Bridge Rehabilitation Inspection

Session 5

Session 5 – Learning Outcomes

Upon completion of this session participants will be able to:

- Identify the critical elements of bridge rehabilitation construction.
- Perform basic checks on critical bridge rehabilitation elements.
- Perform joint replacement inspection.
- Perform concrete surface repair inspection.
- Perform concrete overlay inspection.
- Perform polymer overlay inspection.
- Perform deck replacement inspection.

Session 5 – Topics not covered

- Less commonly used overlay types
- Widenings
- Bearing replacement
- FRP (fiber reinforced polymer)
- Painting –
  - SSPC Bridge Coating Inspection Course
- Cathodic protection

Bridge Rehabilitation – Key Resources

- AASHTOWare Project Construction
  - https://awpkb.dot.wi.gov/Content/constr/constr.htm
- CMM – Section 5-28 *Concrete Deck Overlays and Structure Repairs*
  - https://wisconsindot.gov/rdwy/cmm/cm-05-28.pdf#cm5-28
- Bridge Manual – Chapter 40
  - https://wisconsindot.gov/dtsdManuals/strct/manuals/bridge/ch40.pdf
- Bridge Standard Detail Drawings
  - https://wisconsindot.gov/dtsdManuals/strct/manuals/bridge/std-ch40.pdf
- Annual Region Construction Conferences
  - Attend in February/March
- Contact BOS/Consultant Designer
  - Structure Design Contact on Plan Set
  - Region Liaison
  - Aaron Bonk, P.E. – Structures Design Chief (608) 261-0261

Joint Replacement Overview

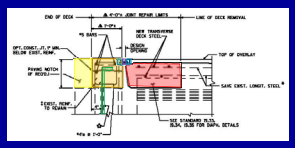
Overview
- Common Types of Expansion Devices
- Demolition
- Epoxy Anchors
- Setting Joint
- Reinforcement Installation
- Gland Installation
- Special Considerations

Common Joint Types

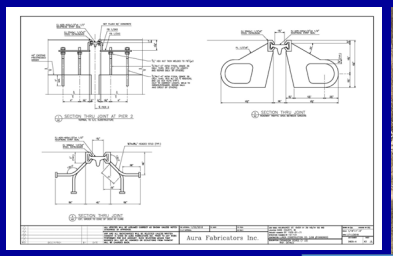
- Called "Expansion Devices" in Bridge Manual Chapter 28
  - https://wisconsindot.gov/dtsdManuals/strct/manuals/bridge/ch28.pdf
- Strip Seal
- Compression Seal
- Modular

Key Components/Terms – Joint Replacement

- Diaphragm (concrete will be removed and replaced)
- Paving block (concrete will be removed and replaced)
- Paving Notch
- Adhesive anchors
- Extrusions (extruded steel sections)
- Neoprene Gland
- Cover Plates



Common Joint Types – Strip Seal



Steel extrusion

Reminder – All shop drawings get submitted to Fabrication Library

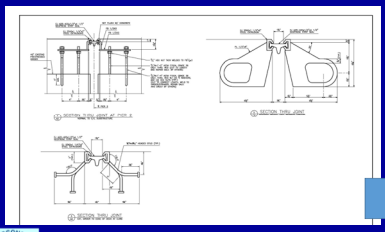
Fabrication Resources Webpage

- Application forms and the email address to request to be added to the APL for the following:
  - ✓ Steel Bridges
  - ✓ Fabricated Bridge Components
  - ✓ Sign Bridges and Overhead Sign Supports
- Fabrication Forms
  - ✓ Contractor Certificates of Shop Drawing QC
  - ✓ Fabrication Status Reports
- Roles and Responsibilities Document

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/fab-cnstr.aspx

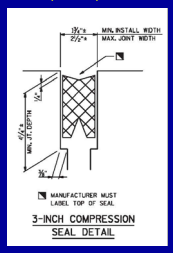
Common Joint Types – Strip Seal

502.3101 Expansion Device (structure) - LF



Common Joint Types – Compression Seal

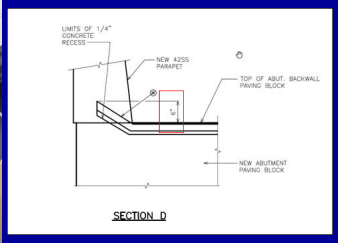
502.2000 Compression Joint Sealer Preformed Elastomeric (width) - LF



