

New National Highway Institute Training on Bridge Maintenance

Western Bridge Preservation Partnership

Eric Thorkildsen, PE
Greenman-Pedersen, Inc.

Presentation

- Sponsors of the Training
 - National Highway Institute (NHI)
 - *Training arm of Federal Highway (FHWA)*
- How to train bridge maintenance personnel
 - Adult Learning Techniques
- What have we developed
 - Reference Manual
 - Web Based Training
 - Instructor Led Training

Bridge Maintenance Course



Fundamentals of Bridge Maintenance
FHWA-NHI-130107A

Introduction to Bridge Maintenance

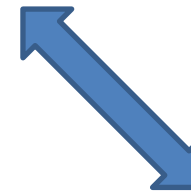
Resources
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Help

NHI 130107A Module 1

FHWA-NHI-130107A
Fundamentals of Bridge Maintenance

Module 1
Introduction to Bridge Maintenance

Next



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FHWA-NHI Course No. 130108

Bridge Maintenance Reference Manual

NHI
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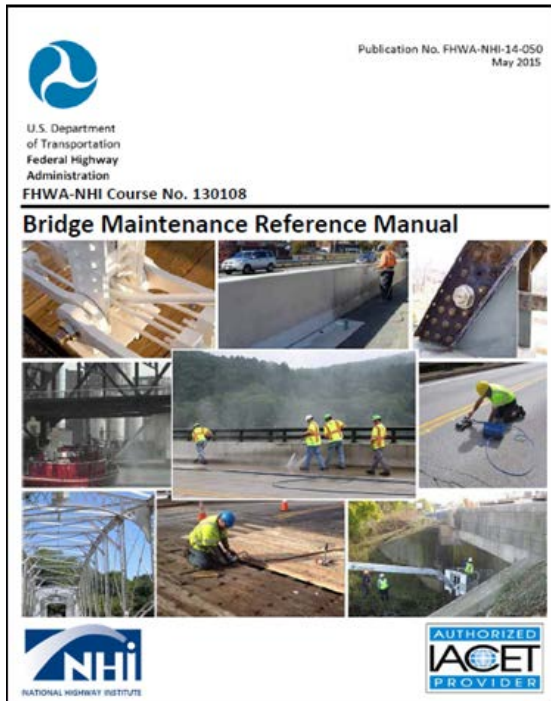
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Reference Manual

- Over 1,000 pages
- 25 Chapters
- 22 Checklists
- Decision Aid Matrices



4. Sealing the concrete to prevent chloride intrusion

11.2 Preventive and Basic Maintenance of Steel Superstructures

Preventive maintenance of steel superstructures consists mainly of measures to clean to steel and protect the steel from corrosion. The preservation of steel involves protection from exposure to electrolytes, such as water or soil. When deicing salt is added to the electrolyte, there is a dramatic increase in the rate of corrosion of the structural steel.

Common protective coatings for steel superstructures are weathering steel, galvanizing, metalizing, and paint. Weathering steel is a type of steel that forms its own protective coating and theoretically does not need painting. However, many state highway departments have indicated poor performance from their bridges constructed with this type of steel. Therefore, members constructed from weathering steel should be monitored for excessive corrosion and be painted if necessary. Typical painting requirements are based on whether the steel is new or is to be repainted.



What To Look For

When performing maintenance on steel superstructures it is always good to see if anything does not look right. This includes:

- Impact damage to steel fascia girders. Generally the girder being twisted and bent from impact
- Severe corrosion and section loss
- Bent cross frame members indicating movement and buckling

11.2.1 Cleaning

Similar to concrete superstructures, the cleaning of steel superstructures is extremely important. Regular cleaning of the superstructure members is necessary to remove accumulation of sand, debris, bird droppings, and other harmful material by flushing with high-pressure water jet or compressed air, sweeping, or shoveling to remove build up. This is particularly critical in areas where there are likely to be chlorides in the debris or on surfaces, such as areas where salt is used for snow and ice control, and marine environments.

