Major Concrete Structures Inspection

Part Two - Superstructure

Participant Workbook
# Table of Contents

I. Introduction ........................................................................................................... 2

II. Executive Summary ............................................................................................... 2

III. Course Goals and Outcomes ............................................................................... 3

   Course Goal ........................................................................................................... 3

   Course Outcomes ................................................................................................. 3

IV. Course Agenda ....................................................................................................... 4

V. Course Material ...................................................................................................... 5

   Session Four: Beams and Girders ....................................................................... 8

   Session Five: Bridge Deck Construction ............................................................. 24

   Session Six: Documentation ............................................................................... 35
I. Introduction

The *Major Concrete Structures Inspection Training* is a two-day course aimed at helping those involved in highway construction develop the knowledge and skills to properly inspect bridge construction. The course will be conducted in two sessions, (Part One – Substructure) and (Part Two – Superstructure) and provides a basic knowledge of bridge construction and reviews overall process of bridge construction inspection to assure conformance to project contract documents. This course provides a basic knowledge of ADOT’s Construction Manual, Standard Specification, Materials Testing Manual and Standard Drawings B & C to addresses the technical resources available to support field inspectors in making effective bridge construction operation decisions.

II. Executive Summary

The *Major Concrete Structures Inspection Training* is a two-day course aimed at transportation professionals involved in highway bridge construction. The course provides techniques and strategies for those individuals directly involved in the implementation of a Major Concrete Structure. The course focuses heavily on resources and solutions, and how those solutions can produce a high quality major concrete structures project. This will be achieved through six instructional modules, as follows:

<table>
<thead>
<tr>
<th>MODULE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>Introduction to Bridges</td>
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<tr>
<td>Two</td>
<td>Bridge Foundations</td>
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<tr>
<td>Three</td>
<td>Substructure Construction</td>
</tr>
<tr>
<td>Four</td>
<td>Beams and Girders</td>
</tr>
<tr>
<td>Five</td>
<td>Bridge Deck Construction</td>
</tr>
<tr>
<td>Six</td>
<td>Documentation</td>
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</tbody>
</table>

Through these modules, the participants will develop competencies and be capable of executing them in their everyday job performance:

- Explain the role of construction inspector as part of the overall project team
- Interpret drawings, specifications and special provisions with skill
- Describe construction sequence for various bridge systems (e.g. foundations, substructures, superstructures, miscellaneous), bridge types and materials
- Anticipate possible construction and materials problems and explain basic inspection and materials testing requirements
- Maintain controls and check for proper location, elevation and dimensions
- Demonstrate use of job aids, such as Quantlists, for regular systematic inspections of materials and standards of construction
- Make and maintain sufficient records
The following key points are covered in these course modules:

1. What does a Construction Inspector need to know about the module topic?
2. How does the module achieve an overall awareness of the problems and consequences that can arise during construction?
3. What inspections should be performed to confirm conformance to the contract documents, or document non-conformance?

In summary, the purpose of this course is not to make participants experts, but to provide them with the basic tools and resources needed for effective bridge construction inspection and direction on where to go for more information.

III. Course Goal and Outcomes

Course Goal

After the training session the participant will be able to identify, interpret and determine that the various components of a major structure have been constructed per plans and specifications.

Course Outcomes

At the end of this course, participants will be able to:

1. Identify the various types and parts of major structures
2. Calculate quantities, document pay item quantities
3. Inspect compliance of project plans and shop drawings for proper installation with the use of all Contract Documents, Construction Manual, Standard Specifications and Quantified Checklists to inspect all work elements.
IV. Course Agenda

**Day Two – Part Two – Superstructures**

<table>
<thead>
<tr>
<th>Time</th>
<th>Lesson Title</th>
<th>Length (minutes)</th>
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<tbody>
<tr>
<td>8:00 - 8:15</td>
<td>Welcome</td>
<td>15</td>
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<tr>
<td>8:15 - 9:45</td>
<td>Section 4: Beams and Girders</td>
<td>90</td>
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<tr>
<td>9:45 - 10:00</td>
<td>Break</td>
<td>15</td>
</tr>
<tr>
<td>10:00 - 11:30</td>
<td>Section 5: Bridge Deck Construction</td>
<td>90</td>
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<tr>
<td>11:30 - 12:30</td>
<td>Lunch</td>
<td>60</td>
</tr>
<tr>
<td>12:30 - 2:00</td>
<td>Session 6: Documentation</td>
<td>90</td>
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<tr>
<td>2:00 - 2:15</td>
<td>Break</td>
<td>15</td>
</tr>
<tr>
<td>2:15 - 4:15</td>
<td>Final Exam</td>
<td>120</td>
</tr>
<tr>
<td>4:15 - 4:30</td>
<td>Wrap-up</td>
<td>15</td>
</tr>
</tbody>
</table>
V. Course Material

Major Concrete Structures Inspection
A training course for the Arizona Department of Transportation
Part Two - Superstructure

Perry Powell is your instructor.