3-INCH COMPRESSION SEAL DETAIL

Common Joint Types – Compression Seal

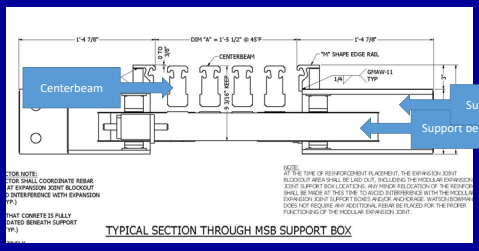
502.2000 Compression Joint Sealer Preformed Elastomeric (width) - LF



SECTION D

Common Joint Types – Modular

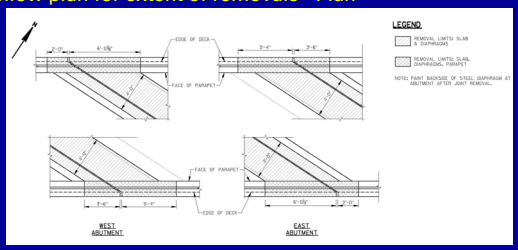
502.3111.S Expansion Device Modular (Structure) - LF



Common Joint Types – Modular

Joint Replacement Demolition

- Follow plan for extent of removals - Plan



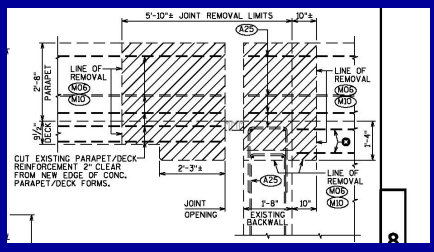
Joint Replacement Demolition

INCORRECT

- Follow plan for extent of removals – What happened…

Joint Replacement Demolition

- Follow plan for extent of removals - Plan



Joint Replacement Demolition

CORRECT

- Follow plan for extent of removals – What happened…

Joint Replacement Demolition

General

- Avoid girder damage – use correct jack size
- Preserve and incorporate as much existing rebar as practical
- Use two-part epoxy to repair epoxy bar per Spec. 505.2.4.2

Joint Replacement Demolition

Joint Replacement Demolition

Protect Traffic from debris during demolition

Adhesive Anchors – Key Inspection Items

(Epoxy Anchors) Bid Items 502.41xx or 502.42xx

- Before the contractor starts drilling make sure they have the correct bit size!
- Read the adhesive manufacturer's installation instructions
  - Example for Red Head A7+ = 1/16" to 1/8" larger than diameter of rod/rebar

Adhesive Anchors – Key Inspection Items

(Epoxy Anchors) Bid Items 502.41xx or 502.42xx

- Check the APL (approved product list) for approved adhesives
- This adhesive is not on the APL and it is also expired (best used by 10/08/2014)

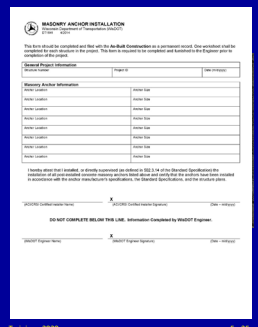
Adhesive Anchors – Key Inspection Items

Bid Items 502.41xx or 502.42xx - EACH

- Check the APL (approved product list) for approved adhesives
- This adhesive is on the APL and it was not expired at the time of placement

Adhesive Anchors – Key Inspection Items

- The anchors must be installed by or under the direct supervision of an ACI/CRSI certified installer.
- If the contractor doesn't have a certified installer then a non-destructive pullout test must be performed
- https://www.concrete.org/certification/verifyacertification
- Installer must fill out form DT1641
- https://wisconsindot.gov/Documents/formdocs/dt1641.doc

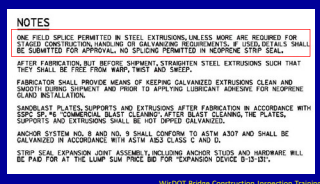


MASONRY ANCHOR INSTALLATION

DO NOT COMPLETE BELOW THIS LINE. Information Completed by WisDOT Engineer.