Part of the cleaning process should be the clearing of any drains and downspouts that could clog and inadvertently flood steel components. A simple modification such as extending the superstructure drain pipe 6 inches below the bottom flange of the girder is considered a preventive maintenance task.

11.2.1.1 Debris Removal

Traffic, pedestrians, animals and/or flooding cause superstructure debris. All debris should be removed for safety reasons and to prevent deterioration in areas where the debris accumulates and could trap moisture such as on flanges, diaphragms, gusset plates, etc. Steel bridges tend

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Suggested Procedure

Concrete Deck Repairs

“Suggested Procedures”

1. Identify the deck location to be repaired
2. Control traffic in accordance with traffic management plan
3. Hammer sound or chain area around the spall to identify and mark adjacent unsound concrete.
4. Sawcut to a depth of at least $\frac{3}{4}$ inch in a geometric pattern 1 inch outside the lines marked in the previous step.
5. Use a lightweight chipping gun to chip the concrete out between the edge of the spall and the sawcut lines. Remove the concrete to at least 1 inch below the top mat of reinforcing steel.
6. Use sand blasting equipment to remove any rust from exposed reinforcing steel.
7. Replace any missing steel with proper overlap lengths. Consult an engineer as necessary.
8. Remove any loose concrete material or other debris from inside the spalled area.
9. Wet the concrete in the spalled area and surrounding but do not allow standing water.
10. Mix rapid setting concrete and place concrete in the spalled area up to the surface of the surrounding deck.
11. Use a 2 by 4 or similar lumber to screed the newly placed concrete to the level of the surrounding deck.
12. Use a wet broom to provide a roughened surface in a transverse direction to traffic.
13. Use water and broom to clean the areas around the newly placed concrete.

Tips



What To Look For

When performing maintenance on steel superstructures it is always good to see if anything does not look right. This includes:

- Impact damage to steel fascia girders. Generally the girder being twisted and bent from impact
- Severe corrosion and section loss
- Bent cross frame members indicating movement and buckling



Recommendation

An air-entrained admixture is recommended for use in all concrete used in structures that are exposed to freezing temperatures



When to Call the Engineer

Concrete mix design and selection should be performed by an engineer or technician properly trained in concrete mix design and knowledgeable with the exposure environment, placement conditions and desired properties.

Web Based Training

- 8 Hours on-line
- Background Info
- 6 Modules

NHI
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Fundamentals of Bridge Maintenance

Welcome & Introduction

Resources
Glossary
Help

FHWA-NHI-130107A

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Fundamentals of Bridge Maintenance

Module 0

Welcome and Introduction



Next

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Fundamentals of Bridge Maintenance

