

**ACCESS METHODS, COORDINATION,  
TEST EQUIPMENT & MOT**

3/7/2024 IL NBI Refresher Course 2024

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**Access Methods, Coordination, Test Equip. & MOT**

**Types of Access Equipment**

- Under Bridge Inspection Trucks (UBIT)
- Platform Inspection Trucks
- Manlift (Scissor Lift and Boom Lifts)
- Bucket Truck
- Ladder
- Boat
- Technical Climbing
- UAS/Drones

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## Access Methods, Coordination, Test Equip. & MOT

### Under Bridge Inspection Trucks



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## Access Methods, Coordination, Test Equip. & MOT

### Platform Inspection Trucks



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## Access Methods, Coordination, Test Equip. & MOT

### Manlift



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## Access Methods, Coordination, Test Equip. & MOT

### Bucket Truck



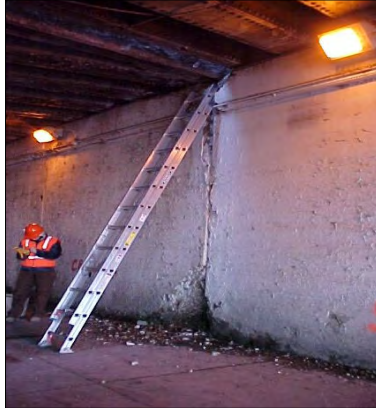
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## Access Methods, Coordination, Test Equip. & MOT

### Ladder



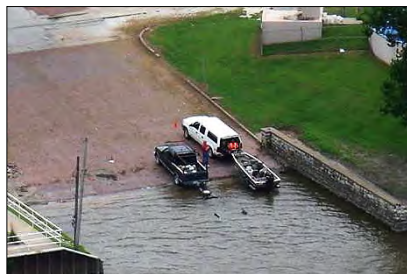
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## Access Methods, Coordination, Test Equip. & MOT

### Boat



**Boats provide access for water-level inspections including soundings for scour measurements.**

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## Access Methods, Coordination, Test Equip. & MOT

### UAS/Drones

- UAS – Unmanned Aerial System
- UAS/Drones may be used for a recon or initial assessment of conditions at an inspection site
- They do not take the place of arms length inspection requirements
- IDOT still considering policy on their use



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## Access Methods, Coordination, Test Equip. & MOT

### Improve Visibility

- **Bridge Washing**
  - Improves visibility
  - Saves inspection time
  - Improves insp. quality
  - Preserves the bridge
- **Lights & Mirrors**
  - Flashlights
  - Floodlights
  - Mirrors



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## Access Methods, Coordination, Test Equip. & MOT

### Coordination - Projects Involving Railroads:

- Special Agreements (Right of Entry, etc.) may be required
- Special training may be required
- Flagger may be required
- Advance Notice and Scheduling – start coordination early!!
- Payment to Railroad may be required to meet some requirements – insurance .....

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## Access Methods, Coordination, Test Equip. & MOT

### Private Property Concerns & Coordination:

- Obtain permission to use / park on private property during inspection
- Avoid damage to private property
- Carry identifying credentials

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## Access Methods, Coordination, Test Equip. & MOT

### Coordination - Notifications

- Law enforcement notifications
  - Good for large or high-profile locations
  - Avoid being miss identified as doing something illegal
- Coast Guard
- Railroad or other non-highway entities under/near bridge
- Public notification - Press Release prior to lane closures
  - Coordinate inspection dates & allowable times with owner
  - Owner will often set up the press release

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## Access Methods, Coordination, Test Equip. & MOT

### Test Equipment

- Electronic Distance Measuring
- Smart Levels
- Ultrasonic Thickness Measuring

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**Access Methods, Coordination, Test Equip. & MOT**

**Electronic Distance Measuring**

- Allows quick measurement
- One person can operate
- Accurate
- Can be hard to see laser over long distances



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**Smart Levels**

- Quick measurement of angles
- One person can operate
- Accurate
- Requires a relatively even surface



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### Access Methods, Coordination, Test Equip. & MOT

## Ultrasonic Thickness Measuring

- Quick measurement of homogenous metal thickness
- Only need access to one side of steel
- Need a relatively clean and smooth surface to measure



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### Access Methods, Coordination, Test Equip. & MOT

## Maintenance of Traffic

- Provide safe work zone for BI
- Minimize interference with traffic
- Minimize duration of closure
- Follow appropriate closure standard for roadway type:
  - Expressway
  - Highway
  - City street
- References - IDOT:
  - Highway Standards – Division 700
  - IDOT Work Site Protection Manuals



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DISCUSSION

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# INSPECTOR SAFETY

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## Inspector Safety

### Poor Access & Safety Procedures!

- Improper use of equipment
- No safety harness
- No floatation devices
- No hard hats

***Use appropriate safety practices & equipment in the field!***



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## Inspector Safety

### Safety of the Inspection Team and Traveling Public must be considered during each inspection

- Safety Resources
  - FHWA Bridge Inspector's Reference Manual (BIRM)
  - OSHA guidelines
  - IDOT Departmental Order 5-1: Employee Safety Code
- Safety Planning
  - Establish a standard safety plan for review prior to each typical inspection
  - Make adjustments to the plan if required for each specific structure
  - Complex structure inspections will require a structure specific safety plan
- Safety Execution
  - Brief safety measures prior to starting work each day
  - Adjust as necessary if changes occur in the field
  - All team members look out for each other as well as themselves

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## Inspector Safety

### Do you have the Proper Safety Equipment?

- Hard Hats
- Gloves
- Boots
- Safety Harness
- Protective Eyewear
- Hearing Protection
- Water Safety – flotation vest
- Filter Mask (Histoplasmosis)
- Air Meter (Confined Space Entry)
- Air Blowers (Confined Space Entry)

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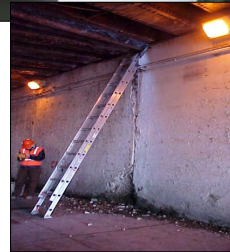
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## Inspector Safety

### Inspection Access

- Operator equip. training
- Safety practices in the bucket
  - Safety harness
  - Hard hat
- Hazards in the bucket
  - Power lines!
  - Vehicles / trains / barges
- Wildlife around bridge
  - Actual animals
  - Animal "residue"



S-5

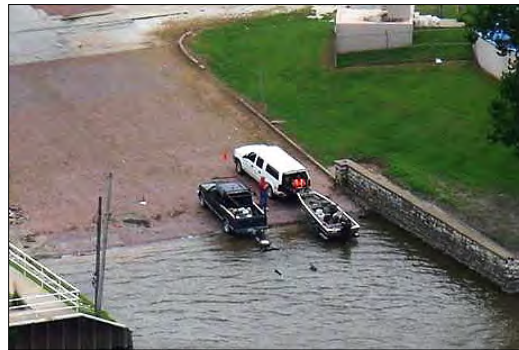
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## Inspector Safety

### Boats

- Operator equip. training
- Safety practices in the boat
  - Floatation vest
  - Safety equipment for the boat as needed
    - Fire extinguisher
    - Horn / whistle
    - Lights .....
- Hazards on the water
  - Other boats
  - Floating debris
  - Asian carp!



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## Inspector Safety

### Climbing

- Inspector training
- Safety practices
  - Safety harness
  - Hard hat
  - Special rigging
- Structure specific safety plan



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## Inspector Safety

### Confined Space Inspection

- Structure specific safety plan
- Inspector trained in confined space insp.
- Safety Equipment
  - Air blower
  - Air quality meter
  - Hard hat
  - Communication devices
- External safety personnel



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## Inspector Safety

### Avoid one-person inspections due to potential hazards

- Deep / Fast moving water
- Inspections near traffic
- Potential to fall
- Wild or Farm Animals
- Criminal Activity



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## Access Methods, Coordination, Test Equip. & MOT

### Maintenance of Traffic

- Reference IDOT's 'Work Site Protection Manuals'
- Ensure safety of inspectors
- Ensure safety of traffic
- Minimize interference with traffic
- Minimize duration of closure
- Follow appropriate standard for roadway type
  - Expressway
  - Village street



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## Access Methods, Coordination, Test Equip. & MOT

### Maintenance of Traffic

- Provide safe work zone for BI
- Minimize interference with traffic
- Safety precautions:
  - High visibility vest
  - No/minimal moving out of closure
  - Place blocking vehicle up traffic in closure
  - Be aware of traffic and location of other inspectors
- References - IDOT:
  - Highway Standards – Division 700
  - IDOT Work Site Protection Manuals



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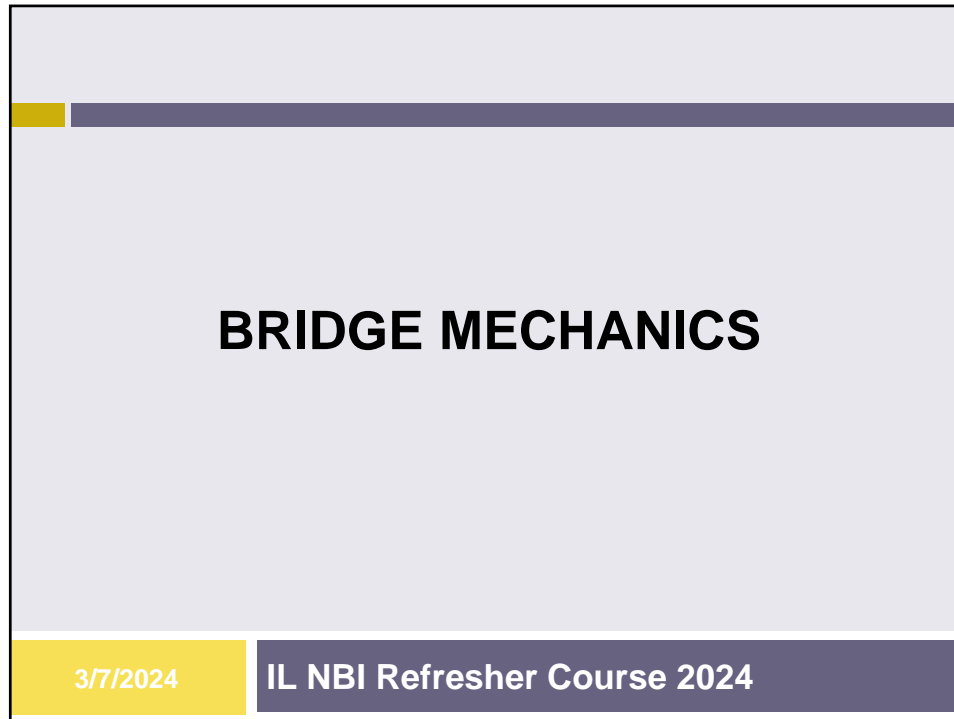
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## DISCUSSION

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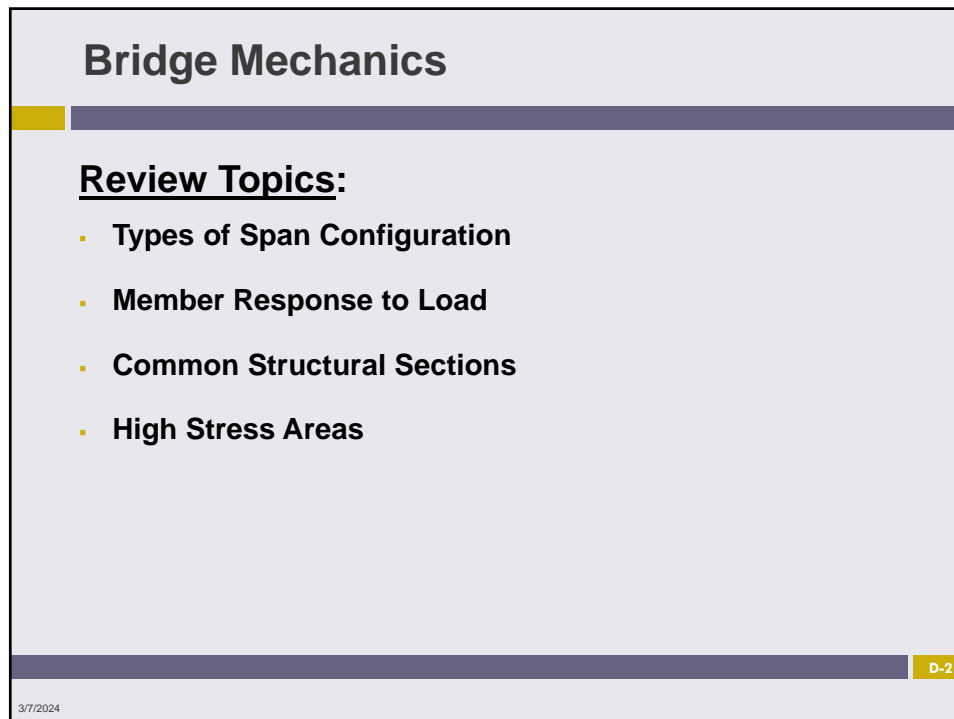


The slide features a light gray background with a dark gray horizontal bar at the top. A yellow vertical bar is on the left side of the top bar. The title "BRIDGE MECHANICS" is centered in bold black text. At the bottom, there is a yellow box on the left containing the date "3/7/2024" and a dark gray box on the right containing the text "IL NBI Refresher Course 2024".