Inspect the delivered joint

- When reviewing the shop drawings check for the number of field welds, most plan sets say only one field weld is permitted.
- Make sure that the person who field welds the joint steel is certified (need form DT2320) https://wisconsindot.gov/Documents/formdocs/dt2320.docx
- Check that what is delivered matches the shop drawings



NOTES

ONE FIELD SPLICE PERMITTED IN STEEL EXTRUSIONS, UNLESS MORE ARE REQUIRED FOR STAGED CONSTRUCTION, HANDLING OR GALVANIZING REQUIREMENTS. IF USED, DETAILS SHALL BE SUBMITTED FOR APPROVAL. NO SPLICING PERMITTED IN NEOPRENE STRIP SEAL.

AFTER FABRICATION, BUT BEFORE SHIPMENT, STRAIGHTEN STEEL EXTRUSIONS SUCH THAT THEY SHALL BE FREE FROM WARP, TWIST AND SWEEP.

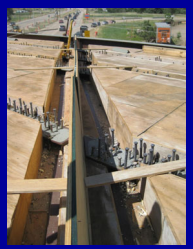
FABRICATOR SHALL PROVIDE MEANS OF KEEPING GALVANIZED EXTRUSIONS CLEAN AND SMOOTH DURING SHIPMENT AND PRIOR TO APPLYING LUBRICANT ADHESIVE FOR NEOPRENE GLAND INSTALLATION.

SANDBLAST PLATES, SUPPORTS AND EXTRUSIONS AFTER FABRICATION IN ACCORDANCE WITH SSPC SP. #6 "COMMERCIAL BLAST CLEANING". AFTER BLAST CLEANING, THE PLATES, SUPPORTS AND EXTRUSIONS SHALL BE HOT DIPPED GALVANIZED.

ANCHOR SYSTEM NO. 8 AND NO. 9 SHALL CONFORM TO ASTM A307 AND SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A153 CLASS C AND D.

STRIP SEAL EXPANSION JOINT ASSEMBLY, INCLUDING ANCHOR STUDS AND HARDWARE WILL BE PAID FOR AT THE LUMP SUM PRICE BID FOR "EXPANSION DEVICE D-13-131".

Set the joint



Set the joint

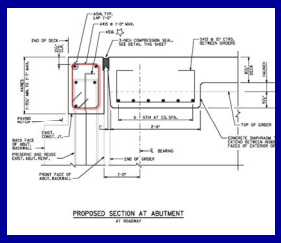
Set the joint

Set the joint

Set the joint

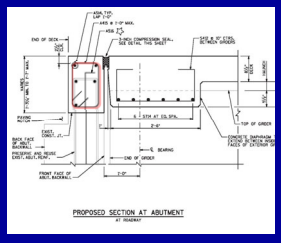
Install the reinforcement

Make sure stirrup has the clearance called out in the plan, no more no less!



Install the reinforcement

Make sure stirrup has the clearance called out in the plan, no more no less!



Install the reinforcement

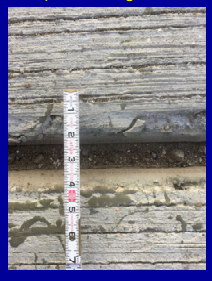
Straighten & clean reinforcement that is incorporated into new work

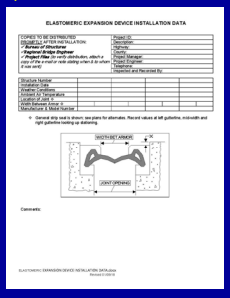
Install the reinforcement

The sidewalk cover plate is in place to locate the anchor locations.

Measure the joint

https://awpkb.dot.wi.gov/Content/constr/Pantry/StatewideForms.htm

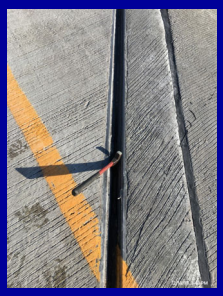




ELASTOMERIC EXPANSION DEVICE INSTALLATION DATA

Joint Replacement – Neoprene Gland Installation

Joint Replacement – Neoprene Gland Installation



Joint Replacement – Special Consideration: Pedestrians

Joint Replacement – Special Consideration: Parapet Conduit

Joint Replacement – Special Consideration: Parapet Conduit

Joint Replacement – Special Consideration: Cover Plate Blockout

- Cover plate
- When parapet is poured a block out is used that will allow the cover plate to move as the bridge expands and contracts
- Make sure it is on the correct side
  - Cover plate will not be snagged by plow blade.