Welcome & Introduction

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WBT Sequence

- Module 0: Welcome & Introduction

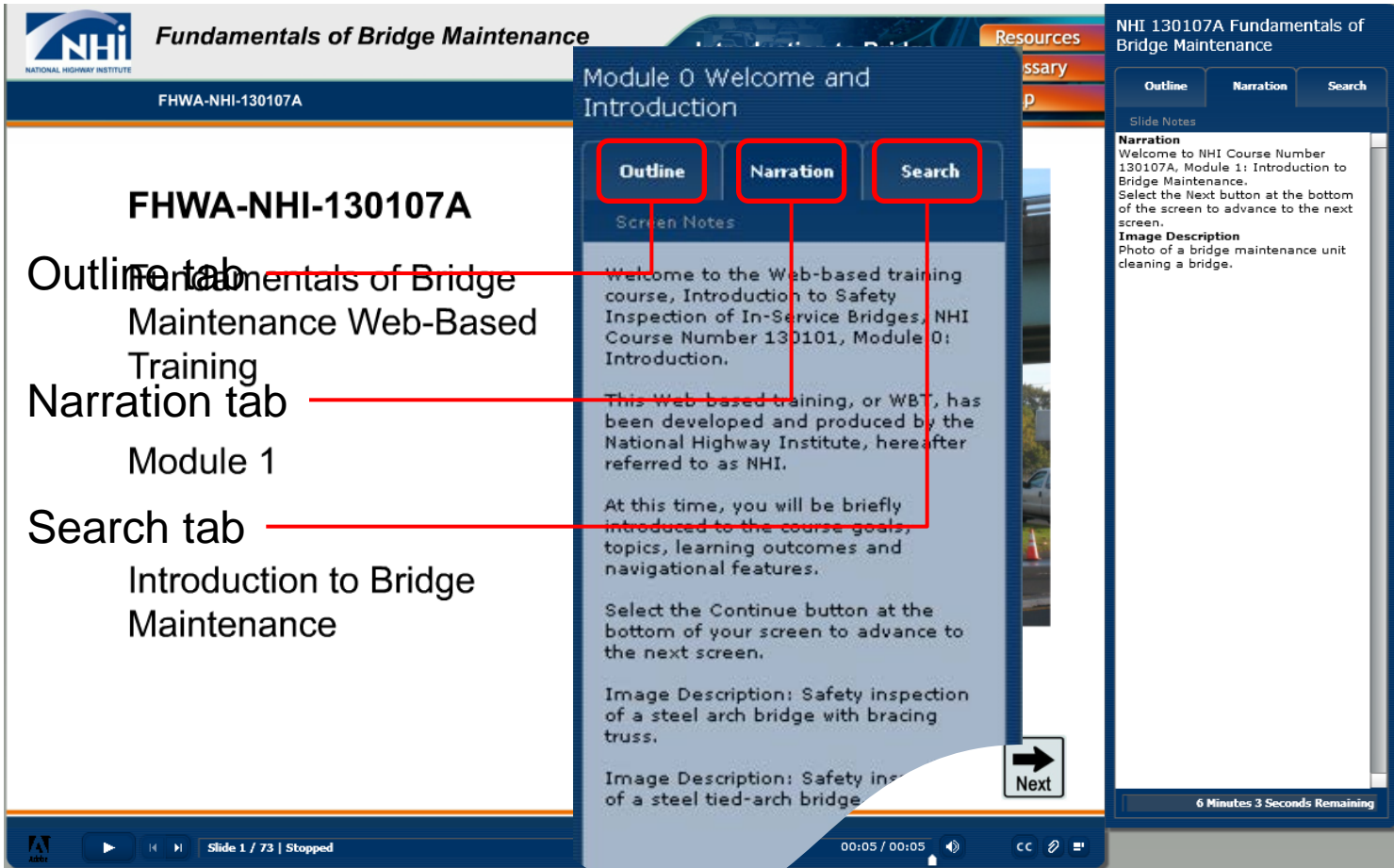
- Module 1: Introduction to Bridge Maintenance
- Module 2: Bridge Maintenance Management
- Module 3: Bridge Anatomy
- Module 4: Bridge Mechanics
- Module 5: Concrete Basics
- Module 6: Maintenance of Ancillary Items

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Navigational Features: Adobe Presenter



The screenshot displays the Adobe Presenter interface for the course 'Fundamentals of Bridge Maintenance' (FHWA-NHI-130107A). The main content area shows the title 'Fundamentals of Bridge Maintenance Web-Based Training' and 'Module 1 Introduction to Bridge Maintenance'. A central overlay window titled 'Module 0 Welcome and Introduction' is open, showing 'Screen Notes' and a 'Next' button. Three red boxes highlight the 'Outline', 'Narration', and 'Search' tabs in this overlay. A separate panel on the right shows the 'Outline', 'Narration', and 'Search' tabs, with the 'Narration' tab selected, displaying slide notes. The bottom of the interface includes a navigation bar with a play button, 'Slide 1 / 73 | Stopped', a timer '00:05 / 00:05', and a 'Next' button.