# BRIDGE MECHANICS

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The slide features a light gray background with a dark gray horizontal bar at the top. A yellow vertical bar is on the left side of the top bar. The title "Bridge Mechanics" is centered in bold black text. Below the title, the text "Review Topics:" is followed by a bulleted list of four items. At the bottom, there is a dark gray box on the right containing the text "D-2" and a yellow box on the left containing the date "3/7/2024".

## Bridge Mechanics

**Review Topics:**

- **Types of Span Configuration**
- **Member Response to Load**
- **Common Structural Sections**
- **High Stress Areas**

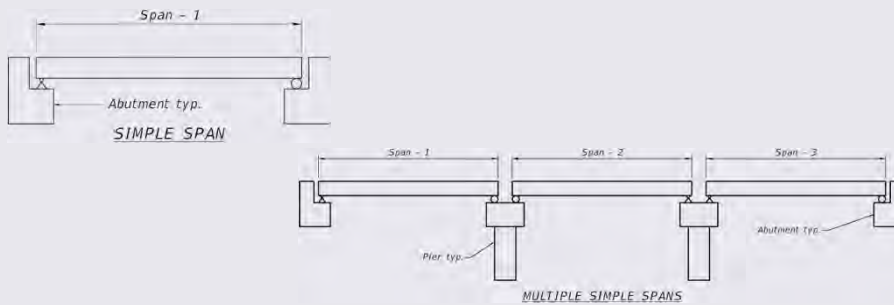
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# Bridge Mechanics

## Types of Span Configuration:

**Simple Span** – A span with the girders having only two supports, each of which is near the end of the span. A bridge may be made up of one or more simple spans acting independently from each other. *Beams are discontinuous over interior supports.*



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# Bridge Mechanics

## Types of Span Configuration – Simple Spans:



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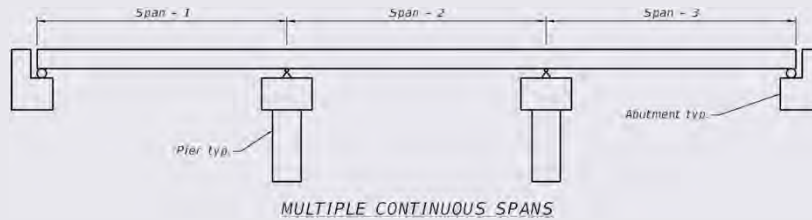
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# Bridge Mechanics

## Types of Span Configuration:

**Continuous Spans** – Multiple spans with the girders being continuous over interior supports. The behavior of each span affects that of the adjacent continuous spans.



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# Bridge Mechanics

## Types of Span Configuration – Continuous Spans:



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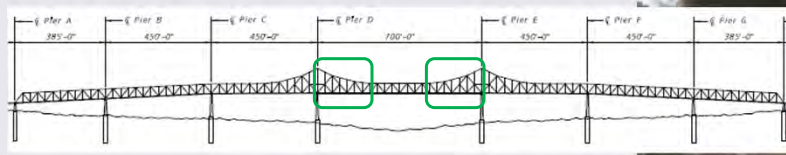
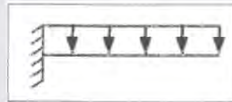
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## Bridge Mechanics

### Types of Span Configuration:

**Cantilever Span** – A span or portion of a span being supported at only one end. Typically, only a portion/s of a bridge will be a cantilever.



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## Bridge Mechanics

### Bridge Member Responses to Load:

1. **Axial Force (tension or compression)**

A force which acts through the longitudinal axis of a member and causes tension or compression

2. **Bending Force**

A force developed when an external load applied transversely to a member causes it to bend resulting in internal moment

3. **Shear Force**

An internal force which results from equal but opposite transverse forces

4. **Torsion**

A force developed from an externally applied moment which causes a member to rotate or twist about its longitudinal axis

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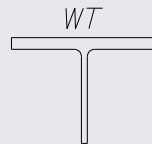
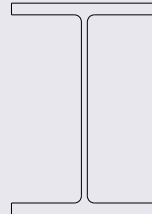
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## Bridge Mechanics

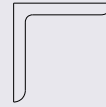
### Common Steel Sections:

- Many types of steel members are used in bridge structures.
- A few of the most commonly used shapes are shown on this and the following slide.

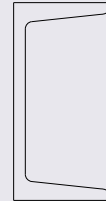
*W, WF, B, CB,  
I, S, HP...*



*Angle*



*C or CB*



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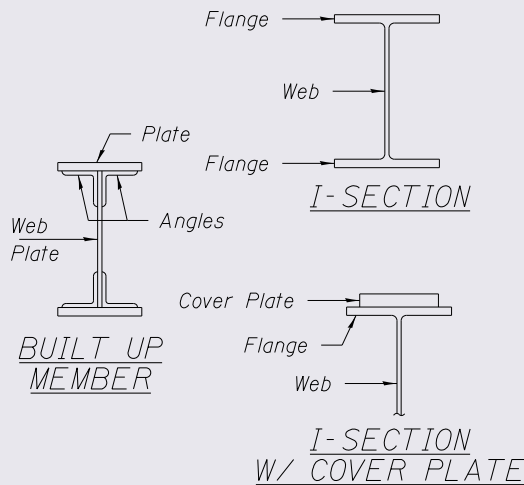
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## Bridge Mechanics

### Common Steel Sections:

- **Steel I-Sections:**
  - Plate Girder (welded or built-up member)
  - Wide Flange
  - Other "I" Sections
- **Member may also include flange cover plates.**
- **Typically used as longitudinal girders for bridges and in truss floor systems.**



D-10

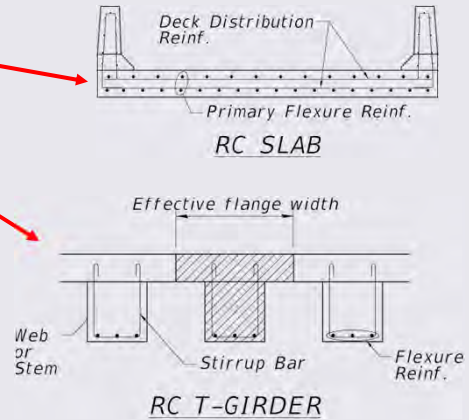
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## Bridge Mechanics

### Common CIP Concrete Sections:

- RC Slabs
- RC T-Girders



D-11

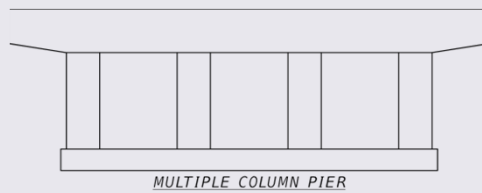
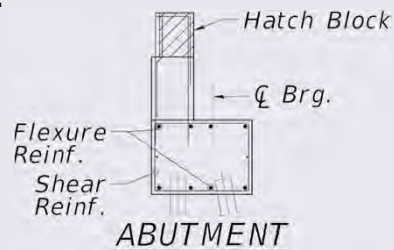
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## Bridge Mechanics

### Common CIP Concrete Sections:

- RC Substructure Caps
- RC Columns
- RC Pier Stems



D-12

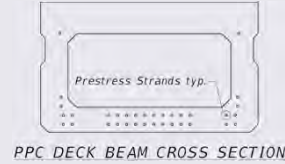
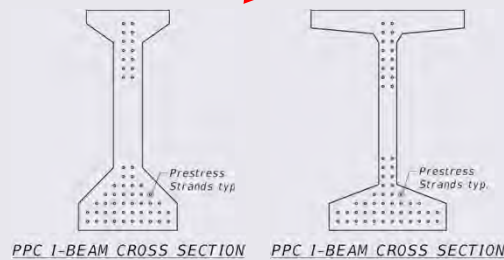
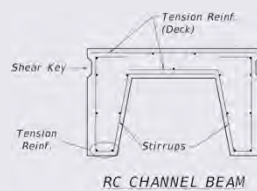
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## Bridge Mechanics

### Common Precast Concrete Sections:

- Pre-Stressed
  - Deck Beams
  - I-Beams
- Non-Prestressed – RC Channel Beams



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## Bridge Mechanics

### High Stress Area - Defined:

- **High Stress Areas**, are locations on structural members where the applied stresses from loads are largest and if damage occurred in these locations, it could significantly affect the capacity of the member.
- These areas can vary with the type of member, where the member is used and the location of the damage on the member within the structural system.
- High stress areas on some of the most common member types are covered in the following slides.

D-14

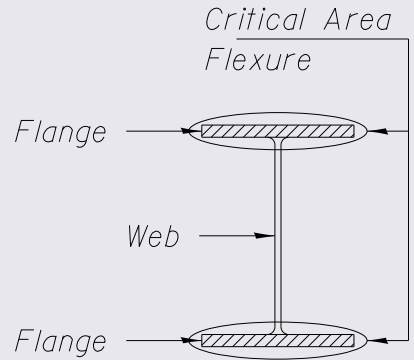
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## Bridge Mechanics

### High Stress Area – Steel Flexural Member:

- Steel I-members in flexure typically develop the highest bending stress in the flanges, making these a critical area.
- Section Loss in the flange reduces the members flexural capacity.



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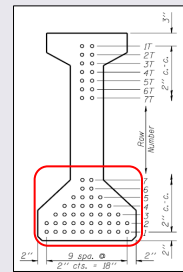
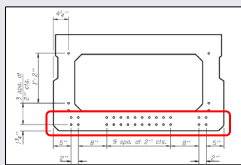
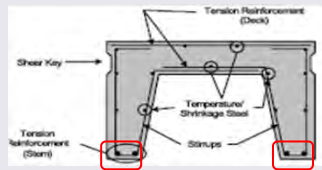
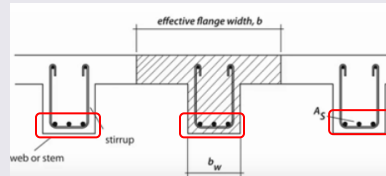
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## Bridge Mechanics

### High Stress Area – Concrete Flexural Members:

- RC superstructure members in flexure typically develop the highest bending stress in the bottom reinf., making this a critical area.
- Section Loss in the bottom reinf. reduces the members flexural capacity.



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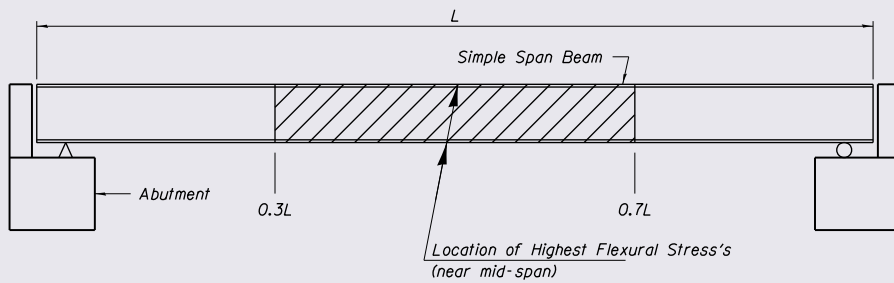
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## Bridge Mechanics

### High Stress Area – Girder Flexure:

High flexural stress in **simple span** structural members is typically found in the location shown here.