- Perry brings over 30 years of experience in the field of building roads and bridges.
Welcome

- What is your name?
- What do you do?
- Which Org are you from?
- What experience do you have inspecting construction work?
- What experience do you have with major structures?

Classroom Guidelines

- Breaks
- Telephone & Restrooms
- Turn off Cell Phones and Pagers
- Keep Drinks in Covered Containers
- Clean Up any Spills
Ground Rules

• Participate – you are expected to add any experience you have with the topic.
• Be on time when coming back from a break.
• Stay on task – When you make a comment it needs to relate to the topic.
• Share responsibility for training – If you do not understand something ask.

Ground Rules

• Listen when others talk - Do not interrupt.
• Respect the opinions and attitudes of others.
• We will use a flip chart as a “Parking Lot” for any questions that can not be answered today and will need more investigation.
Superstructure Safety

Section Four- Beams and Girders
Objective: Learn the basic types of bridges beams and girders and Key aspects of beams and girders

Section Four Beams And Girders
Basic Information

• Types Of Beams And Girders
• Key Aspects of Beams And Girders
Video
Superstructure Overview

Beams and Girders
Basic Information
• Types Of Beams And Girders

Types of Beams & Girders
Beams and Girders
Basic Information
• Key Aspects of Beams And Girders

Key Aspects of Beams & Girders

Beams and Girders
Basic Information
• Key Aspects of Beams And Girders
  ➢ Bearing Points

Bearing Points
Diaphragms

Camber and Deflection
Beams and Girders

Basic Information

- Key Aspects of Beams And Girders
  - Camber and Deflection

Camber and Deflection

Beams and Girders

Steel Girders

- Preparing The Girder Seats

Preparing the Girder Seats
Beams and Girders

Steel Girders

• Delivery Of The Materials

Delivery of the Materials

Beams and Girders

Steel Girders

• Erecting Girders And Diaphragms

Erecting Girders & Diaphragms
Beams and Girders

Steel Girders

• Final Bolting

Final Bolting

Beams and Girders

Precast Concrete Beams

• Preparing The Beam Seats

Preparing the Beam Seats
Beams and Girders

Precast Concrete Beams

- Delivery And Handling Of Materials

Delivery and Handling of Materials

Beams and Girders

Precast Concrete Beams

- Erecting Precast Concrete Beams

Erecting Precast Concrete Beams
Beams and Girders

Precast Concrete Beams

• Constructing Diaphragms

Constructing Diaphragms

Beams and Girders

• Cast-In-Place Box Girders

Cast-In-Place Box Girders
Beams and Girders

• Falsework Preparations

Falsework Preparations

Beams and Girders

• Bottom Slab And Walls Construction

Bottom Slab & Walls Construction
Beams and Girders
- Bottom Slab And Walls Construction
  - During Construction

During Construction

Beams and Girders
- Bottom Slab And Walls Construction
  - During Construction - Continued

During Construction
Beams and Girders

• Deck Construction

Deck Construction

Beams and Girders

• Post-Tensioning

Post-Tensioning
Beams and Girders

• Post-Tensioning
  ➢ During Stressing Operations

During Stressing Operations

Beams and Girders

• Post-Tensioning
  ➢ After the cables are tensioned and anchored

After the Cables are Tensioned & Anchored
Beams and Girders

• Falsework Removal

Falsework Removal

Section Four Quiz

Beams and Girders

Section Four Quiz

1. In a cast-in-place box girder bridge, any deck falsework or form supports that bear directly on the bottom slab must be ... (Circle one or more).
   a) about halfway between girder
   b) at least 1 foot from the nearest girder wall.
   c) within 10 inches of the nearest girder wall.
   d) removed after the deck is poured and cured.

2. Which of the following inspection items is generally applicable to all types (steel, precast concrete and cast-in-place concrete) of beams and girders? (Circle one or more).
   a) checking the elevations of the beam or girder seats
   b) seeing that pier and abutment diaphragms are constructed in conjunction with the bridge deck
   c) inspecting the construction of the soffit fill or other falsework
   d) checking the alignment of the metal bearing plate assemblies
Section Four Quiz

Beams and Girders

Section Four Quiz

3. Which of the following best summarizes the overall construction sequence for steel girders? (Circle one)
   a) (1) girders, (2) bolts, (3) diaphragms, and (4) bearing devices
   b) (1) bearing devices, (2) girders, (3) bolts, and (4) diaphragms
   c) (1) bearing devices, (2) girders, (3) diaphragms, and (4) bolts
   d) (1) girders, (2) bearing devices, (3) bolts, and (4) diaphragms
   e) (1) bearing devices, (2), diaphragms, (3) girders, and (4) bolts