FHWA-NHI-130107A

Outline tab Fundamentals of Bridge Maintenance Web-Based Training

Narration tab Module 1

Search tab Introduction to Bridge Maintenance

Module 0 Welcome and Introduction

Outline Narration Search

Screen Notes

Welcome to the Web-based training course, Introduction to Safety Inspection of In-Service Bridges, NHI Course Number 130101, Module 0: Introduction.

This Web-based training, or WBT, has been developed and produced by the National Highway Institute, hereafter referred to as NHI.

At this time, you will be briefly introduced to the course goals, topics, learning outcomes and navigational features.

Select the Continue button at the bottom of your screen to advance to the next screen.

Image Description: Safety inspection of a steel arch bridge with bracing truss.

Image Description: Safety inspection of a steel tied-arch bridge.

Next

NHI 130107A Fundamentals of Bridge Maintenance

Outline Narration Search

Slide Notes

Narration
Welcome to NHI Course Number 130107A, Module 1: Introduction to Bridge Maintenance.
Select the Next button at the bottom of the screen to advance to the next screen.

Image Description
Photo of a bridge maintenance unit cleaning a bridge.

6 Minutes 3 Seconds Remaining

Slide 1 / 73 | Stopped 00:05 / 00:05



FHWA-NHI-130107A

Fundamentals of Bridge Maintenance

Module 2

Bridge Maintenance Management




Module Introduction

This module contains the following lessons:

- Lesson 1: Bridge Inspections
- Lesson 2: Maintenance Management Systems (MMS) and Bridge Management Systems (BMS)
- Lesson 3: Bridge Maintenance Planning and Scheduling
- Lesson 4: Contracting Methods
- Lesson 5: QA/QC Practices

During each lesson, knowledge checks are provided to test your understanding of the material presented.



This module will take approximately
80 minutes to complete.



Instructor Led Training

- 4 Days
- 7 Modules
- Lecture
- Hands On Activities
- Adult Learning

NHI-130108 Bridge Maintenance

...

Module 1:
General Bridge Maintenance Concepts
and Special Considerations

Lesson 1:
Bridge Maintenance Concepts

• 1:1-1

Importance of Bridge Maintenance



- Spend **\$50 million** to replace a bridge or **\$1 million** to get 5 more years out of it?



• 1:1-5

April 18th, Lansing, MI



Course Objectives

- Identify common deficiencies that occur in bridges
- Discuss common defects in bridge elements
- Describe preventive maintenance techniques and protective systems intended to prevent deterioration in bridges
- Investigate proper bridge maintenance procedures using bridge maintenance resources
- Identify situations and repairs that warrant involvement of an engineer

How to... 0-3

NHI-130108

Bridge Maintenance

...

Module 3:

Maintenance and Preservation Techniques
for Special Deck Elements and Features

Lesson 1:

Maintenance and Preservation
Techniques for Expansion Joints



Learning Outcomes

- Explain the purpose and significance of expansion joints
- Identify common types of expansion joints
- Identify expansion joint components
- Recognize common expansion joint defects

Purpose of Expansion Joints

- Provide a gap for bridge movement
 - Expansion
 - Contraction
 - Rotation
- Provide a smooth riding surface
 - Approach roadway to a bridge deck, or
 - Between adjoining segments of a bridge deck





