 1/4 " asphalt overlay with a sealing membrane
2. Reinforced 4 1/2 " concrete overlay
3. 1 1/2 " polymer modified concrete (PMC) overlay
4. 3/8" thin epoxy overlay

# Deck Preservation

3 1/4 " asphalt overlay with a sealing membrane

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Most used overlay in the state.

Not only used in repair projects, but also on Tennessee resurfacing projects.

# Deck Preservation

3 1/4 " asphalt overlay with a sealing membrane

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## Preparation and Application

Remove the existing asphalt overlay (if applicable).

Chain drag the bridge deck and mark full and partial depth repair areas.

Saw cut the edges of the areas to be repaired 1" deep

Remove concrete from area - at least a 3/4 " below the top mat of steel in partial depth areas.

Clean rust from the existing rebar.

Cast the repair area with high early strength or 18 hour concrete, cure with wet burlap cover – continue until all areas are repaired.

# Deck Preservation

3 1/4 " asphalt overlay with a sealing membrane

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## Preparation and Application

Seal any expansion joints 1" wide or less with a new backer rod and silicone, transversely cover with a 3' wide strip of approved waterproofing membrane and/or remove and replace existing strip seal or modular joints if necessary.

Apply waterproofing membrane from the qualified products list directly on deck surface. Seal edges with epoxy mastic, leave enough membrane to overlap with the next phase.

Place a 2" lift of BM-2, then a 1 1/4 " lift of D surface mix, transition to existing roadway.

# Deck Preservation

3 1/4 " asphalt overlay with a sealing membrane

## PROS

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- Lowest cost
- Can be placed quickly.
- Don't have to wait for the overlay to cure.
- Keeps water off the substructure.

## CONS

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- Need to adjust the height of stripseal and modular joints...adds time to remove the existing and install the new joint.
- Additional time required for joint header to cure.
- Joint work adds to the project cost.
- Once the seal is compromised the whole seal is replaced.



# Deck Preservation

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## Reinforced 4 ½" concrete overlay

Used when there are a considerable amount of quantities of partial depth deck repair, or if we need to replace the cantilevers.

When replacing cantilevers we can also replace the exterior beams and get additional width on the superstructure.

# Deck Preservation

Reinforced 4 ½ ” concrete overlay

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## Preparation and Application

Remove the existing asphalt overlay (if applicable).

Mark and repair large full depth deck repair areas.

Mill ½ ” off the existing deck surface.

Use hydrodemolition to remove partial depth areas and create a highly bondable surface. Make sure debris created from the hydrodemolition is captured by the vacuum trucks before it starts to bond back to the bridge deck. Debris that is left will create a weak layer between the deck surface and new overlay.

# Deck Preservation

Reinforced 4 ½ ” concrete overlay

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## Preparation and Application

Clean exposed reinforcement.

Place new epoxy coated reinforcement and concrete for the overlay. Lightly wet the bridge deck surface (no ponding water on the deck surface) ahead of the screed machine as concrete is placed. Allow overlay to wet cure for at least 120 hours.

Mechanically groove the overlay surface.

# Deck Preservation

Reinforced 4 ½ ” concrete overlay

## PROS

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- Durable
- Extends bridge deck life.
- Possible to add width to the superstructure.

## CONS

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- Cost
- Longest cure time
- Need to adjust the height of stripseal and modular joints...adds time to remove the existing and install the new joint.
- Joint work adds to the project cost.

# Deck Preservation

Reinforced 4 ½ ” concrete overlay

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## Concerns:

On some older overlays, when surface preparation was done using milling machines and jack hammers, some deteriorated concrete wasn't completely removed before placement of concrete. Those areas are now spalling off under the overlay that is still in good shape.

We also have some older overlays have separated from the old deck creating a “floating” overlay.

# Deck Preservation

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1 ½" polymer modified concrete (PMC) overlay

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1 ½" polymer modified concrete (PMC) overlay

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## Preparation and Application

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Mark and repair large full depth deck repair areas.

Mill ½" off the existing deck surface.

Use hydrodemolition to remove partial depth areas and create a highly bondable surface. Make sure debris created from the hydrodemolition is captured by the vacuum trucks before it starts to bond back to the bridge deck. Debris that is left will create a weak layer between the deck surface and new overlay.

# Deck Preservation

1 ½" polymer modified concrete (PMC) overlay

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## Preparation and Application

Power wash surface to produce a bright clean appearance free of dust, dirt, oil, and other foreign matter.

Clean any exposed reinforcement.

Cover the surface with plastic to keep debris and oils from the mobile mixer off the surface.

Lightly wet the bridge deck surface (no ponding water on the deck surface) ahead of the screed machine as PMC is placed.

Place wet burlap on the new surface 8'-10' behind the screed machine, spray burlap with water before covering with plastic. Keep the plastic 10'-30' behind the newly placed burlap.



# Deck Preservation

1 ½" polymer modified concrete (PMC) overlay

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## Preparation and Application

Place soaker hoses under the plastic once the overlay can support them.

Wet cure for 24 hours (Type 1 cement)

Mechanically groove the overlay surface.

Open up to traffic after the 24 hour wet cure and attains a compressive strength of 3500 psi.

# Deck Preservation

1 1/2" polymer modified concrete (PMC) overlay

## PROS

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- Durable
- Extends bridge deck life.
- Can open up to traffic sooner than a typical concrete overlay.
- Don't need extra reinforcement in the overlay

## CONS

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- Cost
- Need to adjust the height of stripseal and modular joints...adds time to remove the existing and install the new joint.
- Joint work adds to the project cost.
- Sensitive to wind and temperature.