D-17

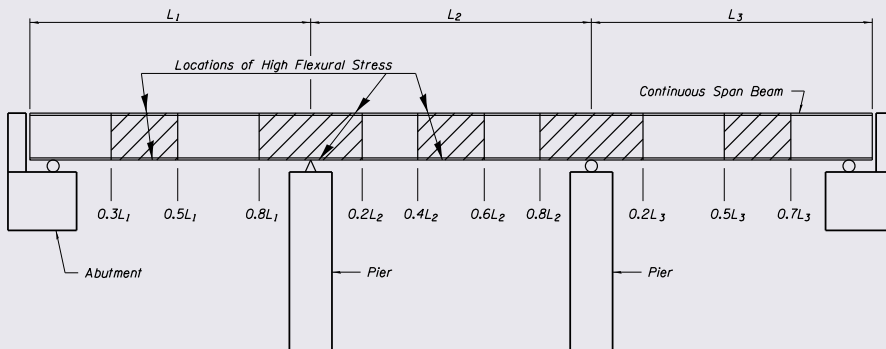
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## Bridge Mechanics

### High Stress Areas – Girder Flexure:

High flexural stresses in **continuous span** structural members are typically found in the locations shown here. (Note: These locations vary depending on the span ratios.)



D-18

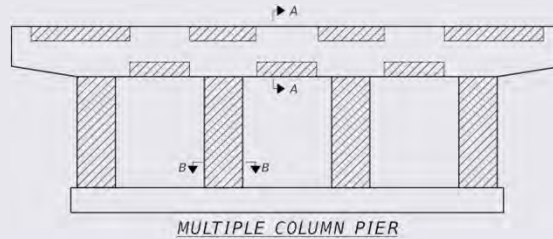
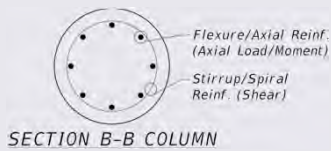
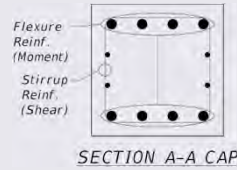
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# Bridge Mechanics

## High Stress Area – Concrete Pier Flexural & Axial Loads:

- Substructure elements similar behavior
- Section Loss in the moment reinforcement reduces the members flexural capacity



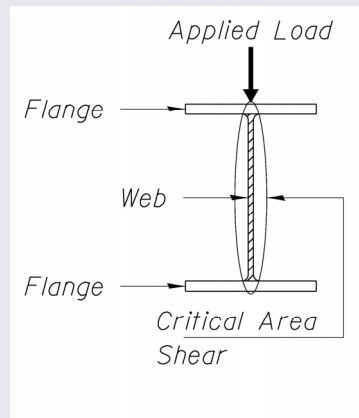
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# Bridge Mechanics

## High Stress Area – Steel Shear Member:

- Members in shear carry stress primarily parallel to the axis of the applied load.
- In I-shaped flexural members the bulk of the shear stress is carried by the web making this a high stress area.
- Section loss in this area decreases the members shear capacity.



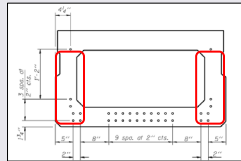
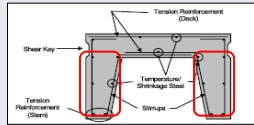
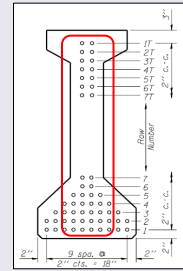
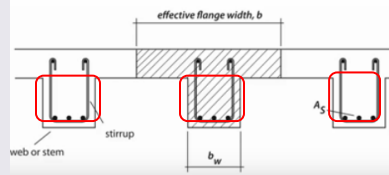
D-20

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## Bridge Mechanics

### High Stress Area – Concrete Shear Member:

- In concrete flexural members the bulk of the shear stress is typically carried by the web & stirrup bars making these high stress areas.
- Section loss in these areas decrease the members shear capacity.



D-21

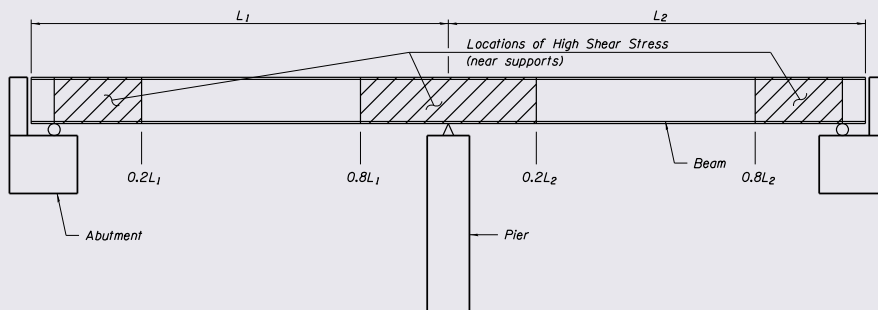
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## Bridge Mechanics

### High Stress Areas – Girder Shear:

High shear stress in structural members is typically found in the locations shown here near the bearing points. (Note: These locations vary depending on the span ratios.)



D-22

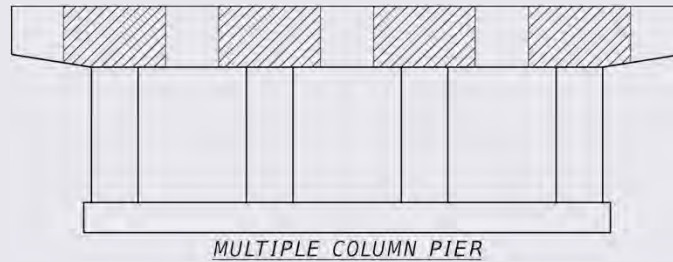
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## Bridge Mechanics

### High Stress Areas – Pier Shear:

High shear stress in **pier caps** is typically found in the locations shown here near the bearing points. (Note: These locations vary depending on the span ratios and superstructure beam locations.)



D-23

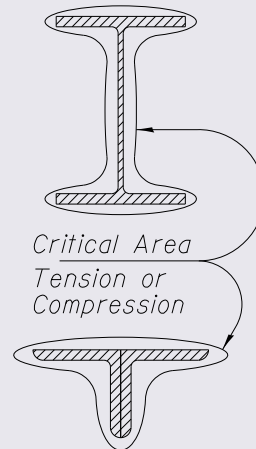
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## Bridge Mechanics

### High Stress Areas – Tension & Compression Member:

- Tension & Compression members come in many types: W, angle, channel, pipes, rods, bars, etc.
- The tens./comp. stress is often roughly evenly distributed in the member through most of its length.
- The critical area on these members is generally any point on the member.



D-24

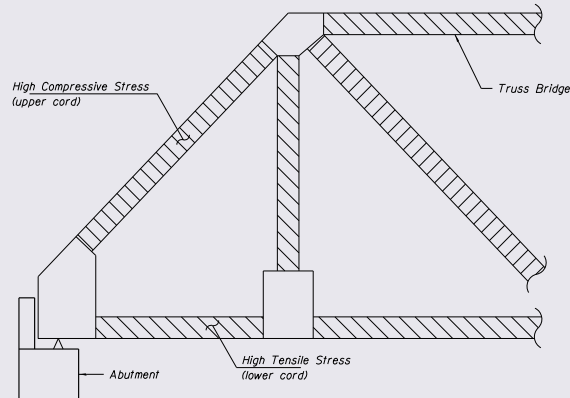
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## Bridge Mechanics

### High Stress Areas – Tension & Compression Member:

High tension or compressive stresses in structural members are typically found in the locations shown here.



D-25

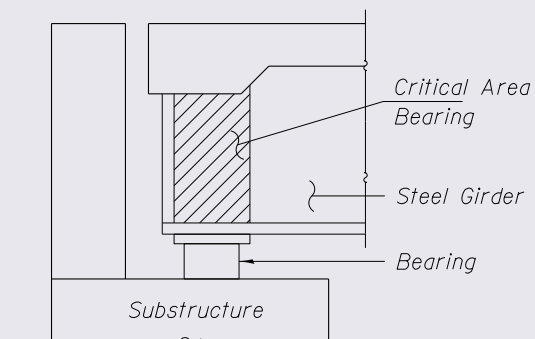
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## Bridge Mechanics

### High Stress Area – Girder Bearing:

- Bearing occurs where one structure member rests on and transfers load to another through contact, such as a superstructure girder resting on a substructure cap.
- Bearing stress is highest in the girder immediately above and adjacent to the bearing location.
- The critical area in this case is the beam web.



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DISCUSSION

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# WATERWAY ADEQUACY

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## Item 71 – Waterway Adequacy

- Appraises the waterway opening with respect to passage of flow through the bridge
- Site conditions may warrant higher or lower ratings than indicated by the hydraulic table
- Requires knowledge of the history of high water elevations at the site

3/7/2024 O-2

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## Item 71 – Waterway Adequacy

### Key Words

| Descriptions for Chance of Overtopping: |                        |
|---|------------------------|
| Remote                                  | Greater than 100 years |
| Slight                                  | 11 to 100 years        |
| Occasional                              | 3 to 10 years          |
| Frequent                                | Less than 3 years      |

| Adjectives Describing Traffic Delays: |   |
|---------------------------------------|---|
| Insignificant                         | Minor inconvenience. Highway passable in a matter of hours. |
| Significant                           | Traffic delays of up to several days.                       |
| Severe                                | Long term delays to traffic with resulting hardship.        |

O-3

3/7/2024

3

## Item 71 – Waterway Adequacy

| Interstate | Other Principal and Minor Arterials and Major Collectors | Minor Collectors, Local | Description   |
|------------|--|-------------------------|---|
| N          | N  | N                       | Bridge not over a waterway.   |
| 9          | 9  | 9                       | Bridge deck and roadway approaches above flood water elevations (high water). Chance of overtopping is <b>remote</b> .              |
| 8          | 8  | 8                       | Bridge deck above roadway approaches. <b>Slight</b> chance of overtopping roadway approaches.                                       |
| 6          | 6  | 7                       | <b>Slight</b> chance of overtopping bridge deck and roadway approaches.   |
| 4          | 5  | 6                       | Bridge deck above roadway approaches. <b>Occasional</b> overtopping of roadway approaches with <b>insignificant</b> traffic delays. |
| 3          | 4  | 5                       | Bridge deck above roadway approaches. <b>Occasional</b> overtopping of roadway approaches with <b>significant</b> traffic delays. * |
| 2          | 3  | 4                       | <b>Occasional</b> overtopping of bridge deck and roadway approaches with <b>significant</b> traffic delays. *                       |
| 2          | 2  | 3                       | <b>Frequent</b> overtopping of bridge deck and roadway approaches with <b>significant</b> traffic delays. *                         |
| 2          | 2  | 2                       | <b>Occasional</b> or frequent overtopping of bridge deck and roadway approaches with <b>severe</b> traffic delays. *                |
| 0          | 0  | 0                       | Bridge closed.  |

O-4

3/7/2024

4



## Item 71 – Waterway Adequacy



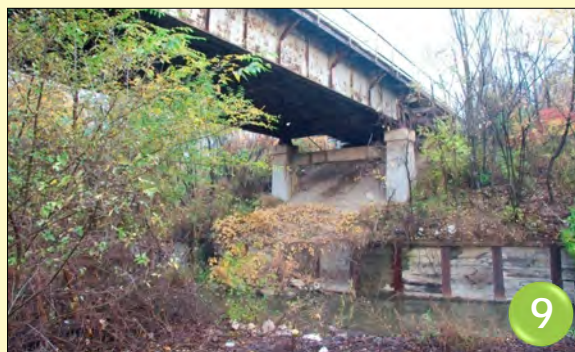
| Interstate | Other Principal and Minor Arterials and Major Collectors | Minor Collectors, Local | Description                 |
|------------|--|-------------------------|-----------------------------|
| N          | N  | N                       | Bridge not over a waterway. |

O-5

3/7/2024

5

## Item 71 – Waterway Adequacy



| Interstate | Other Principal and Minor Arterials and Major Collectors | Minor Collectors, Local | Description  |
|------------|--|-------------------------|--|
| 9          | 9  | 9                       | Bridge deck and roadway approaches above flood water elevations (high water). Chance of overtopping is remote. |