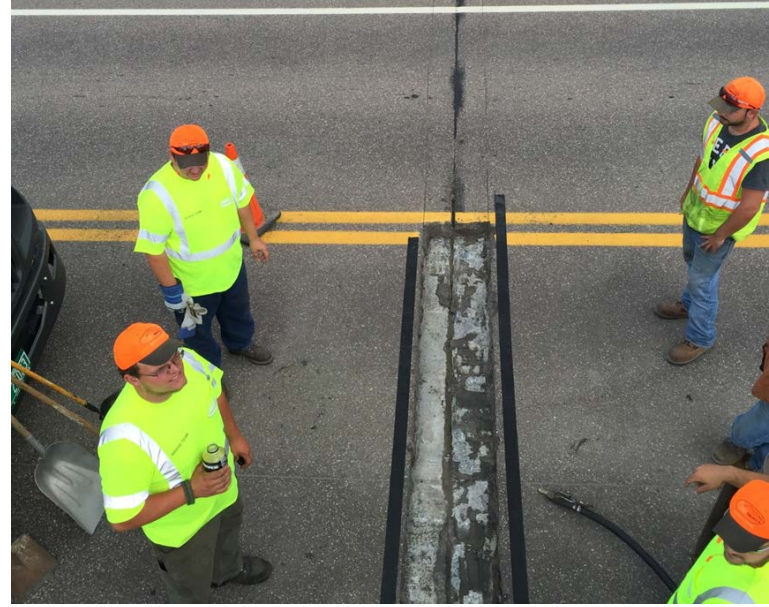
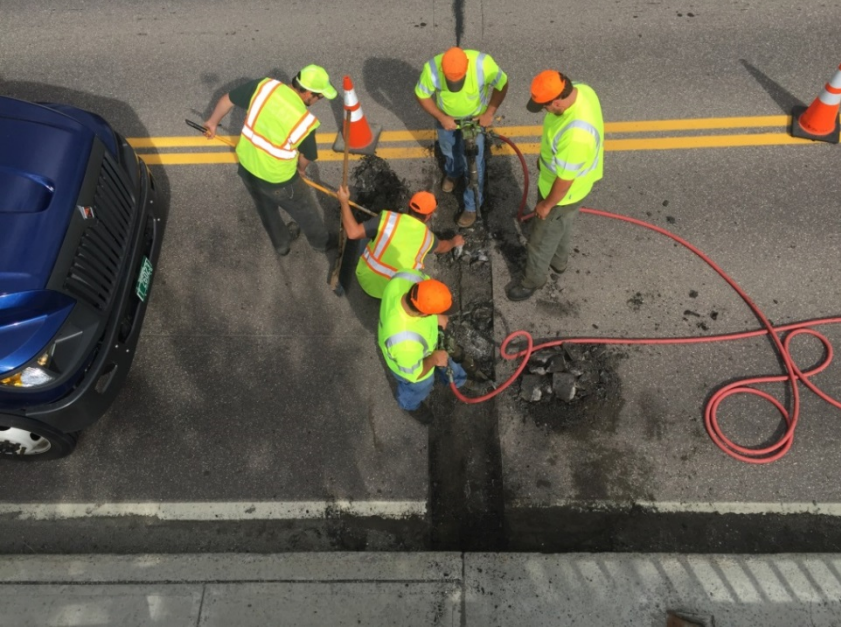
Common Expansion Joint Defects

- Impact Damage
- Leakage
- Seal Adhesion
- Seal Damage
- Seal Cracking
- Debris Impaction
- Adjacent Deck or Header
- Metal Deterioration or Damage

11/20

REGISTRATION
KNOWLEDGE
ENVIRONMENT
MANAGEMENT
SERVE
KATY
CAPITAL NO
PROGRESSIVE
WALTERS
PRO-ACTIVE
SHARED VALUE





Asphalt Joint



Reference Manual Procedures

rod and applied to all surfaces of the block out. Bridging plates are then installed; the plates should be centered over the joint and secured with locating pins along the centerline. The joint is then tanked (flooded) again with the binder material.