Concrete Surface Repair - Overview

Overview

- Determine Locations
- Correct/record Materials
- Saw cut
- Chipping Concrete
- Incorporate existing reinforcement
- Install nails and wire
- Measure areas
- Form/Pour

Concrete Surface Repair - Determine Locations

Concrete Surface Repair – Correct Materials

- Vertical vs. horizontal repairs
- Make sure to check the approved productions list

Concrete Surface Repair – Saw cut & chip concrete

Concrete Surface Repair – Incorporate existing reinforcement

Concrete Surface Repair – Install nails & wire

Concrete Surface Repair – Form and pour

Concrete Surface Repair – Measure areas

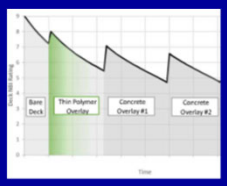
Overlay - Overview

Overview

- Common Types
- Milling
- Determine Locations of Deck Preparation and Full Depth Removal
- Deck Preparation Type 1 & Deck Preparation Type 2, Full Depth Repair
- Calibration of Mobile Mixer
- Dry Run
- Concrete Placement

Overlay – Common Types

- Concrete
- Polymer
- Polyester Polymer Concrete
- Polymer Modified Asphaltic
- Asphaltic



Overlay – Milling

Several WisDOT projects have experienced considerable overruns due to aggressive milling.

Overlay – Milling – Warning don't mill too much!

Dead load concerns …

- 1" of concrete is removed by milling
- Minimum concrete overlay thickness is 1.5"
- Do the math = extra 0.5" of concrete
- Don't worry! The additional dead load of 0.5" of concrete is considered by the designer and is reflected by the structure ratings on the plan
- DO NOT MILL 1.5" TO AVOID INCREASING DEAD LOAD

Overlay – Milling – Warning don't mill too much!

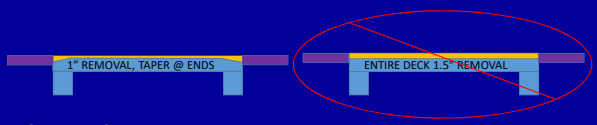
Bump concerns …

- No approach work, in other words approaches are not being overlaid
- 1" of concrete is removed by milling
- Minimum concrete overlay thickness is 1.5"
- Do the math = extra 0.5" of concrete at the bridge ends
- DO NOT MILL 1.5" ACROSS ENTIRE BRIDGE LENGTH TO AVOID BUMP
- OK TO REMOVE ADDITIONAL DEPTH AT THE BRIDGE ENDS FOR A SHORT DISTANCE (TAPERED UP TO 1" REMOVAL)

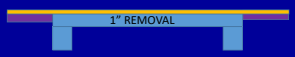
Overlay – Milling – Warning don't mill too much!

Bump concerns …

- Case 1: No approach work, in other words approaches are not being overlaid (short distance of taper OK)



- Case 2: If approaches are overlaid, then no taper is necessary.



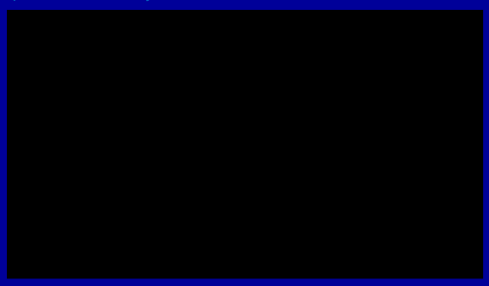
Overlay – Milling – Warning don't mill too much!

Amount of Preparation Decks Type 1 concerns …

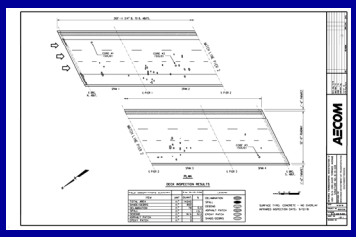
- DO NOT MILL DEEPER THAN 1" TO DECREASE AMOUNT OF HANDWORK
- Milling produces micro-cracking damage in bridge decks.
- Milling deeper than 1" results in increased levels of damage to the deck in addition to increasing the quantity of overlay concrete.