O-6

3/7/2024

6

## Item 71 – Waterway Adequacy



| Interstate | Other Principal and Minor Arterials and Major Collectors | Minor Collectors, Local | Description  |
|------------|--|-------------------------|--|
| 8          | 8  | 8                       | Bridge deck above roadway approaches. Slight chance of overtopping roadway approaches. |

O-7

3/7/2024

7

## Item 71 – Waterway Adequacy



| Interstate | Other Principal and Minor Arterials and Major Collectors | Minor Collectors, Local | Description  |
|------------|--|-------------------------|--|
| 6          | 6  | 7                       | Slight chance of overtopping bridge deck and roadway approaches. |

O-8

3/7/2024

8

## Item 71 – Waterway Adequacy



| Interstate | Other Principal and Minor Arterials and Major Collectors | Minor Collectors, Local | Description   |
|------------|--|-------------------------|---|
| 4          | 5  | 6                       | Bridge deck above roadway approaches. Occasional overtopping of roadway approaches with insignificant traffic delays. |

O-9

3/7/2024

9

## Item 71 – Waterway Adequacy



| Interstate | Other Principal and Minor Arterials and Major Collectors | Minor Collectors, Local | Description   |
|------------|--|-------------------------|---|
| 3          | 4  | 5                       | Bridge deck above roadway approaches. Occasional overtopping of roadway approaches with significant traffic delays. * |

O-10

3/7/2024

10

## Item 71 – Waterway Adequacy



| Interstate | Other Principal and Minor Arterials and Major Collectors | Minor Collectors, Local | Description   |
|------------|--|-------------------------|---|
| 2          | 3  | 4                       | Occasional overtopping of bridge deck and roadway approaches with significant traffic delays. * |

O-11

3/7/2024

11

## Item 71 – Waterway Adequacy



| Interstate | Other Principal and Minor Arterials and Major Collectors | Minor Collectors, Local | Description   |
|------------|--|-------------------------|---|
| 2          | 2  | 3                       | Frequent overtopping of bridge deck and roadway approaches with significant traffic delays. * |

O-12

3/7/2024

12

## Item 71 – Waterway Adequacy



| Interstate | Other Principal and Minor Arterials and Major Collectors | Minor Collectors, Local | Description  |
|------------|--|-------------------------|--|
| 2          | 2  | 2                       | Occasional or frequent overtopping of bridge deck and roadway approaches with severe traffic delays. * |

O-13

3/7/2024

13

## Discussion

3/7/2024

14

# REINFORCED CONCRETE SUPERSTRUCTURES

3/7/2024 IL NBI Refresher Course 2024

1

## Item 59 – Concrete Superstructure

- **Common Types of Concrete Superstructures**
- **Deck Condition vs. Superstructure Condition**
- **Condition Ratings**

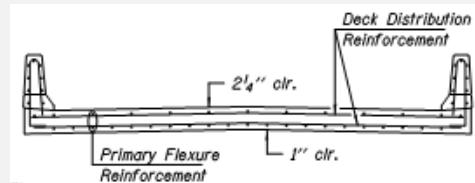
J-2

2

## Item 59 – Concrete Superstructure

### Cast in Place Conc. Slabs

- Common since early 1900's
- "Slab Superstructure" vs. "Deck"
  - Top of the slab superstructure serves as an integral deck
  - Slab superstructures span longitudinally vs. decks that usually span transversely
- Deck (Item 58) shall be rated same as Super (Item 59). The rating is based on the Super criteria



J-3

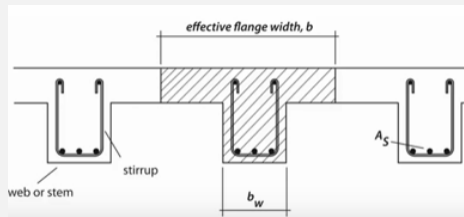
3/7/2024

3

## Item 59 – Concrete Superstructure

### Concrete T-Beams

- Common in 1930's - 50's
- Monolithic deck and stem forms the shape of a letter "T"
- Typically cast-in-place construction
- Top flange is considered the Deck (Item 58)
- Deck and stem act together as the superstructure (Item 59)



J-4

3/7/2024

4

## Item 59 – Concrete Superstructure

### Concrete T-Beams

- Look for heavy section loss in girder stem bars
  - Primary longitudinal bars
  - Shear bars (stirrups)
- Damage at beam ends around bearing



J-5

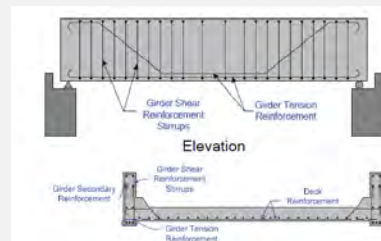
3/7/2024

5

## Item 59 – Concrete Superstructure

### Concrete Through Girders

- Common in 1940's, rarely used now
- Monolithic deck supported by a two-girder system
- Deck is cast between girders
- Upper portions of through girders serve as bridge railing
- Even though it is a two-girder system, girders are not FCMs



J-6

3/7/2024

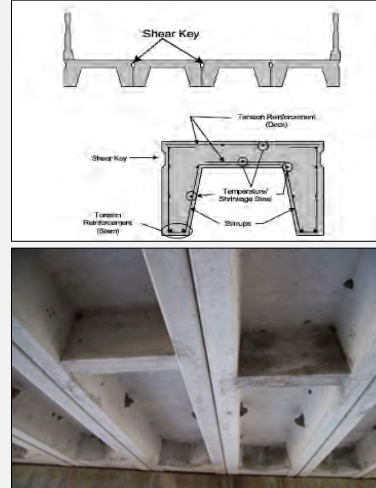
6



## Item 59 – Concrete Superstructure

### PC Channel Beam

- Appearance of bridge cross section resembles T-Beam
- Usually made of precast concrete
- Typically not prestressed
- Top flange is considered the Deck (Item 58)
- Deck and stems act together as superstructure (item 59)
- Deck is integral with the Super. Low Deck (Item 58) rating may adversely affect Super (Item 59) rating, however; Super rating will not affect Deck rating



J-7

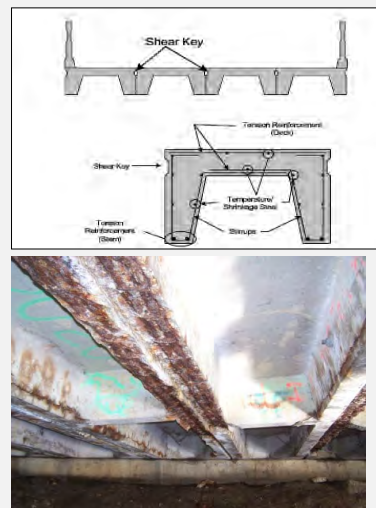
3/7/2024

7

## Item 59 – Concrete Superstructure

### PC Channel Beam

- Look for heavy section loss in beam leg bars
  - Primary longitudinal bars
  - Shear bars (stirrups)
- Heavy concrete spalling and delamination at girder ends



J-8

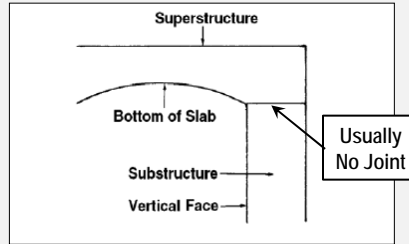
3/7/2024

8

## Item 59 – Concrete Superstructure

### 3-Sided Precast Structures

- Top may be arched or flat
- Most common version is precast concrete
- Top is considered the Superstructure (Item 59)
- Sides are considered the Substructure (Item 60)
- Deck (Item 58) is coded “N”



J-9

3/7/2024

## Item 59 – Concrete Superstructure

### Key Indicators

- Cracks
- Scaling
- Spalls/Delams
- Section Loss

| Code | Description   |
|------|---|
| 8    | VERY GOOD. No significant defects, very minor shrinkage cracks, surface scaling, spalling or pop-outs which do not expose reinforcing steel.  |
| 7    | GOOD. Isolated non-structural cracks up to 0.03", minor pop-outs or spalls without exposed primary reinforcing steel, stirrups may be exposed in a few locations.   |
| 6    | SATISFACTORY. Extensive non-structural cracks up to 0.06", isolated hairline structural cracks, spalls and delaminations may be present on up to 10% of a beams cross section or 6' width of a slab with exposed primary reinforcement with surface rust only, up to 20% of a beam cross section or 6' width of a slab may be map cracked, spalled and delaminated. Spalls and delaminations up to 5% on the sides of a beam cross section. |
| 5    | FAIR. Non-structural cracks greater than 0.06", structural cracks up to 0.03", spalling with section loss of reinforcing steel up to 10% in a beam or 6' width of slab, up to 10% of compression surface area spalled or delaminated in a beam cross section or 6' width of slab. Up to 10% section loss of the concrete cross section.   |

J-10

3/7/2024

## Item 59 – Concrete Superstructure

### Key Indicators

- Cracks
- Scaling
- Spalls/Delams
- Section Loss

| Code | Description  |
|------|--|
| 4    | POOR. Flexural or shear <b>cracks</b> up to 0.06", primary reinforcing steel exposed with <b>section loss</b> up to 30% in a 6' width of slab or in a beam cross section, up to 50% of the compression surface area <b>spalled or delaminated</b> , channel beams <b>spalled or delaminated</b> up to 30% <b>section loss</b> of the beam concrete cross section around the bottom primary reinforcement steel but not within 4' of beam ends. |
| 3    | SERIOUS. Primary reinforcing steel exposed with <b>section loss</b> up to 50% on a 6' width for slabs or cross section for beams, up to 100% <b>section loss</b> of compression surface area in a 6' width of slab or beam cross section, up to 50% <b>section loss</b> of the concrete cross section of a beam, channel beams <b>spalled or delaminated</b> around the bottom primary reinforcement steel within 4' of beam ends.             |
| 2    | CRITICAL. Similar to the description for a condition rating of "3" although more extensive with over 50% <b>loss</b> of reinforcing steel, channel beams fully delaminated or <b>spalled</b> at ends with broken stirrups, requires special <b>feature</b> inspections, temporary support or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.                            |

J-11


3/7/2024

11

## Item 59 – Concrete Superstructure

### New Superstructure

- Slab
- No Defects



New superstructure – Allowed first inspection only

J-12

3/7/2024

12

## Item 59 – Concrete Superstructure

### New Superstructure

- Channel Beam
- No Defects



New superstructure – Allowed first inspection only

J-13

3/7/2024

13

## Item 59 – Concrete Superstructure

### Very Good Condition

- Slab
- No significant defects



**VERY GOOD.** No significant defects, very minor shrinkage **cracks**, surface **scaling**, **spalling** or pop-outs which do not expose reinforcing steel.

J-14

3/7/2024

14

## Item 59 – Concrete Superstructure

### Very Good Condition

- Channel Beam
- Minor shrinkage cracks in legs



VERY GOOD. No significant defects, very minor shrinkage **cracks**, surface **scaling**, **spalling** or pop-outs which do not expose reinforcing steel.

J-15

3/7/2024

15

## Item 59 – Concrete Superstructure

### Very Good Condition

- 3-Sided Precast
- No significant defects



VERY GOOD. No significant defects, very minor shrinkage **cracks**, surface **scaling**, **spalling** or pop-outs which do not expose reinforcing steel.

J-16

3/7/2024

16

## Item 59 – Concrete Superstructure

### Good Condition

- Slab
- Minor non-structural cracks less than 0.03” present



GOOD. Isolated non-structural **cracks** up to 0.03”, minor pop-outs or **spalls** without exposed primary reinforcing steel, stirrups may be exposed in a few locations.

J-17

3/7/2024

17

## Item 59 – Concrete Superstructure

### Good Condition

- Through Girder
- Minor spalling without exposed reinforcement



GOOD. Isolated non-structural **cracks** up to 0.03”, minor pop-outs or **spalls** without exposed primary reinforcing steel, stirrups may be exposed in a few locations.