The aggregates and binder are prepared for mixing. The aggregate should be heated and then placed in a separate drum to be coated with the asphalt binder (this method ensures best results for coating the aggregate). The coated aggregate should then be loosely placed in the cut out, then leveled and compacted in 2 inch lifts. The aggregate mixture is then tanked (flooded) with the binder material to fill the voids, only the tips of the aggregate should be seen. The next lift is placed in a similar manner. In the final lift the aggregate should not protrude above the wearing course surface. The binder is applied to the final lift ensuring there are no voids and no stones protruding (Figure 8.25). The final course is topped with a thin anti-tracking layer to provide skid resistance.



Figure 8.25 Plug Installation Showing Coated Aggregate and Binder

The temperature at the time of installation, as well as the temperature of the binder and the aggregate, is important to the installation of this joint. It is critical to know the temperatures of the materials and to calibrate any temperature monitors. The cleanliness of the block out and the aggregate are also important to monitor.

A suggested procedure for asphaltic plug seal installation:



Suggested Procedure

Asphaltic Plug Seal Installation

1. Saw-cut and remove the wearing surface and waterproofing membrane (if applicable) from the deck.
2. The block out is then cleaned and dried, repairing concrete as necessary.
3. The backer rod is then placed allowing at least 1 inch depth of binder material from the top of the deck. Note: the binder material is typically polymer modified asphalt that is commercially available for asphalt plug seal installation.
4. Then the joint is tanked (flooded) with binder material heated to manufacturer specifications.
5. Next the bridging plate is installed (Figure 8.26), centered over the gap with locating pins, and the binder is placed atop the bridging plate.
6. The aggregate must be clean and graded properly then heated to the appropriate temperature. The heated aggregate is then mixed with heated binder to provide a coating.
7. The coated aggregate is then placed in the block out in a maximum of 2 inch lifts.
8. The binder is heated to the appropriate pouring temperature and poured/flooded into the block out with the coated aggregate.
9. This process is repeated until the block out is filled.
10. A thin layer of anti-tracking material is placed upon the top surface to provide skid resistance.



Figure 8.26 Bridging Plate Installation

Job Aid Checklists

Bridge Maintenance Course Series

Reference Manual

A.11 Repairing/Replacing Joints

Description

Repair or remove and replace deteriorated or damaged sections of joint systems, including surrounding concrete. Perform this work on all types of joint systems, as required.

Project Objectives

Provide proper operation of the joint system and safety for the traveling public.

Labor Skills

- Physical labor
- Welding

Materials

- Concrete/elastomeric material
- Blasting sand
- Compression gland, or liquid seal
- Compression-seal lubricant/sealant
- Structural steel shape (armor angle or extrusion)
- Expanded polystyrene board and backer rod
- Epoxy anchor capsules and anchoring devices
- Forming lumber
- Welding rod
- Solvent for cleanup

Equipment

- Welder
- 175-CFM air compressor with hoses, etc.
- Electrical generator
- Sandblaster
- Concrete mixer
- Pneumatic hammer (less than 30 pound)
- Concrete vibrator
- Concrete saw
- Rubber seal installation tools
- Joint levelers
- Hammer drill
- Various hand tools
- Personal-safety equipment
- Oxygen/acetylene or oxygen/propane torches

Procedure

- Prepare work-zone (e.g., traffic control, environmental protection, equipment).
- Sawcut and chip out concrete adjoining joint.

A-25

Bridge Maintenance Course Series

Reference Manual



Figure A.20 Chipping out Concrete at Joint

- Remove existing joint system.



Figure A.21 Removed Joint System

- Prepare box out for new joint system.
- Set, level, drill, anchor, and weld armor angle/extrusion.