4. As prefabricated steel girders are delivered to the site, they should be checked for which of the following? (Circle one or more)
   a) an ADOT stamp on each girder
   b) the heat number on each girder
   c) a Certificate of Compliance
   d) a Certificate of Analysis
   e) special lifting devices at or near the bearing points

Beams and Girders

Section Four Quiz – Continued

5. For which of the following types of beams and girders would a metal bearing plate assembly most likely be used? (Circle one or more)
   a) steel girders
   b) precast concrete I-beams
   c) cast-in-place concrete box girders without post-tensioning
   d) cast-in-place concrete box girders with post-tensioning

6. Which of the following practices should not be allowed in transporting, handling and storing a precast concrete girder? (Circle one or more)
   a) transporting beams on their sides
   b) lifting beams with straps or cables placed under the center of the beam
   c) lifting beams by the reinforcing bars that extend above the top of the beams to tie-in to the deck
   d) storing beams with support at or near the final bearing points
Section Four Quiz

Beams and Girders
Section Four Quiz – Continued

7. In a precast concrete girder bridge the pier and abutment diaphragms are usually formed and poured ... (Circle one)
   a) ... before the intermediate diaphragms.
   b) ... at the same time as the intermediate diaphragms.
   c) ... after the intermediate diaphragms, in conjunction with the deck.

8. According to the Rillito River Bridge plans, cable restrainers are?
   a) Fixed at abutments and piers
   b) Expansion at abutments and piers
   c) Fixed at abutments and expansion at piers
   d) Expansion at abutments and fixed at piers

Beams and Girders
Section Four Quiz – Continued

9. In a post-tensioned box girder bridge, which of the following activities must be completed before the prestressing cables can be tensioned? (Circle one or more)
   a) placement and curing (for at least 7 days) of the deck
   b) construction of above-deck incidentals
   c) pressure-testing the post-tensioning ducts
   d) removing the soffit fill
   e) removing the exterior side forms
Section Five - Bridge Deck Construction

Objective: Learn bridge deck construction methodology which includes:
- Profiling, falsework & forms, reinforcement & expansion joints
- Screed rails and pouring the deck

Video – Bridge Deck Construction Overview
**Bridge Deck Construction**

- Profiling

![Profiling Diagram]

**Bridge Deck Construction**

- Profiling
  - The Build-up

![Build-Up Diagram]
Bridge Deck Construction

- Profiling
  - For cast-in-place concrete box girders

Cast-In-Place Concrete Box Girders

Bridge Deck Construction

- Falsework And Forms

Falsework and Forms
Bridge Deck Construction

• Reinforcement And Expansion Joints

Reinforcement & Expansion Joints

Bridge Deck Construction

• Setting Screed Rails And Equipment

Setting Screed Rails & Equipment
Bridge Deck Construction

- Pouring The Deck
  - Concrete Placement

Concrete Placement

- Screeding

Screeding
Bridge Deck Construction

• Pouring The Deck
  ➢ Finishing

Finishing

Bridge Deck Construction

• Pouring The Deck
  ➢ Handwork

Handwork
Bridge Deck Construction

• Pouring The Deck
  ➢ Curing

Curing

Bridge Deck Construction

• Completing The Superstructure
  ➢ Falsework And Forms Removal

Falsework & Forms Removal
Bridge Deck Construction
• Completing The Superstructure
  ➢ Above-Deck Incidentals

Above-Deck Incidentals

Bridge Deck Construction
• Completing The Superstructure
  ➢ Painting

Painting
Section Five Quiz

Bridge Deck Construction
Section Five Quiz

1. In checking the screed clearances prior to a deck pour, which of the following deviations from the plan dimensions should not be permitted? (Circle one or more)
   a) a deck thickness ¼-inch thicker than planned
   b) a deck thickness ½-inch thinner than planned
   c) a re-steel clearance ¼-inch less than planned
   d) a re-steel clearance ½-inch more than planned

2. After concrete placement has begun in a bridge deck, which of the following screed equipment adjustments should not be permitted? (Circle one or more)
   a) raising saddle supports
   b) lowering the legs of the screed bridge
   c) changing the crown of the screed bridge
   d) none of the above – they are all permissible

Bridge Deck Construction
Section Five Quiz - Continued

3. During the screening operations in a deck pour, you should see that the screed...
   (Circle one or more)
   a) makes only one pass over each part of the deck
   b) makes at least three passes over each part of the deck.
   c) makes as many passes as necessary to produce a smooth uniform surface.
   d) maintains a small roll of excess mix in front of the screed.
   e) maintains a large roll of excess mix in front of the screed.