J-18


3/7/2024

18

## Item 59 – Concrete Superstructure

### Good Condition

- 3-Sided Precast
- Non-structural cracks less than 0.03" present



**GOOD.** Isolated non-structural **cracks** up to 0.03", minor pop-outs or **spalls** without exposed primary reinforcing steel, stirrups may be exposed in a few locations.

J-19


3/7/2024

19

## Item 59 – Concrete Superstructure

### Satisfactory Condition

- Slab
- Non-structural cracks less than 0.06" present
- 7% of surface area is delaminated with leaching present over a 6' wide section



**SATISFACTORY.** Extensive non-structural **cracks** up to 0.06", isolated hairline structural **cracks, spalls and delaminations** may be present on up to 10% of a beams cross section or 6' width of a slab with exposed primary reinforcement with surface rust only, up to 20% of a beam cross section or 6' width of a slab may be map **cracked, spalled and delaminated**. Spalls and delaminations up to 5% on the sides of a beam cross section.

J-20


3/7/2024

20

## Item 59 – Concrete Superstructure

### Satisfactory Condition

- T-Beam
- Non-structural cracks less than 0.06” present
- 9% of a beam surface area has spalls, delaminations, and leaching present



**SATISFACTORY.** Extensive non-structural **cracks** up to 0.06”, isolated hairline structural **cracks, spalls and delaminations** may be present on up to 10% of a beams cross section or 6’ width of a slab with exposed primary reinforcement with surface rust only, up to 20% of a beam cross section or 6’ width of a slab may be map cracked, spalled and delaminated. Spalls and delaminations up to 5% on the sides of a beam cross section.


3/7/2024
J-21

21

## Item 59 – Concrete Superstructure

### Satisfactory Condition

- Channel Beam
- Non-structural cracks less than 0.06” present
- 5% of a beams surface area has delaminations and map cracking
- Be sure cracks are due to delaminations!



**SATISFACTORY.** Extensive non-structural **cracks** up to 0.06”, isolated hairline structural **cracks, spalls and delaminations** may be present on up to 10% of a beams cross section or 6’ width of a slab with exposed primary reinforcement with surface rust only, up to 20% of a beam cross section or 6’ width of a slab may be map cracked, spalled and delaminated. Spalls and delaminations up to 5% on the sides of a beam cross section.

3/7/2024
J-22


22



## Item 59 – Concrete Superstructure

### Satisfactory Condition

- 3-Sided Precast
- Tight non-structural cracks less than 0.06" present
- Leaching keyway



**SATISFACTORY.** Extensive non-structural cracks up to 0.06", isolated hairline structural cracks, spalls and delaminations may be present on up to 10% of a beams cross section or 6' width of a slab with exposed primary reinforcement with surface rust only, up to 20% of a beam cross section or 6' width of a slab may be map cracked, spalled and delaminated. Spalls and delaminations up to 5% on the sides of a beam cross section.


3/7/2024
J-23

23

## Item 59 – Concrete Superstructure

### Fair Condition

- Slab
- 8% spalls and delaminations present
- Less than 10% section loss in reinforcement over 6' width



**FAIR.** Non-structural cracks greater than 0.06", structural cracks up to 0.03", spalling with section loss of reinforcing steel up to 10% in a beam or 6' width of slab, up to 10% of compression surface area spalled or delaminated in a beam cross section or 6' width of slab. Up to 10% section loss of the concrete cross section.

3/7/2024
J-24

24

## Item 59 – Concrete Superstructure

### Fair Condition

- T-Beam
- Spalling and delaminations present
- 10% section loss in beam primary reinforcement



FAIR. Non-structural cracks greater than 0.06", structural cracks up to 0.03", **spalling with section loss** of reinforcing steel up to 10% in a beam or 6' width of slab, up to 10% of compression surface area spalled or delaminated in a beam cross section or 6' width of slab. Up to 10% section loss of the concrete cross section.

J-25

3/7/2024

25

## Item 59 – Concrete Superstructure

### Fair Condition

- Through Girder
- Isolated structural cracks less than 0.03" wide
- Spalling with 6% section loss in beam primary reinforcement



FAIR. Non-structural cracks greater than 0.06", **structural cracks** up to 0.03", **spalling with section loss** of reinforcing steel up to 10% in a beam or 6' width of slab, up to 10% of compression surface area spalled or delaminated in a beam cross section or 6' width of slab. Up to 10% section loss of the concrete cross section.

J-26

3/7/2024

26

## Item 59 – Concrete Superstructure

### Fair Condition

- Channel Beam
- Map cracking, delaminations, and leaching present on 10% of beam surface
- No significant section loss in exposed steel



**FAIR.** Non-structural cracks greater than 0.06", structural cracks up to 0.03", **spalling with section loss** of reinforcing steel up to 10% in a beam or 6' width of slab, up to 10% of compression surface area spalled or delaminated in a beam cross section or 6' width of slab. Up to 10% section loss of the concrete cross section.

J-27

3/7/2024

27

## Item 59 – Concrete Superstructure

### Fair Condition

- 3-Sided Precast
- 8% of surface area is spalled or delaminated
- 6% section loss in reinforcement



**FAIR.** Non-structural cracks greater than 0.06", structural cracks up to 0.03", **spalling with section loss** of reinforcing steel up to 10% in a beam or 6' width of slab, up to 10% of compression surface area spalled or delaminated in a beam cross section or 6' width of slab. Up to 10% section loss of the concrete cross section.

J-28

3/7/2024

28

## Item 59 – Concrete Superstructure

### Poor Condition

- Slab
- Spalling with exposed reinforcement present
- 15% section loss in primary reinforcement over a 6' width



POOR. Flexural or shear cracks up to 0.06", primary reinforcing steel exposed with **section loss** up to 30% in a 6' width of slab or in a beam cross section, up to 50% of the compression surface area **spalled or delaminated**, channel beams spalled or delaminated up to 30% section loss of the beam concrete cross section around the bottom primary reinforcement steel but not within 4' of beam ends.

J-29

3/7/2024

29

## Item 59 – Concrete Superstructure

### Poor Condition

- T-Beam
- Structural cracks near beam ends less than 0.06" in width
- Delaminations and widespread leaching present
- 25% section loss in beam primary reinf.



POOR. Flexural or shear **cracks** up to 0.06", primary reinforcing steel exposed with **section loss up to 30%** in a 6' width of slab or in a beam cross section, up to 50% of the compression surface area **spalled or delaminated**, channel beams spalled or delaminated up to 30% section loss of the beam concrete cross section around the bottom primary reinforcement steel but not within 4' of beam ends.

J-30

3/7/2024

30

## Item 59 – Concrete Superstructure

### Poor Condition

- Through Girder
- Spalled concrete with exposed reinforcement
- 20% section loss in exposed primary reinforcement



POOR. Flexural or shear cracks up to 0.06", primary reinforcing steel exposed with **section loss** up to 30% in a 6' width of slab or in a beam cross section, up to 50% of the compression surface area spalled or delaminated, channel beams spalled or delaminated up to 30% section loss of the beam concrete cross section around the bottom primary reinforcement steel but not within 4' of beam ends.

J-31

3/7/2024

31

## Item 59 – Concrete Superstructure

### Serious Condition

- Slab
- Concrete spalling with reinforcement exposed
- 35% section loss in exposed primary reinforcement
- Concrete cores may be needed



SERIOUS. Primary reinforcing steel exposed with **section loss** up to 50% on a 6' width for slabs or cross section for beams, up to 100% section loss of compression surface area in a 6' width of slab or beam cross section, up to 50% section loss of the concrete cross section of a beam, channel beams spalled or delaminated around the bottom primary reinforcement steel within 4' of beam ends.

J-32

3/7/2024

32

## Item 59 – Concrete Superstructure

### Serious Condition

- T-Beam
- Concrete spalling with reinforcement exposed
- 40% section loss in exposed primary reinforcement



**SERIOUS.** Primary reinforcing steel exposed with **section loss** up to 50% on a 6' width for slabs or cross section for beams, up to 100% section loss of compression surface area in a 6' width of slab or beam cross section, up to 50% section loss of the concrete cross section of a beam, channel beams spalled or delaminated around the bottom primary reinforcement steel within 4' of beam ends.

J-33

3/7/2024

33

## Item 59 – Concrete Superstructure

### Serious Condition

- Through Girder
- Concrete spalling with reinforcement exposed
- 35% section loss in exposed primary reinforcement



**SERIOUS.** Primary reinforcing steel exposed with **section loss** up to 50% on a 6' width for slabs or cross section for beams, up to 100% section loss of compression surface area in a 6' width of slab or beam cross section, up to 50% section loss of the concrete cross section of a beam, channel beams spalled or delaminated around the bottom primary reinforcement steel within 4' of beam ends.

J-34

3/7/2024

34

## Item 59 – Concrete Superstructure

### Serious Condition

- Channel Beam
- Concrete spalling with reinforcement exposed
- 35% section loss in exposed primary reinforcement



**SERIOUS.** Primary reinforcing steel exposed with **section loss** up to 50% on a 6' width for slabs or cross section for beams, up to 100% section loss of compression surface area in a 6' width of slab or beam cross section, up to 50% section loss of the concrete cross section of a beam, channel beams spalled or delaminated around the bottom primary reinforcement steel within 4' of beam ends.

J-35

3/7/2024

35

## Item 59 – Concrete Superstructure

### Critical Condition

- Channel Beam
- Concrete spalling with reinforcement exposed
- 40% section loss in primary reinforcement
- Broken stirrups at beam ends
- Bureau of Bridges and Structures should be notified immediately!



**CRITICAL.** Similar to the description for a condition rating of "3" although more extensive with over 50% **loss of reinforcing steel**, channel beams fully delaminated or **spalled at ends with broken stirrups**, requires special feature inspections, temporary support or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.

J-36

3/7/2024

36

## Item 59 – Concrete Superstructure

### Critical Condition

- Slab
- Large spall with two layers of exposed reinforcement
- 50% section loss in bottom reinforcement
- Full-depth hole through slab above reinforcement
- Middle third of soffit is delaminated and sagging



**CRITICAL.** Similar to the description for a condition rating of “3” although more extensive with over 50% loss of reinforcing steel, channel beams fully delaminated or spalled at ends with broken stirrups, requires special feature inspections, temporary support or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.



# SUBSTRUCTURES


3/7/2024 IL NBI Refresher Course 2024

1

## Item 60 – Substructure Condition

### Typical Elements

- Abutments
- Piers
- Piles
- Footings
- Fenders



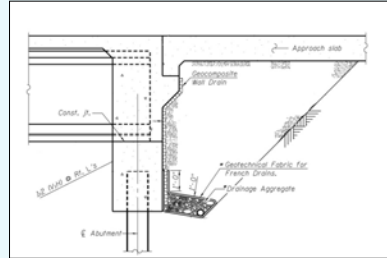
3/7/2024 L-2

2

## Item 60 – Substructure Condition

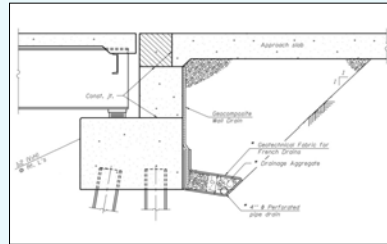
- **Integral Abutment**

Substructure is the portion of the bridge below the intersection of the bottom of the superstructure with the vertical wall face



- **Non-Integral Abutment**

- Substructure is the portion below the bearings
- Includes backwalls



3/7/2024

L-3

3

## Item 60 – Substructure Condition

### Temporary Shoring

- If left in place for 5 yrs. or more, temporary supports are considered the Substructure
- The rating coded for Item 60 would be based on the criteria for the material used for the former “temporary” support
- Steel shoring, similar to the example in the lower photo, becomes a Fracture Critical Member in the Substructure



3/7/2024

L-4

4

## Item 60 – Substructure Condition

### Excessive Deterioration in Exposed Piling:

- Heavy damage too exposed piles is a problem and has caused multiple bridge failures and closures
- Inspectors need to pay extra attention to these types of piles



3/7/2024

L-5

5

## Item 60 – Substructure Condition

### Pile Deterioration Problems

- **Exposed piling without concrete encasement:**
  - Steel Piling
    - H-Pile
    - Metal Shell
  - Timber Piling
- **Accelerated deterioration possible:**
  - At the top where it meets the cap
  - At or just below the mud-line, in areas with frequent wetting and drying occurring



3/7/2024

L-6

6

## Item 60 – Substructure Condition

### IL County Bridge Failure

- Pier collapsed on 4 span bridge in September 2013
- Collapse immediately preceded by a < legal loads truck crossing bridge
- Failure of deteriorated piling was the cause



3/7/2024

L-7

7

## Item 60 – Substructure Condition

### IL County Failure

- Exposed steel H-Piles
- Accelerated deterioration and section loss occurred
  - At the water line
  - In areas with frequent wetting and drying
- Difficult location to easily see during inspection



**Pier similar to the one that failed**

3/7/2024

L-8

8

## Item 60 – Substructure Condition

### IL County Failure

#### Steel H-piling



Heavy section loss



Failed pile sections

3/7/2024

L-9

9

## Item 60 – Substructure Condition

### Pile Deterioration Problems

- Damaged Timber Piling
- Heavy deterioration found just below the mud-line



3/7/2024

L-10

10

## Item 60 – Substructure Condition



2016 State Rte. Bridge closure in [Ohio](#) due to deteriorated exposed steel piles at the water line. SUBSTRUCTURE Rating was a "7".