Overlay – Determining Location of Deck Preparation

https://youtu.be/OWkMUtjSuKE



Overlay – Determining Location of Deck Preparation



Overlay – Determining Location of Deck Preparation

https://youtu.be/eQAg9AkQ0qw

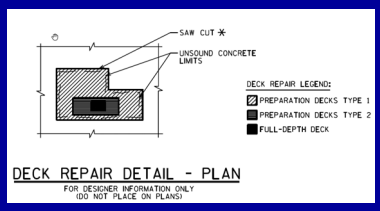
- Sound the deck
  - Delamination makes dull hollow sound
- Can also identify when hammering results in dust/dirt bouncing
- Extremely important that all unsound areas are detected

Overlay – Determining Location of Deck Preparation

Overlay – Deck Preparation

Bid Items: 509.0301, 509.0302, 509.2000

Unit: SY



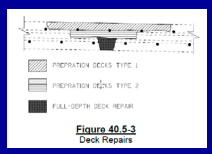
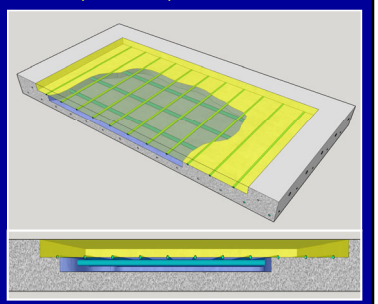


Figure 40.5.3
Deck Repairs

Overlay – Deck Preparation

Example 1: Deck Prep Type 1 & 2, No Full-Depth Deck Repair

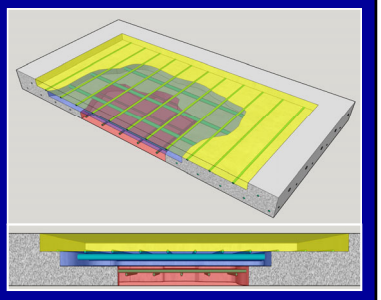
- Per 509.4 Measurement (1): The department will not subtract areas of type 2 removal from areas of type 1 removal.



Overlay – Deck Preparation

Example 2: Deck Prep Type 1 & 2 and Unplanned Full-Depth Deck Repair

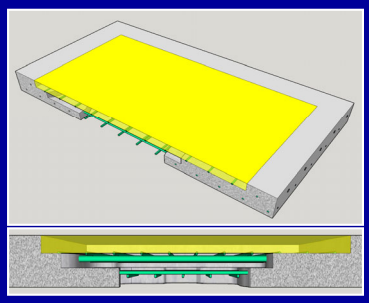
- In this example the full depth removal area was directed by the engineer <u>after</u> the type 1 or type 2 deck removals were underway



Overlay – Deck Preparation

Example 2: Payment Area for Preparation Decks Type 1 – 509.0301

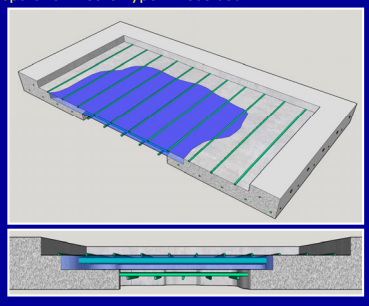
- In this example the full depth removal area was directed by the engineer after the type 1 or type 2 deck removals were underway



Overlay – Deck Preparation

Example 2: Payment Area for Preparation Decks Type 2 – 509.0302

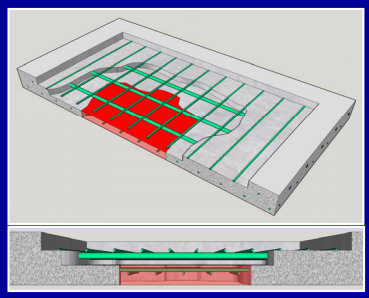
- In this example the full depth removal area was directed by the engineer <u>after</u> the type 1 or type 2 deck removals were underway



Overlay – Deck Preparation

Example 2: Payment Area for Full-Depth Deck Repair – 509.2000

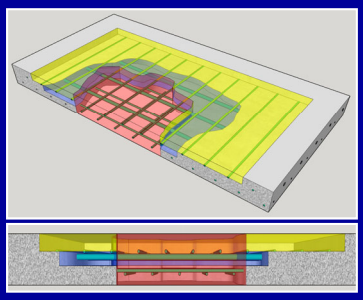
- In this example the full depth removal area was directed by the engineer <u>after</u> the type 1 or type 2 deck removals were underway