4. Which of the following finishing activities is usually required for a deck that will be covered later with a special riding surface? (Circle one or more)
   a) float finishing
   b) checking the surface with a straightedge
   c) tine-texturing
   d) none of the above
Section Five Quiz

Bridge Deck Construction
Section Five Quiz - Continued

5. When tested with a 10-foot straightedge, a bridge deck that is designed as a final traffic-riding surface must be within ... (Circle one)
   a) ½-inch per 10 feet.
   b) ¼-inch per 10 feet.
   c) ⅛-inch per 10 feet.
   d) the tolerances specified in the plans.

6. Which of the following concrete curing methods is required for a bridge deck that will serve as a final traffic-riding surface? (Circle one or more)
   a) curing compound applied immediately after finishing operations are completed
   b) curing compound applied within four hours after finishing operations are completed
   c) water curing starting immediately after finishing operations are completed
   d) water curing starting within four hours after finishing operations are completed

Bridge Deck Construction
Section Five Quiz - Continued

7. Which of the following summarized sequences best reflects the required procedure for removing the falsework and forms for a post-tensioned box girder bridge? (Circle one)
   a) (1) 7 days, (2) post-tension, (3) side forms, (4) soffit fill/falsework
   b) (1) side forms, (2) soffit fill/falsework, (3) 7 days, (4) post-tension
   c) (1) post-tension, (2) side forms, (3) 7 days, (4) soffit fill/falsework
   d) (1) 7 days, (2) side forms, (3) post-tension, (4) soffit fill/falsework

8. Which of the following types of above-deck incidentals cannot be poured until after the soffit fill/falsework (for cast-in-place box girders) or deck falsework (for other types of beams and girders) is released? (Circle one or more)
   a) curbs along the outer edges
   b) median curbs
   c) barrier walls
   d) sidewalks
   e) sign supports
Section Five Quiz

Bridge Deck Construction

Section Five Quiz - Continued

9. The initial gap setting for the Reilto River Bridge deck expansion joints are?
   a) 1 3/8''
   b) 1 5/8''
   c) 2 1/2''
   d) 3''

10. What is the thickness of the Reilto River Bridge expansion bearing pads?
    a) 1 1/2''
    b) 1 5/8''
    c) 2 1/2''
    d) 3 1/2''
Section Six - Bridge Deck Construction

Objective: Learn the basis of measurement for payments for all bridge items

Video – Documentation Overview
Lump-Sum Payments

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<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Amount</th>
<th>Notes</th>
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<td>2</td>
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Line-Item Payments

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
<th>Amount</th>
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</tbody>
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**Documentation Measurement For Payments**

- Lump-Sum Payments
- Line-Item Payments
Documentation

Key Information And Events

• Alignment And Grade Controls

Alignment & Grade Control

Documentation

Key Information And Events

• Structural Excavation

Structural Excavation
**Documentation**

Key Information And Events

- Piling

![Image of Piling](image)

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**Documentation**

Key Information And Events

- Drilled Shaft Foundations

![Image of Drilled Shaft Foundations](image)
Documentation
Key Information And Events

• Reinforcing Steel

Reinforcing Steel

Documentation
Key Information And Events

• Falsework And Forms

Falsework & Forms
Documentation
Key Information And Events

• Concrete Operations

Concrete Operations

Documentation
Key Information And Events

• Concrete Operations - continued

Concrete Operations
Documentation

Structural Steel

Structural Steel

Documentation

Precast Concrete

Precast Concrete
Documentation

Post-Tensioning Operations

Completing The Superstructure

Completing the Superstructure
Documentation

Records And Reports

• Basic Documents

Basic Documents

• Piling Records

Piling Records
Section Six Quiz

Documentation
Section Six Quiz

1. When a structure is paid as a “Lump Sum!” you do not need to document the quantities of concrete, reinforcing steel or any other items used.
   a) True
   b) False

2. Which of the following should be documented for a drilled shaft foundation (circle one or more)?
   a) Shaft Diameter
   b) Depth of shaft
   c) Amount of concrete used
   d) Grade of reinforcing steel

Documentation
Section Six Quiz

3. Since steel or precast concrete girders were inspected at the fabrication yard no additional documentation by the field staff is required.
   a) True
   b) False

4. For a CIP PT structure you should document which of the following (circle one or more)?
   a) Results of air test
   b) Concrete strength prior to jacking
   c) Length of time strands were in duct prior to jacking
   d) Elongation and stress readings
Section Six Quiz

5. The approximate quantity of Class S Concrete for the Rillito River Bridge abutments #1 and #2 is ______ CY?
   a) 83
   b) 140
   c) 166
   d) 192

6. There are ______ fixed vertical restrainer cables on pier #2?
   a) 6
   b) 8
   c) 10
   d) 12