[Missouri DOT](#) has reported seeing similar problems.



2016 Local Rte. Bridge closure in [Illinois](#) due to deteriorated exposed steel piles just below the pier cap.

3/7/2024

L-11

11

## Item 60 – Substructure Condition

### Exposed Pile Inspection:

**Extra attention required during inspection!!**

- **Check condition of piles at / below water / mud-line (12"-18")**
- **Return later to inspect during a low water period if necessary**
- **Timber Piles**
  - Sound piles with hammer full height
  - Core piles if hollow to determine section loss %
- **Steel Piles**
  - Also check top of pile at bottom of cap
  - Take thickness readings if necessary to determine section loss %
- **See IDOT CL 2014-15 on Exposed Bridge Piling**

3/7/2024

L-12

12

## Item 60 – Substructure Condition

### Underwater Inspection:

For substructures requiring underwater inspection that are not being completed by a diver:

- Verify stream cross section elevations
- Plot and compare new to previous cross section elevations
- Probe around footings to verify if they have been exposed
- Look for deterioration of the underwater portion of the substructure

3/7/2024

L-13

13

## Item 60 – Substructure Condition

### Key Indicators

- Cracks
- Scaling
- Spalling
- Delaminations
- Section Loss
- Scour
- Movement

| Code | Description (CONCRETE OR MASONRY)  |
|------|--|
| N    | Culvert.   |
| 9    | New substructure.  |
| 8    | VERY GOOD. No significant defects. Shrinkage <b>cracks</b> , very light surface <b>scaling</b> , <b>spalling</b> or pop-outs which do not expose reinforcing steel. Insignificant damage caused by drift or collision with no misalignment and no corrective action warranted.   |
| 7    | GOOD. Minor <b>cracking</b> , <b>spalls</b> or <b>scaling</b> with few incidences of exposed reinforcing steel. Insignificant damage caused by drift or collision with no misalignment and no corrective action warranted. Minor <b>scour</b> may have occurred at the foundation.   |
| 6    | SATISFACTORY. Moderate deterioration or disintegration, <b>spalls</b> , <b>cracking</b> and leaching on concrete or masonry units with up to 2% <b>section loss</b> or <b>loss of bearing area</b> . Shallow, local <b>scour</b> may have occurred near foundations with exposure of top of pile supported footings, less than 2' deep <b>scour</b> around pile bents. No exposed piles. |

3/7/2024

L-14

14

## Item 60 – Substructure Condition

### Key Indicators

- Cracks
- Scaling
- Spalling
- Delaminations
- Section Loss
- Scour
- Movement

Section loss % based on the total of all primary reinf. at the section, not the individual bars.

| Code | Description  |
|------|--|
| 5    | FAIR. Large portions of concrete or masonry units are <b>spalled, scaled, or delaminated</b> with exposed reinforcing steel up to 10% <b>loss of concrete</b> (horizontal cross section), up to 10% <b>loss of reinforcement</b> steel, extensive map <b>cracking</b> with leaching, spread footings with no undermining on soil and up to 5% undermining on rock, less than 2' of exposed piles or seal coat below pile supported footings, less than 6' deep <b>scour</b> around pile bents, up to 10% section <b>loss of bearing seats or piles</b> .   |
| 4    | POOR. Active <b>cracks</b> in concrete and masonry units that indicate a reduction in the substructure unit's capacity to support the superstructure loads, up to 30% <b>section loss</b> of bearing seat(s) or pile(s), <b>section loss</b> of primary steel reinforcement up to 30%. <b>Section loss</b> of concrete up to 30%, undermining of spread footing which may be affecting the stability of the unit but no significant <b>settlement</b> has yet occurred, worst condition or combination of deterioration stated in condition rating "5". If the rating of this item is due to <b>scour</b> , the rating for Item 113 shall be re-evaluated. |

L-15

3/7/2024

15

## Item 60 – Substructure Condition

### Key Indicators

- Cracks
- Scaling
- Spalling
- Delaminations
- Section Loss
- Scour
- Movement

| Code | Description   |
|------|---|
| 3    | SERIOUS. <b>Section losses</b> up to 50%, <b>loss of bearing</b> seat area to cause more than 2" drop, adjacent column ties are broken causing the vertical reinforcement to be ineffective, severe <b>scour</b> or undermining of footings affecting the stability of the unit with some <b>settlement</b> of the substructure. If the rating of this item is due to <b>scour</b> , the rating for Item 113 shall be re-evaluated. |
| 2    | CRITICAL. Conditions worse than condition rating of "3", <b>section loss</b> greater than 50%, special feature inspection is required to allow bridge to remain open, measurable lateral or vertical <b>movement, unstable</b> structures. The Bureau of Bridges and Structures shall be notified immediately. If the rating of this item is due to scour, the rating for Item 113 shall be re-evaluated.                           |

L-16

3/7/2024

16



## Item 60 – Substructure Condition

**New  
Construction**

**Note Integral  
Abutment**



Allowed 1<sup>st</sup> inspection only.

L-17

3/7/2024

17

## Item 60 – Substructure Condition

**New  
Construction**



Allowed 1<sup>st</sup> inspection only.

L-18

3/7/2024

18

## Item 60 – Substructure Condition

**Very Good Condition**

Light surface scaling



**VERY GOOD.** No significant defects. Shrinkage cracks, very light surface **scaling**, spalling or pop-outs which do not expose reinforcing steel. Insignificant damage caused by drift or collision with no misalignment and no corrective action warranted.

L-19

3/7/2024

19

## Item 60 – Substructure Condition

**Very Good Condition**

Light surface scaling



**VERY GOOD.** No significant defects. Shrinkage cracks, very light surface **scaling**, spalling or pop-outs which do not expose reinforcing steel. Insignificant damage caused by drift or collision with no misalignment and no corrective action warranted.

L-20

3/7/2024

20

## Item 60 – Substructure Condition

**Very Good Condition**

No noted defects



**VERY GOOD.** No significant defects. Shrinkage cracks, very light surface scaling, spalling or pop-outs which do not expose reinforcing steel. Insignificant damage caused by drift or collision with no misalignment and no corrective action warranted.

L-21

3/7/2024

21

## Item 60 – Substructure Condition

**Good Condition**

Minor cracking and scaling of the underside of the pier cap



**GOOD.** Minor **cracking**, spalls or **scaling** with few incidences of exposed reinforcement with only surface rust. Minor scour may have occurred at the foundation.

L-22

3/7/2024

22

## Item 60 – Substructure Condition

### Good Condition

Minor cracking and scaling of abutment backwall and pier caps



GOOD. Minor **cracking**, spalls or **scaling** with few incidences of exposed reinforcement with only surface rust. Minor scour may have occurred at the foundation.

L-23

3/7/2024

23

## Item 60 – Substructure Condition

### Good Condition

- Minor cracking and scaling on piers
- Minor scour
- Very minor surface rust on FCM cap beam
- Steel sheet piling in good condition



GOOD. Minor **cracking**, spalls or **scaling** with few incidences of exposed reinforcement with only surface rust. Minor **scour** may have occurred at the foundation.

GOOD (Steel). Some **light surface rust**, minor scour may have occurred.

L-24

3/7/2024

24

## Item 60 – Substructure Condition

### Satisfactory Condition

Hairline vertical cracks in the pier bents with minor spalls



**SATISFACTORY.** Moderate deterioration or disintegration, **spalls, cracking** and leaching on concrete or masonry units with up to 2% section loss or loss of bearing area. Shallow, local scour may have occurred near foundations with exposure of top of pile supported footings, less than 2' deep scour around pile bents. No exposed piles.

L-25

3/7/2024

25

## Item 60 – Substructure Condition

### Satisfactory Condition

- Minor spall on the corner of one bent with exposed reinforcement
- Minor spalls on concrete cap with no reinforcement exposed



**SATISFACTORY.** Moderate deterioration or disintegration, **spalls, cracking** and leaching on concrete or masonry units with up to 2% section loss or loss of bearing area. Shallow, local scour may have occurred near foundations with exposure of top of pile supported footings, less than 2' deep scour around pile bents. No exposed piles.

L-26


3/7/2024

26

## Item 60 – Substructure Condition

**Satisfactory Condition**

The concrete backwall has leaching cracks throughout



**SATISFACTORY.** Moderate deterioration or disintegration, spalls, **cracking** and leaching on concrete or masonry units with up to 2% section loss or loss of bearing area. Shallow, local scour may have occurred near foundations with exposure of top of pile supported footings, less than 2' deep scour around pile bents. No exposed piles.

3/7/2024
L-27

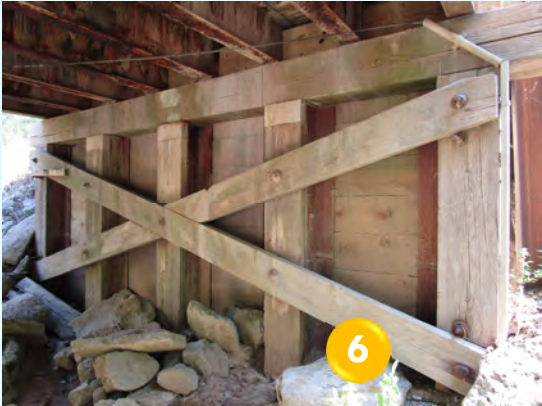
27

## Item 60 – Substructure Condition

**Satisfactory Condition**

Timber Abutment

- Minor splitting in abut cap ends
- Minor decay in cap ends beneath fascia beams



**SATISFACTORY.** **Surface decay, cracking, splitting of timber,** fire damage limited to surface scorching of timber with up to 2% section loss, shallow, local scour may have occurred near foundations. No exposed piles.

3/7/2024
L-28

28

## Item 60 – Substructure Condition

### Fair Condition

- Large areas of concrete cap are spalled with exposed reinforcement
- Section loss is 7% of total primary reinforcement at section



FAIR. Large portions of concrete or masonry units are **spalled**, scaled, or delaminated with **exposed reinforcing steel** up to 10% loss of concrete (horizontal cross section), up to 10% **loss of reinforcement** steel, extensive map cracking with leaching, spread footings with no undermining on soil and up to 5% undermining on rock, less than 2' of exposed piles or seal coat below pile supported footings, less than 6' deep scour around pile bents, up to 10% section loss of bearing seats or piles.

L-29

3/7/2024

29

## Item 60 – Substructure Condition

### Fair Condition

- Large areas of cap are spalled with exposed reinforcement
- Section loss is 10% of total primary reinforcement in section



FAIR. Large portions of concrete or masonry units are **spalled**, scaled, or **delaminated** with exposed reinforcing steel up to 10% loss of concrete (horizontal cross section), up to 10% **loss of reinforcement** steel, extensive map cracking with leaching, spread footings with no undermining on soil and up to 5% undermining on rock, less than 2' of exposed piles or seal coat below pile supported footings, less than 6' deep scour around pile bents, up to 10% section loss of bearing seats or piles.