Overlay – Deck Preparation

Example 3: Deck Prep Type 1 & 2 and Planned Full-Depth Deck Repair

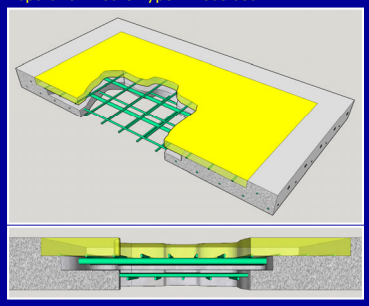
- In this example the full depth removal area was directed by the engineer <u>before</u> the type 1 or type 2 deck removals were underway



Overlay – Deck Preparation

Example 3: Payment Area for Preparation Decks Type 1 – 509.0301

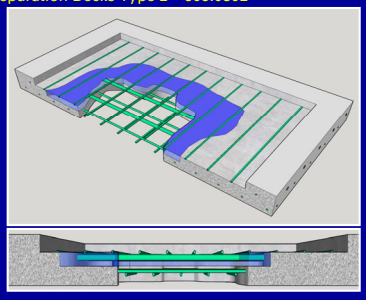
- In this example the full depth removal area was directed by the engineer <u>before</u> the type 1 or type 2 deck removals were underway



Overlay – Deck Preparation

Example 3: Payment Area for Preparation Decks Type 2 – 509.0302

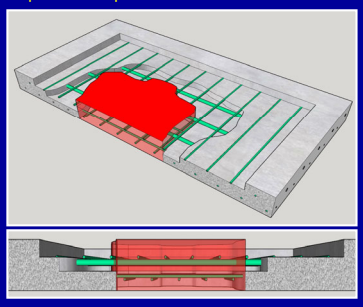
- In this example the full depth removal area was directed by the engineer before the type 1 or type 2 deck removals were underway



Overlay – Deck Preparation

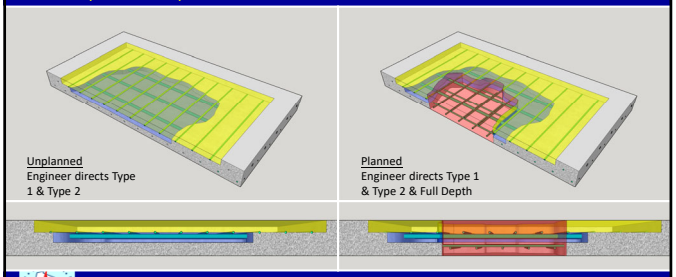
Example 3: Payment Area for Full-Depth Deck Repair – 509.2000

- In this example the full depth removal area was directed by the engineer before the type 1 or type 2 deck removals were underway



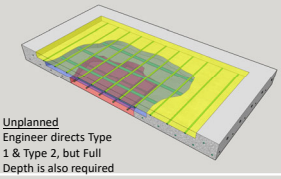
Overlay – Deck Preparation

Comparison: Unplanned vs. Planned

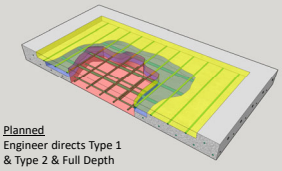


Overlay – Deck Preparation

Comparison: Unplanned vs. Planned



Unplanned
Engineer directs Type 1 & Type 2, but Full Depth is also required

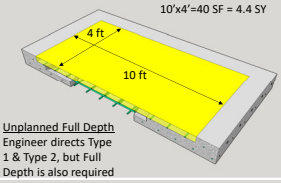


Planned
Engineer directs Type 1 & Type 2 & Full Depth

Overlay – Deck Preparation

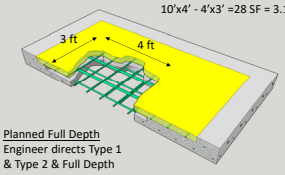
Comparison: Unplanned vs. Planned – Payment Preparation Decks Type 1

10'x4'=40 SF = 4.4 SY



Unplanned Full Depth
Engineer directs Type 1 & Type 2, but Full Depth is also required