# Deck Preservation

1 ½" polymer modified concrete (PMC) overlay

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## Concerns:

Cleanliness of the surface before placement, a dirty surface prevents the required bond to stay in place.

Cracking during the cure, if its windy, hot or both you have to be quick about getting the overlay covered and the surface kept wet.

# Deck Preservation

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3/8" thin epoxy overlay

# Deck Preservation

3/8" thin epoxy overlay

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## Preparation and Application

Chain drag the bridge deck and mark full and partial depth repair areas.

Saw cut the edges of the areas to be repaired 1" deep

Remove concrete from area - at least a 3/4 " below the top mat of steel in partial depth areas.

Clean rust from the existing rebar.

Cast the repair area with concrete and allow to cure 28 days (per manufacturer recommendations).

# Deck Preservation

3/8" thin epoxy overlay

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## Preparation and Application

Shot blast the deck surface to remove weak, contaminated deteriorated concrete, asphalt materials, oils, dirt, rubber, curing compounds, paint, carbonation, laitance, and other potentially detrimental materials. Areas that can't be reached by shot blasting can be sand blasted for cleanliness.

Get approval from the on-site manufacturer representative to continue with overlay application.

Depending on the amount of deck area to receive the overlay; hand mix in clean tubs and dump or mechanically mix and pump epoxy on the deck surface and spread with squeegees.

Broadcast aggregate over the epoxy before epoxy sets.

# Deck Preservation

3/8" thin epoxy overlay

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## Preparation and Application

After the first layer cures, apply another layer of epoxy and aggregate.

Contractor to prove 3/8" min thickness by taking cores in three random locations chosen by the engineer.

# Deck Preservation

3/8" thin epoxy overlay

## PROS

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- Durable
- Extends bridge deck life.
- Quick cure time, hours instead of days
- Don't need to adjust joint header height accommodate overlay thickness
- High skid resistance numbers

## CONS

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- Cost
- Temperature, moisture, and surface preparation sensitive.



# Deck Preservation

3/8" thin epoxy overlay

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## Concerns:

Does patching really require the 28 days? Are we getting 28 days cure time before overlay is placed?

What is the limit of patching before you need to use another type overlay?

How do you remove a thin epoxy overlay that may have failed?

## Types of joints in Tennessee:

1. Finger joints
2. Strip seal and Modular Joints
3. Elastomeric headers with two part cold pour silicone
4. Preformed compression joints

# Joints

## Finger joints

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We have a few of the larger river crossing bridges with finger joints still in them. The others have been replaced with either modular joints or stripseal joints.

Work done on finger joints is typically replacing a section of the joint, replacing bolts underneath, or replacing the drain trough below the joint.

# Joints

## Finger joints

### PROS

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- Can accommodate larger expansion.

### CONS

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- Fingers break out, hard to repair
- Sometimes the fingers don't line up on opposite sides and can create a traffic hazard.
- Drain trough fails and need to be replaced

# Joints

## Strip seal and Modular Joints

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We have stripseals and modular joints on older bridges that have replaced either sliding plate or finger joints. When we repair some of the decks we are putting overlays on, we lock up the small simple span expansion joints and put in stripseals to take up the movement at one bent or abutment.

We also have stripseals and modular joints on some of our new long span bridges where all the movement is too large to expand into the backfill.

With the length of time a stripseal is in place, there is a possibility the joint company has changed the membrane shape and will not fit in the old extrusions. Therefore, we typically replace stripseal joints when the seal membrane deteriorates or an extrusion loosens.

# Joints

## Strip seal and Modular Joints

### PROS

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- Last for years
- Snow plow proof

### CONS

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- Cost
- Finding a replacement for the seal membrane.
- Extrusions that become loose are a traffic hazard.
- Considerable amount of work removing and replacing the old joint.
- Need additional support under modular joint control boxes otherwise the joint will beat itself apart.

# Joints

Elastomeric headers with two part cold pour silicone

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We have installed many of these joints over the past decade. They were the standard expansion joint at the ends of our pavement at bridge ends until recently.

These joints are also used to replace sliding plate expansion joints on bridge spans with little movement.

# Joints

Elastomeric headers with two part cold pour silicone

## PROS

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- Easy to install
- Not a long cure time, traffic is not impacted as long.
- Can be repaired without removing the whole joint.

## CONS

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- Elastomeric concrete cost
- Both sides of the joints may not be level, causing impacts on the edge of the header causing break outs and joint failures.
- Seems to work better in a low volume, low speed area.



# Joints

## Preformed compression joints

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We have recently changed our Pavement at Bridge End standard from the elastomeric header and silicone joint to an upside down vee preformed compression joint. The new detail doesn't include the use of elastomeric headers, we are hoping that the new joint will stay in place for more than a couple years.

We have recently used close cell foam joint fillers on some smaller deck expansion joints.

Many of our old preformed compression joints were replaced with the elastomeric/silicone joints over the years.

# Joints

## Preformed compression joints

### PROS

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- Easy to install
- Not a long cure time, traffic is not impacted as long.
- No elastomeric concrete involved
- Vee joint is supposed to clean itself.

### CONS

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- On older joints UV deteriorates the rubber, and it is no longer flexible, compression joint pulls away from the sides of the joint and eventually ends up in traffic.

# Joints

## Preformed compression joints

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### Concerns:

We now have many elastomeric/silicone joints on our bridges with block outs in the concrete for elastomeric headers. How do you cheaply retrofit those joints with the upside down vee and not use the elastomeric concrete?