L-30

3/7/2024

30

## Item 60 – Substructure Condition

### Satisfactory Condition

#### Timber Abut & Piers

- Minor surface decay with cracking and splitting of timber piles
- Pier cross brace rotted at outer pile
- Sound piles to check for hollow sections, check for decay at/below mud line



**FAIR.** Minor decay, cracking or splitting of timber, a few secondary members may need replacement but primary members are performing their function as designed with section loss up to 10%, fire damage limited to surface charring of timber with minor section loss up to 10%, spread footings exposed with no undermining on soil and up to 5% undermining on rock, less than 2' of piles or seal coat exposed below pile supported footings, less than 6' deep scour around pile bents with pile caps installed above the ground, no misalignment or settlement noted.

L-31

31

## Item 60 – Substructure Condition

### Fair Condition

- Large areas of spalled and delaminated concrete on face of abutment
- Minor vertical cracks throughout



**FAIR.** Large portions of concrete or masonry units are spalled, scaled, or delaminated with exposed reinforcing steel up to 10% loss of concrete (horizontal cross section), up to 10% loss of reinforcement steel, extensive map cracking with leaching, spread footings with no undermining on soil and up to 5% undermining on rock, less than 2' of exposed piles or seal coat below pile supported footings, less than 6' deep scour around pile bents, up to 10% section loss of bearing seats or piles.

L-32

3/7/2024

32



## Item 60 – Substructure Condition

### Fair Condition

- Large areas of cap are spalled with exposed reinforcement
- Section loss is 8% of total primary reinforcement in section
- Map cracking with efflorescence noted



**FAIR.** Large portions of concrete or masonry units are spalled, scaled, or delaminated with exposed reinforcing steel up to 10% loss of concrete (horizontal cross section), up to 10% loss of reinforcement steel, extensive map cracking with leaching, spread footings with no undermining on soil and up to 5% undermining on rock, less than 2' of exposed piles or seal coat below pile supported footings, less than 6' deep scour around pile bents, up to 10% section loss of bearing seats or piles.

L-33

3/7/2024

33

## Item 60 – Substructure Condition

### Poor Condition

- Active cracks and spalls noted
- 22% loss in concrete cross section



**POOR.** Active cracks in concrete and masonry units that indicate a reduction in the substructure unit's capacity to support the superstructure loads, up to 30% section loss of bearing seat(s) or pile(s), section loss of primary steel reinforcement up to 30%. Section loss of concrete up to 30%, undermining of spread footing which may be affecting the stability of the unit but no significant settlement has yet occurred, worst condition or combination of deterioration stated in condition rating "5". If the rating of this item is due to scour, the rating for Item 113 shall be re-evaluated.

L-34

3/7/2024

34

## Item 60 – Substructure Condition

### Poor Condition

- Large area of spalled concrete under exterior beam
- Integrity of bearing seat reduced due to spalls



POOR. Active cracks in concrete and masonry units that indicate a reduction in the substructure unit's capacity to support the superstructure loads, up to 30% section loss of bearing seat(s) or pile(s), section loss of primary steel reinforcement up to 30%. Section loss of concrete up to 30%, undermining of spread footing which may be affecting the stability of the unit but no significant settlement has yet occurred, worst condition or combination of deterioration stated in condition rating "5". If the rating of this item is due to scour, the rating for Item 113 shall be re-evaluated.

L-35

3/7/2024

35

## Item 60 – Substructure Condition

### Poor Condition

- Widespread spalling of concrete on face of abutment
- Integrity of bearing seat reduced due to spalls up to 25%



POOR. Active cracks in concrete and masonry units that indicate a reduction in the substructure unit's capacity to support the superstructure loads, up to 30% section loss of bearing seat(s) or pile(s), section loss of primary steel reinforcement up to 30%. Section loss of concrete up to 30%, undermining of spread footing which may be affecting the stability of the unit but no significant settlement has yet occurred, worst condition or combination of deterioration stated in condition rating "5". If the rating of this item is due to scour, the rating for Item 113 shall be re-evaluated.

L-36

3/7/2024

36

## Item 60 – Substructure Condition

### Serious Condition

- Abutment undermined by scour
- Abutment stability affected



**SERIOUS.** Section losses up to 50%, loss of bearing seat area to cause more than 2" drop, adjacent column ties are broken causing the vertical reinforcement to be ineffective, **severe scour or undermining of footings affecting the stability of the unit with some settlement of the substructure.** If the rating of this item is due to **scour**, the rating for Item 113 shall be re-evaluated.

L-37

3/7/2024

37

## Item 60 – Substructure Condition

### Critical Condition

- Abutment undermined by scour
- Abutment corner has settled approximately 6"



**CRITICAL.** Conditions worse than condition rating of "3", section loss greater than 50%, special feature inspection is required to allow bridge to remain open, **measurable lateral or vertical movement, unstable structures.** The Bureau of Bridges and Structures shall be notified immediately. If the rating of this item is due to scour, the rating for Item 113 shall be re-evaluated.

L-38

3/7/2024

38

## Item 60 – Substructure Condition

### Critical Condition

- Concrete section loss of 55% in pier column
- Special Inspection required



CRITICAL. Conditions worse than condition rating of "3", **section loss greater than 50%**, special feature inspection is required to allow bridge to remain open, measurable lateral or vertical movement, unstable structures. The Bureau of Bridges and Structures shall be notified immediately. If the rating of this item is due to scour, the rating for Item 113 shall be re-evaluated.

L-39

3/7/2024

39

## Item 60 – Substructure Condition

### Failure Imminent

Notify the Bureau of Bridges and Structures immediately



Substructure in **"imminent failure" condition** requiring bridge closure or temporary measures to allow structure to remain open.

L-40

3/7/2024

40

## Item 60 – Substructure Condition

### Failure Imminent

- Tops of steel piles are cracked
- Abutment cap has displaced laterally causing instability
- Notify the Bureau of Bridges and Structures immediately



Substructure in **“imminent failure” condition** requiring bridge closure or temporary measures to allow structure to remain open.

L-41

3/7/2024

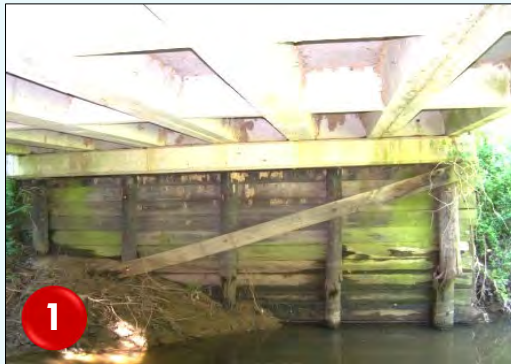
41

## Item 60 – Substructure Condition

### Failure Imminent

#### Timber Abutment

- 3 exposed piles have 100% section loss
- The 2 remaining piles are obscured by debris and may have similar loss of section
- Notify the Bureau of Bridges and Structures immediately



Substructure in **“imminent failure” condition** requiring bridge closure or temporary measures to allow structure to remain open.

L-42

3/7/2024

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**INVENTORY DATA**

3/7/2024 IL NBI Refresher Course 2024

1

**Inventory Data**

**How often do you check Inventory Data?**

1. Every Inspection
2. First Inspection
3. Never
4. What's Inventory Data?

F-2

3/7/2024

2

## Inventory Data

### Why bother, it doesn't change, right?

- **Some items DO CHANGE**
  - Bridge Status
  - New overlays
  - Load postings
  - Rehabilitation or Maintenance work
  - Changes to approach roadways
- Also, **MANY** items in the system are **incorrectly coded!!**

F-3

3/7/2024

3

## Inventory Data

### Typical Findings from QA Reviews

- **Out-of-Date Information - undocumented rehabs**
- **Miscoded Items**
  - Dimensions, Bridge Geometry & Approach rdwy geometry
  - Main Span & Sub Material, Type of Deck
- **Missing Items – never input**
- **The degree of missing and incorrect information is a **BIG PROBLEM** when trying to analyze the IL bridge system**

F-4

3/7/2024

4

## Inventory Data

- We need **your** help to fix the bridge inventory data problem!
- The Bridge Program Managers and Inspectors are the best hope of correcting this issue



F-5

3/7/2024

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## Inventory Data



### What Can You Do?

- Review key inventory data during each routine inspection cycle to verify it is correct. Use these reports:
  - Inspectors Inventory Report (S-114)
  - Structure Summary Report
- Correct mistakes found by writing directly on these reports
- Forward the marked up/corrected reports to your District contact to update the information in the ISIS System
- Or email corrections to: [DOT.BBS.BridgeMgmt@Illinois.gov](mailto:DOT.BBS.BridgeMgmt@Illinois.gov)

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3/7/2024

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## Inventory Data

**COMMON MISCODED ITEMS:**

- Item 19 - Bypass Length
- Item 27A - Construction Year
- Item 31 - Design Load
- Item 34 - Skew Direction
- Item 34A - Skew Angle
- Item 41 - Bridge Status
- Item 43A - Main Span Material
- Item 43B - Main Structure Type
- Item 45 - Number of Main Spans
- Item 46 - Number of Appr. Spans
- Item 48 - Length of Longest Span
- Item 49 - Structure Length
- Item 51 - Bridge Rdwy Width
- Item 52 - Deck Width
- Items 60A / 60B - Substr. Material
- Item 62A - Culvert Cells (Count)
- Item 62B - Culvert Cell Width (Ft.)
- Item 62C - Culvert Cell Height
- Item 62D - Culvert Opening Area
- Item 62E - Culvert Fill Depth
- Item 107 - Deck Structure Type
- Item 107A - Deck Structure Thickness
- Item 108D - Total Deck Thickness

F-7

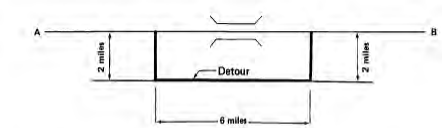
3/7/2024

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## Inventory Data

### Missing Inventory Data: Item 19 - Bypass Length

- This item considers the length of **additional travel distance** required if a structure is closed to traffic
- The additional travel distance required, following a designated detour over a road or bridge of equal or greater quality, is reported in Bypass Length



Additional travel from A to B = 4 miles

| Situation   | Enter |
|---|-------|
| Temporary ground level bypass available   | 00    |
| Structure bypassable utilizing interchange ramps  | 00    |
| Structure over wide river, not bypassable, 21.4 miles additional travel                   | 21    |
| Structure (not an interchange) bypassable using parallel structure                        | 01    |
| Structure not bypassable, 100 miles or more additional travel required or a dead end road | 99    |

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## Inventory Data

### Item 27A – Construction Year

#### ORIGINAL CONSTRUCTION YEAR (coded - O)

- This is the year the bridge was originally built
- If the previous bridge was completely replaced this is the year the new bridge was built and the old date is replaced
- Often miscoded or listed as “1900”

#### RECONSTRUCTION YEAR (coded - R)

- This is the year the bridge was rebuilt

#### MAINTENANCE/REPAIRS YEAR (coded - M)

- This is the year of the last maintenance or repair work

F-9

3/7/2024

9

## Inventory Data

### Item 31 – Design Load

- This is the Live Load the bridge was designed to carry
- It is typically found on the 1<sup>st</sup> or 2<sup>nd</sup> sheet of the bridge design plans
- The vast majority of our structures were designed using the following loads:
  - HL93 (1990's to present)
  - HS20 or HS20-44 (1944-2000's)
  - HS15 or HS15-44 (1944-1970's)
  - H15 and H20-*rare* (1931-1944)
  - Use “Unknown” (when loading not found on plans)
- Item often not filled out or is miscoded

F-10

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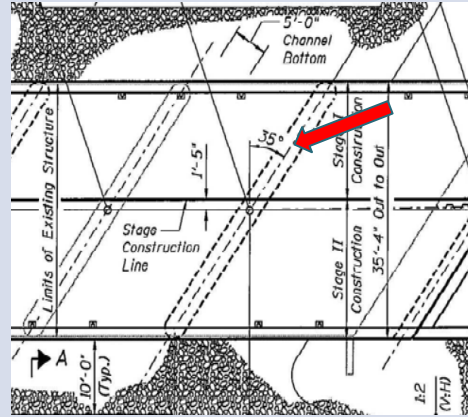
## Inventory Data

### Item 34 - Skew Direction

- Indicates the skew direction of the structure (left ahead shown in picture)
  - N = No Angle
  - R = Right Ahead
  - L = Left Ahead

### Item 34A - Skew Angle

- This is the angle between the centerline of a pier or abutment and a line perpendicular to the roadway centerline
- Information incorrectly coded may be the complement of the skew angle. Often occurs with angles near 45° where error is not obvious.