10'x4' - 4'x3' =28 SF = 3.1 SY

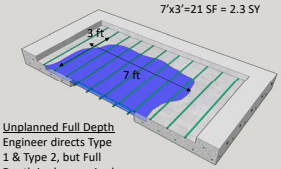


Planned Full Depth
Engineer directs Type 1 & Type 2 & Full Depth

Overlay – Deck Preparation

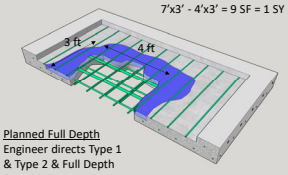
Comparison: Unplanned vs. Planned – Payment Preparation Decks Type 2

7'x3'=21 SF = 2.3 SY

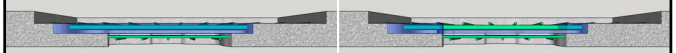


Unplanned Full Depth
Engineer directs Type 1 & Type 2, but Full Depth is also required

7'x3' - 4'x3' = 9 SF = 1 SY

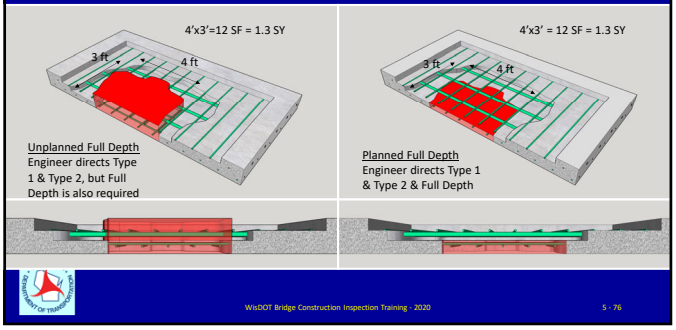


Planned Full Depth
Engineer directs Type 1 & Type 2 & Full Depth



Overlay – Deck Preparation

Comparison: Unplanned vs. Planned – Payment Full Depth

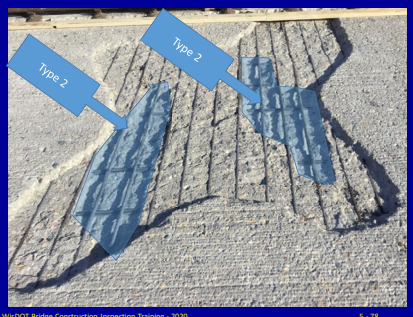


Unplanned Full Depth
Engineer directs Type 1 & Type 2, but Full Depth is also required

Planned Full Depth
Engineer directs Type 1 & Type 2 & Full Depth

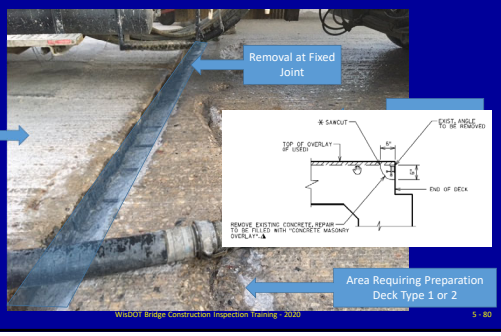
Overlay – Deck Preparation

Overlay – Deck Preparation



Overlay – Deck Preparation

Overlay – Deck Preparation



Overlay – Calibration of Mobile Mixer

Overlay – Dry Run

Overlay – Concrete Overlay Placement

Overlay – Concrete Overlay Placement

Overlay – Concrete Overlay Placement

Overlay – Concrete Overlay Placement

Overlay – Concrete Overlay Placement

Overlay – Concrete Overlay Placement

Overlay – Concrete Overlay Placement

Overlay – Concrete Overlay Placement

Polymer Overlay – Overview

Bid item: 509.5100.S

- Deck Preparation
- Equipment
- Application

Polymer Overlay – Deck Preparation

- Mechanical scarifier
- Remove pavement markings before shot blasting.
- Remove asphalt patches & unsound concrete

Polymer Overlay – Deck Preparation

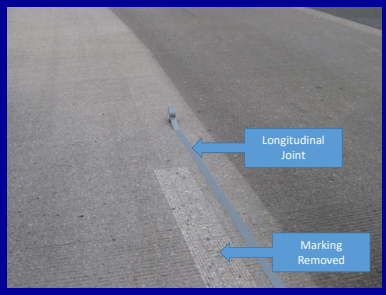
- Shot blasting machine
- Only 24 hours allowed between shot blasting and polymer overlay application