A-26



Culvert Bedding



Mudjacking









Deck Prep





Group Case Study



Module 7: Comprehensive Bridge Maintenance Case Study and Assessment

| Group Members Names |
|---------------------|
| 1. |
| 2. |
| 3. |
| 4. |
| 5. |
| 6. |

This module differs from the other modules in this course because its lessons are completed throughout the entire course, rather than being covered in consecutive order. Furthermore, each lesson builds upon the previous lesson and prepares groups for the next step in formulating their Maintenance Plan. Therefore, it is imperative that groups remain focused and finish the tasks on time. Additionally, the group's Maintenance Plan is evaluated as part of the final assessment for the course; the instructor will evaluate groups using the NHI Rubric. The group's score will then be applied to each group member's final assessment score. It is imperative that all group members participate in the development and presentation of their Case Study in order to "pass" the assessment and receive credit for the course.

| Lesson | Assignment | Additional Requirements |
|-----------------------------|--------------------------------------|---|
| 1: Introduction | Submit a sketch of your bridge | Include span lengths |
| 2: Analysis & Investigation | Submit a Maintenance Report | Include sketch with defect locations |
| 3: Strategy Development | Submit a Maintenance Plan | Include traffic configuration plan |
| 4: Presentation Preparation | Prepare for your Final Presentation | All participants must be assigned a speaking role |
| 5: Presentation Delivery | Present your Case Study to the class | All group members must be able to answer questions about your Case Study from your instructor and peers |

This packet contains the following:

- Bridge Inspection Report with Case Study Details
- Resources List
- Lesson 1 Sketch Paper Template
- Lesson 2 Maintenance Report Template
- Lesson 3 Maintenance Planning Template
- Lesson 4 Presentation Preparation Outline
- Lesson 5 Case Study Rubric

This packet will be collected at the end of each day by the NHI Instructor(s). Participants are not permitted to remove their packets or supplementary materials from the classroom.



Bridge Inspection Report

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| Inspection Findings | 5 |
| Condition Photos | 6 |

This packet will be collected at the end of each day by the NHI Instructor(s). Participants are not permitted to remove their packets or supplementary materials from the classroom.



Inspection Findings

| Element | Description | Element Notes |
|---------|------------------------------------|--|
| 12 | Reinforced Concrete Deck | <p>Transverse, hairline cracks throughout at variable spacing greater than 3' throughout top surface of deck</p> <p>1" to 2" deep spalls with exposed rebar (with no section loss) and areas of distressed patches in both lanes near midspan of Span 2, see Photo 1 and 2. The total area of the spalls is 12 sq. ft; the total area of distressed patches in 100 sq.ft.</p> <p>1" to 2" deep spalls with exposed rebar (with no section loss) and areas of distressed patches in both lanes near midspan of Span 4, see Photo 3.</p> <p>Deep spalls with unsound concrete the full length of the dek 6" adjacent to the joint seal at Pier 3, see Photo 4.</p> |
| 301 | Pourable Joint Seal | Good condition |
| 302 | Compression Joint Seal | The gland at the Pier 3 joint is partially pulled out. See Photo 5. |
| 330 | Metal Bridge Railing | Good condition |
| 515 | Steel Protective Coating | Good condition |
| 331 | Reinforced Concrete Bridge Railing | Good condition |
| 109 | Prestressed Concrete Girder/Beam | Good condition |
| 310 | Elastomeric Bearing | Good condition |
| 215 | Reinforced Concrete Abutment | Good condition |
| 205 | Reinforced Concrete Column | The left column of Pier 4 has a 3/16" wide by 11' long vertical crack. A previous structural review found that this crack does not affect the strength or serviceability of the element. See Photo 9. |
| 234 | Reinforced Concrete Pier Cap | <p>The underside of Pier 2 cap has a spalled area 12' long and 2" deep with exposed rebar and rust staining.</p> <p>Both the right and left cantilevers of the Pier 3 cap exhibit 0.04" wide cracks, some with rust staining. The cracking extends for 2' on the left side and for 4' on the right. See Photo 6, 7 and 8.</p> |