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3/7/2024

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## Inventory Data

### Item 41 – Bridge Status

- 1 - Open, no restrictions
- 2 - Open, load posted (may include other restrictions)
- 3 - Open, posted OTAT or speed limit posted, but no posted load limit restrictions
- 4 - Open, posting recommended but not legally implemented
- 5 - Open, temporary measures in place to allow traffic and having no load or speed restrictions
- 6 - Open, temporary measures in place to allow traffic, but has load or speed restrictions
- 7 - Open, staged construction**
- 8 - Open, new structure, not yet inspected
- 9 - New or planned structure, not yet open
- A - Closed, replacement/repairs under contract**
- B - Closed, replacement/repair anticipated within next 5 years
- C - Road Closed, closure not related to condition of the structure
- E - Closed, permanent closure due to bridge condition, repair/replacement not anticipated within next 5 years.

F-12

3/7/2024

12

## Inventory Data

### Item 43A - Main Span Material

- 1 Concrete
- 2 Concrete **continuous**
- 3 Steel
- 4 Steel **continuous**
- 5 Prestressed concrete
- 6 Prestressed concrete **continuous**
- 7 Timber
- 8 Masonry
- 9 Aluminum, Wrought Iron or Cast Iron
- 0 Other or Varied
- A Precast concrete - **Not prestressed**
- B Post Tension Concrete **Segmental** (revised 2018)
- C Fiber Reinforced Polymer (new item 2018)

F-13

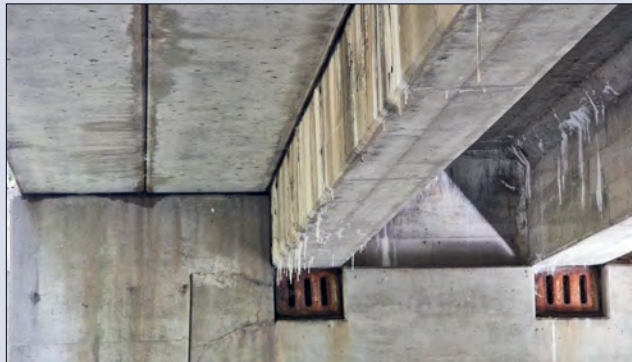
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## Inventory Data

### Item 43A - Main Span Material

- Coding Structures of Multiple Material Types
- Code based on which material constitutes the majority of sq. ft.



F-14

3/7/2024

14

## Inventory Data

### Item 43B - Main Structure Type

- Identifies the predominant type of structure used in the main structure
- Includes all spans of most bridges (but the major unit only of large bridges)

| Code | Description                      | Code | Description                  | Code   | Description              |
|------|----------------------------------|------|------------------------------|--|--------------------------|
| 01   | Slab                             | 11   | Arch - Deck, Filled Spandrel | 24   | Thru Girder              |
| 02   | Multi-Beam                       | 12   | Arch - Thru                  | 25   | Arch-Deck, Open Spandrel |
| 03   | Deck Girder (non-redundant)      | 13   | Suspension                   | 26   | Low Water Crossing       |
| 04   | Tee Beam                         | 14   | Cable Stayed                 | 27   | Retaining Wall           |
| 05   | Box Beam - Multiple Adjacent     | 15   | Movable - Lift               | 28   | Segmental Box Girder     |
| 06   | Box Beam - Single or Spread      | 16   | Movable - Bascule            | 29   | Channel Beam             |
| 07   | Rigid Frame & 3-Sided Struct     | 17   | Movable - Swing              | 30-70  | Truss Types - Specific   |
| 08   | Orthotropic                      | 18   | Tunnel                       | 91   | Culvert Rigid Frame      |
| 09*  | Truss - Deck (non specific)      | 19   | Culvert                      | 00   | Other                    |
| 10*  | Truss-Thru & Pony (non specific) | 20   | Pipeline                     | *-Use codes 30-70 in place of 09 & 10 (they are shown for historical reference only) |                          |

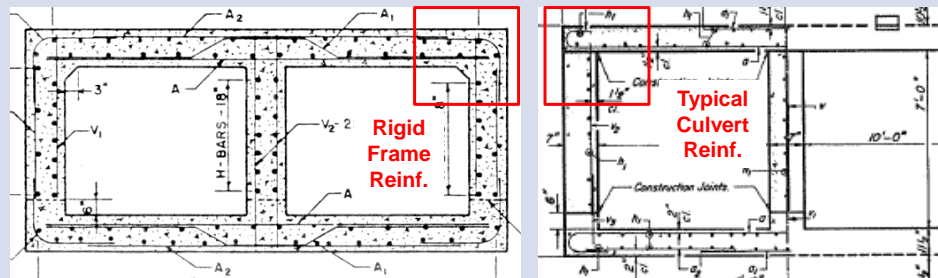
F-15

15

## Inventory Data

### Item 43B - Main Structure Type

- Precast Channel Beams (29) often miscoded as Slab (01)
- Culvert - Rigid Frame (91) versus Culvert (19). **Rigid Frame Culverts** have the vertical bars in the Outer Sidewalls located in the outside face and these bars extend into and lap with the bars in the Top Slab. **Code 91 was added in July 2016** due to the different rating requirements for the two.
- You need to verify if your culverts fit code 19 or 91



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## Inventory Data

### Item 45 – Number of Main Spans

- The total number of spans in the main structure
- Typically consists of all spans of most structures
- Used to differentiate between “main unit” and “approach unit” spans when the approaches are of a different design/material or to identify the main unit of sizable structures

### Item 46 – Number of Approach Spans

- The total number of spans in the approaches to the main structure
- Connects main spans to the roadway or other approach spans

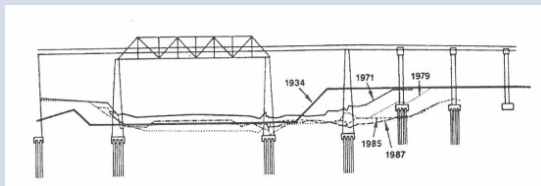
F-17

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17

## Inventory Data

### Items 45 & 46 – Number of Main & Approach Spans



Has approach spans

Doesn't have approach spans



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18

## Inventory Data

### Item 48 – Length of Longest Span

- Indicates the longest span center – center bearing in the structure
- The length is **measured along the centerline of the structure roadway**
- **Skewed culverts are frequently miscoded** with the right-angle dimension
- **PPC Deck Beams and PC Channel Beams are frequently miscoded** with center to center length between substructure units rather than center to center of the beam dowel rods (bearing points) as required

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3/7/2024

19

## Inventory Data

### Item 49 - Structure Length

- The overall length of roadway supported by the structure, measured along the centerline of the structure roadway.
- The length should be measured back to back of backwalls of abutments or from paving notch to paving notch.
- **Skewed culverts are frequently miscoded** with the right-angle dimension

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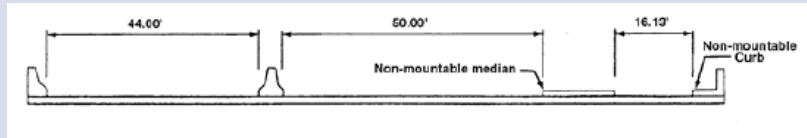
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## Inventory Data

### Item 51 – Total Bridge Roadway Width

- This measures the minimum distance between curbs and rails on the structure roadway
- Raised or non-mountable medians, open medians and barrier widths are to be excluded from the summation along with barrier-protected bicycle and equestrian lanes
- The measurement is exclusive of flared areas for ramps



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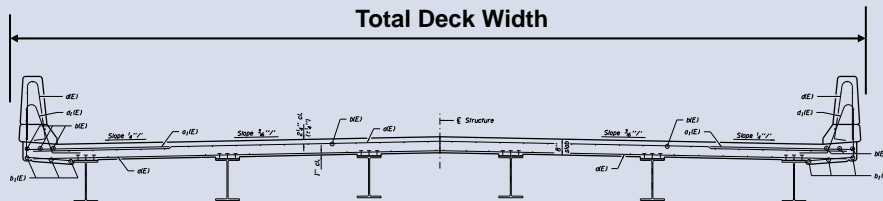
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## Inventory Data

### Item 52 – Total Deck Width

- This measures the out – out width of the deck at right angles to the structures centerline
- The measurement is exclusive of flared areas for ramps



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## Inventory Data

**Items 60A / 60B: Substructure Material**

- 60A = Abutment Material Type
- 60B = Pier Material Type
- See the SIP manual and the examples
- Field verify information

| Code | Description                  |
|------|------------------------------|
| 1    | Timber with repairs made     |
| 2    | Timber                       |
| 3    | Steel                        |
| 4    | Masonry                      |
| 5    | Concrete                     |
| 6    | Exposed Steel (not encased)  |
| 7    | Metal Shell                  |
| 8    | Precast Concrete (not piles) |
| N    | Not Applicable               |

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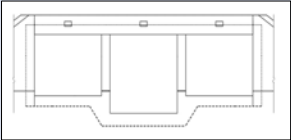
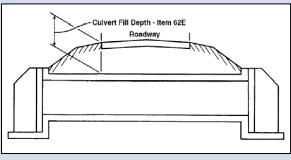
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## Inventory Data

### Culvert Related Items

- **Item 62A – Culvert Cells (total number)**
- **Item 62B – Culvert Cell Width (Ft.)**
  - Horizontal width, measured at right angle to culvert, of individual cells or openings in the culvert
- **Item 62C – Culvert Cell Height**
  - Vertical height of individual cells or openings in the culvert
  - If more than one height exist, record the predominate height
- **Item 62D – Culvert Opening Area**
  - Total cross section area of all cells of the culvert
  - Areas of dissimilar individual cells, report the true calculated square footage of opening.
  - Measurement does not have to agree with the calculation made from values reported in Items 62B and 62C
  - Variable opening dimensions should be recorded in Item 8A1 – Bridge Remarks (General)
- **Item 62E – Culvert Fill Depth**
  - The depth of fill (earth and pavement thickness) measured from the top of the culvert structure to the top of the pavement surface

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## Inventory Data

### Item 107 – Deck Structure Type

- Identifies the type of deck system on the structure
- If more than one type exists, identify the predominant type

| Code | Description                             |
|------|---|
| A    | CIP Concrete normally formed            |
| B    | CIP Concrete PPC Deck Plank formed      |
| C    | CIP Concrete Steel Stay in place forms  |
| D    | Precast Reinforced Concrete Deck Beams  |
| E    | Precast Prestressed Concrete Deck Beams |
| F    | Precast Concrete transverse deck panels |
| G    | Open Steel Grating                      |
| H    | Concrete filled Steel Grating           |
| I    | Steel Plate (orthotropic)               |
| J    | Corrugated steel form and asphalt       |
| K    | Aluminum                                |
| L    | Timber                                  |
| M    | Other                                   |
| N    | Not Applicable                          |

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## Inventory Data

### Measurements for Item 107A and Item 108D

- **Item 107A - Deck Structure Thickness**  
Item 107A reports the structural portion of the deck thickness as originally built and does not include built up wearing surface thickness.
- **Item 108D - Total Deck Thickness**  
This item describes the total thickness of the structure's deck and includes the structural deck and the wearing surface above the top of deck support.
- **Measurements for Item 107A (Deck Structure Thickness) and Item 108D (Total Deck Thickness) must be obtained from the same location on the structure.**
- **May be recorded backwards**
- **May be measured incorrectly**

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## Inventory Data

### Item 108D Total Deck Thickness:

- **Conc. Slab Bridge**
  - Typically measured along the edge of the deck or when a curb is present along the curblines
  - If haunched then at midpoint of longest span
- **Total Deck Thickness (Items 108D): original deck thickness (item 107A) + wearing surface thickness**
- **Measure wearing surface at multiple locations as thickness may vary**
- **Total deck thickness is key to determining superstructure rating and permit capacities**
- **LL Capacity = Total Capacity – DL Capacity**
- **If this value has increased since the last inspection and the structure has not been load rated since the increase, contact the Bureau of Bridges and Structures**

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## Discussion

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