Polymer Overlay – Deck Preparation

Polymer Overlay – Deck Preparation

Pavement marking must be complete removed

- Clean/straight construction joints
- Pavement marking was removed by scarifier



Polymer Overlay - Deck Preparation

Pavement marking must be complete removed

Polymer Overlay - Deck Preparation

Transitional Area

- If the plans show…
  - 1/4" – 5/16" removal on bridge deck at joints, taper 3 feet
  - first lift - 3 feet beyond deck
  - second lift - 6 feet beyond deck

Polymer Overlay - Deck Preparation

Transitional Area

- If the plans show…
  - 1/4" – 5/16" removal on bridge deck at joints, taper 3 feet
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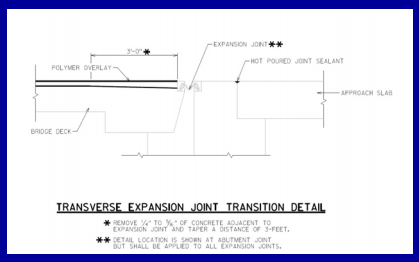


TRANSVERSE EXPANSION JOINT TRANSITION DETAIL

* REMOVE ¼" TO ⅜" OF CONCRETE ADJACENT TO EXPANSION JOINT AND TAPER A DISTANCE OF 3-FEET.
** DETAIL LOCATION IS SHOWN AT ABUTMENT JOINT BUT SHALL BE APPLIED TO ALL EXPANSION JOINTS.

Polymer Overlay - Deck Preparation

Polymer Overlay - Deck Preparation

Cover deck drains & expansion joints

Polymer Overlay - Equipment

- Contractor submits paperwork 20 days before application
- Check Approved Products List
- Pre-installation Meeting
- Manufacturer Rep.

Polymer Overlay - Equipment

Polymer Overlay - Equipment

Polymer Overlay - Application

- Do not allow application if …
  - < 50 degrees
  - Rain predicted during cure
  - Concrete age is less than 28 days
  - Polymer gel time is less than 10 minutes
  - Moisture > 4.5%

Polymer Overlay – Cure Time & Clean-up

Also cover expansion joints

- Cure times dependent on temperature
  - for first course
    - 6 hours at 50 degrees
    - 1 hour at 99 degree
  - for second course
    - 8 hours at 50 degrees
    - 3 hour at 99 degree
- Remove loose aggregate before opening to traffic
  - Sweek/blow/vacuum
  - Aggregate can be reused

Deck Replacement – Overview

- Girder Survey – bottom elevation
- Demolition
- Girder Survey – top elevation
- Girder damage reporting/fixing

Deck Replacement – Girder Survey – bottom elevation

- Prestressed & Steel girders do not always behave as expected after being in service for many years
- Survey the bottom of the girder at mid-span this will help get a better ride out of the new deck

Deck Replacement – Demolition – Equipment

Deck Replacement – Demolition – Steel Girders

Deck Replacement – Demolition – Steel Girders

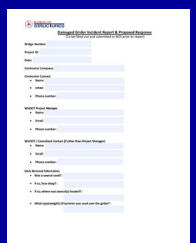
Deck Replacement – Demolition – Prestressed Conc. Girders

Deck Replacement – Demolition – Prestressed Conc. Girders

Deck Replacement – Demolition – Girder Damage

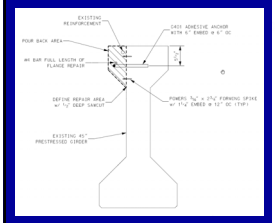
Deck Replacement – Demolition Girder Damage Reporting

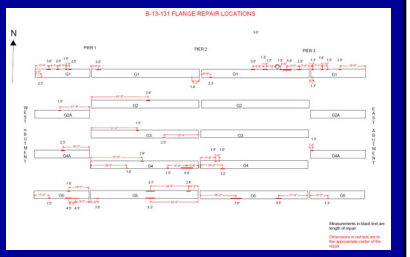
- https://wisconsindot.gov/dtsdManuals/strct/constr-resources/DamagedGirderReport.pdf



- After deck removal, inspect girders for damage
- Alert BOS if damage is found
- BOS form for contractor to complete
  - **Provides pertinent info to BOS**
  - **Contractor proposes remedy**
- BOS will review and provide acceptance/feedback

Deck Replacement – Demolition – Girder Damage Fixing - Example





Bridge Rehabilitation Inspection

SESSION 5 EXERCISES