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Condition Photos



Photo 1 - Spalls and Distressed Patches in Span 2 Deck

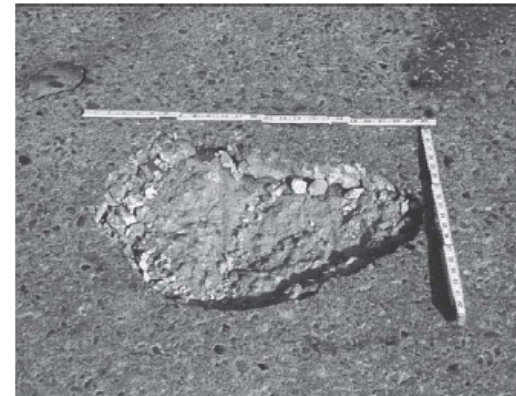


Photo 2 - Spalls and Distressed Patches in Span 2 Deck

This packet will be collected at the end of each day by the NHI instructor(s). Participants are not permitted to remove their packets or supplementary materials from the classroom.

Host Agency Questionnaire

NHI-130108 Bridge Maintenance Instructor-Led Training

Host Agency Questionnaire

Questionnaire to Host Agency Bridge Maintenance Course

The newly revised Bridge Maintenance Instructor-Led Training course has a broad target audience. Knowing the specific background of the audience that will be attending this course for you agency will assist the instructors in effectively covering the course learning outcomes as they relate to the job function, experience and background of your attendees. Please complete the following survey to assist us in these efforts.

Class Composition

Please indicate the approximate number of attendees whose primary duties relate to the following job function:

Engineers: _____

Maintenance Field Workers: _____

Office personnel: _____

Tailoring Course Content

This Instructor-Led Training is delivered throughout the nation and we recognize that not all agencies have the same types of assets, procedures or standards. Therefore, we would like to offer the opportunity to tailor the course to your specific needs. Please indicate if you would like the available optional lessons taught to your audience, and whether or not there are topic areas where you would like instructors to focus on below:

Check the box for each of the following optional lessons being requested by your agency:

- Timber Decks
- Timber Superstructures
- Timber Substructures
- Cables

Please indicate if there are specific topics or lessons that you would like the instructors to provide additional emphasis or background information on below. The course outline is provided below.

[Click here to enter text.](#)

[Click here to enter text.](#)

[Click here to enter text.](#)

NHI-130108 Bridge Maintenance Instructor-Led Training

Host Agency Questionnaire

Course Outline

| Module # | Module Title |
|----------|--|
| 0 | Welcome and Introduction |
| 1 | General Bridge Maintenance Concepts and Special Considerations |
| 2 | Maintenance and Preservation Techniques for Deck/Slabs |
| 3 | Maintenance and Preservation Techniques for Special Deck Elements and Features |
| 4 | Maintenance and Preservation Techniques for Superstructures |
| 5 | Maintenance and Preservation Techniques for Substructures |
| 6 | Maintenance and Preservation Techniques for Culverts |
| 7 | Comprehensive Bridge Case Study and Assessment |

Agency Additions

Additionally, if there is any material, tooling or media your agency would like to share to be incorporated as it relates to the course content, please indicate that below along with how the information will be shared with the instructors. An example would be Michigan DOT brought a special tool they use to remove strip seals.

| Item (Material, Tool, Media, etc). | Topic or Module/Lesson | How will it be shared? (Circle One – if other, please specify) | | | |
|------------------------------------|------------------------|---|-------------|----------|-------|
| | | Email | Flash Drive | Web Link | Other |
| | | Email | Flash Drive | Web Link | Other |
| | | Email | Flash Drive | Web Link | Other |
| | | Email | Flash Drive | Web Link | Other |
| | | Email | Flash Drive | Web Link | Other |
| | | Email | Flash Drive | Web Link | Other |

Schedule

- Reference Manual Spring 2016
- Web Based Training Summer 2016
- Instructor Led Training Summer 2016
- Additional Training late 2016
 - WBT Bridge Coatings
 - WBT Movable Bridges
 - WBT Masonry Bridges

Thank You

Please select the "X" in the upper right hand corner of your screen to close this window and return to the course curriculum.

