



# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

---

TxDOT Bridge Presentations Webinar  
John Delphia, P.E.

# TEXAS BRIDGES

## TOTAL NUMBER OF BRIDGES

On-System – 35,320

Off-System – 18,533

**Total - 53,853**

## BRIDGES OVER WATER

On-System – 26,010

Off-System – 17,571

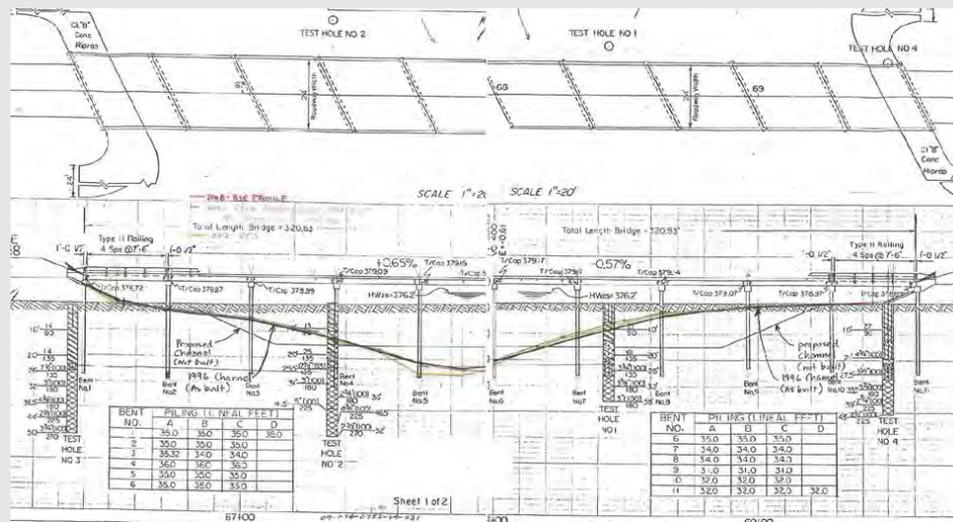
**Total - 43,581**

**~ 81% OF THE BRIDGES ARE OVER WATER**

# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## ROUTINE BRIDGE INSPECTION S

1. PERFORMED EVERY 2 YEARS (maximum interval)
2. DATA IS COLLECTED ON THE VARIOUS STRUCTURAL ELEMENTS
3. CHANNEL PROFILES ARE TAKEN (bridges over waterways)
4. PHOTOS ARE TAKEN



# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## THE BRIDGE INSPECTION RECORD SHEETS ARE FILLED OUT



### Bridge Inspection Record

Modified 02-13-2009  
6th Edition & Nov 2002

District:  County:  Cont-Sec:  Structure:  Route:

Description:

Feature Crossed:  Inspector's Signature:  Date:

Firm Name:

N- Not applicable  
 9- Excellent condition  
 8- Very good condition - no problems noted  
 7- Good condition - some minor problems  
 6- Satisfactory condition - minor deterioration of structural elements (limited)  
 5- Fair condition - minor deterioration of structural elements (extensive)  
 4- Poor condition - deterioration significantly affects structural capacity  
 3- Serious condition - deterioration seriously affects structural capacity  
 2- Critical condition - bridge should be closed until repaired  
 1- Failing condition - bridge closed but repairable  
 0- Failed condition - bridge closed and beyond repair

Enter a rating for each element of each component. The rating should equal or exceed the minimum rating listed to the left of each element. Component ratings should equal the lowest rating of any element of the component. Fully supportive comments are to be made hereon or on attachments for all ratings of 7 or below.

Min.	Deck (Item 58)	Rating
1	Deck -Rating	<input type="text"/>
6	Wearing Surface	<input type="text"/>
6	Joints, Expansion, Open	<input type="text"/>
6	Joints, Expansion, Sealed	<input type="text"/>
6	Joints, Other	<input type="text"/>
6	Drainage System	<input type="text"/>
6	Curbs, Sidewalks & Parapets	<input type="text"/>
6	Median Barrier	<input type="text"/>
6	Railings	<input type="text"/>
7	Railing Protective Coating	<input type="text"/>
7	Delineation (curve Markers)	<input type="text"/>
	Other	<input type="text"/>
Comments: <input type="text"/>		

Min.	Superstructure (Item 59)	Rating
0	Main Members - Steel	<input type="text"/>
0	Main Members - Concrete	<input type="text"/>
0	Main Members - Timber	<input type="text"/>
0	Main Members - Connections	<input type="text"/>
1	Floor System Members	<input type="text"/>
1	Floor System Connections	<input type="text"/>
5	Secondary Members	<input type="text"/>
5	Secondary Members Connections	<input type="text"/>
6	Expansion Bearings	<input type="text"/>
6	Fixed Bearings	<input type="text"/>
6	Steel Protective Coating	<input type="text"/>
	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Bridge Inspection Record (page 1 of 2)

District:  County:  Cont-Sec:  Structure:  Route:

Min.	Substructure (Item 60)	Rating
0	Abutment Caps	<input type="text"/>
0	Above Ground	<input type="text"/>
0	Below Ground or Foundation	<input type="text"/>
5	Backwalls & Wingwalls	<input type="text"/>
0	Intermediate Supports	<input type="text"/>
	Caps - Concrete	<input type="text"/>
	Caps - Steel	<input type="text"/>
	Caps - Timber	<input type="text"/>
	Above Ground - Concrete	<input type="text"/>
	Above Ground - Steel	<input type="text"/>
	Above Ground - Timber	<input type="text"/>
	Above Ground - Masonry	<input type="text"/>
	Below Ground or Foundation	<input type="text"/>
5	Collision Protection System	<input type="text"/>
6	Steel Protective Coating	<input type="text"/>
	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Min.	Culvert (Item 62)	Rating
0	Top Slabs	<input type="text"/>
0	Bottom Slabs or Footing	<input type="text"/>
0	Abutments & Intermediate Supports	<input type="text"/>
5	Headwalls & Wingwalls	<input type="text"/>
	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Min.	Channel (Item 61)	Rating
0	Channel Banks	<input type="text"/>
0	Channel Bed	<input type="text"/>
5	Rip Rap, Toe Walls & Aprons	<input type="text"/>
5	Dikes	<input type="text"/>
5	Jetties	<input type="text"/>
5	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Min.	Approaches (Item 65)	Rating
0	Embankments	<input type="text"/>
4	Embankment Retaining Walls	<input type="text"/>
5	Slope Protection	<input type="text"/>
5	Roadway	<input type="text"/>
6	Relief Joints	<input type="text"/>
6	Drainage	<input type="text"/>
6	Guardence	<input type="text"/>
7	Delineation	<input type="text"/>
7	Sight Distance	<input type="text"/>
	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Min.	Miscellaneous	Rating
7	Signs	<input type="text"/>
7	Illumination	<input type="text"/>
7	Warning Devices	<input type="text"/>
7	Utility Lines	<input type="text"/>
	Other	<input type="text"/>
Comments: <input type="text"/>		

Bridge Inspection Record (page 2 of 2)

# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## THE BRIDGE INSPECTION RECORD SHEET RATINGS



### Bridge Inspection Record

Modified (2-13-2003)  
for Microsoft Word 2002

District:  County:  Cont-Sec: - Structure:  Route:

Description:

Feature Crossed: -  Inspector's Signature:  Date:

Firm Name:

N- Not applicable  
 9- Excellent condition  
 8- Very good condition - no problems noted  
 7- Good condition - some minor problems  
 6- Satisfactory condition - minor deterioration of structural elements (limited)  
 5- Fair condition - minor deterioration of structural elements (extensive)  
 4- Poor condition - deterioration significantly affects structural capacity  
 3- Serious condition - deterioration seriously affects structural capacity  
 2- Critical condition - bridge should be closed until repaired  
 1- Failing condition - bridge closed but repairable  
 0- Failed condition - bridge closed and beyond repair

Enter a rating for each element of each component. The rating should equal or exceed the minimum rating listed to the left of each element. Component ratings should equal the lowest rating of any element of the component. Fully supportive comments are to be made herein or on attachments for all ratings of 7 or below.

Min.	Deck (Item 58)	Rating	Min.	Superstructure (Item 59)	Rating

**By Contract - Bridges with Condition Rating of 4 or less the inspector must:**

- **Provide a list of any bridge with a condition rating of 4 or less on any component on the Bridge Inspection Rating.**
- **Perform calculations of load carrying capacity for bridges that have any condition rating of 4 or less. This includes foundation elements.**



# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## THE BRIDGE INSPECTION FOLLOW UP WORKSHEET IS FILLED OUT



Modified: (12-5-2000)  
for Microsoft Word 7.0, WIN95 & NT

### Bridge Inspection Follow-up Action Worksheet

District:  County:  Cont-Sec:  Structure:  Route:

Description:

Feature Crossed:  Inspector's Signature:  Date:

Firm Name:

#### Reference Features:

- |                                 |                                 |                                  |                                      |
|---------------------------------|---------------------------------|----------------------------------|--------------------------------------|
| 1. Roadway – Wearing Surface    | 5. Superstructure – Bearings    | 9. Substructure – Other          | 13. Structural Paint System          |
| 2. Roadway – Deck               | 6. Superstructure – Other       | 10. Channel & Channel Protection | 14. Vertical Clearance Signs         |
| 3. Roadway – Other              | 7. Substructure – Abutments     | 11. Retaining Walls or Rip Rap   | 15. Other - <input type="checkbox"/> |
| 4. Superstructure – Main Member | 8. Substructure – Bents & Piers | 12. Approaches                   | <input type="checkbox"/>             |

Ref. Feat.	Action / Comments	1085 Ratings
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Include on following lists:  - Overht. Load Damage  - Unrepaired Damage  - Repaired Damage  - Insignificant Damage
- |   |   |   |   |
|---|---|---|---|
| <input type="checkbox"/> - 2 Column Bent (G.S.)         | <input type="checkbox"/> - Pin & Hanger             | <input type="checkbox"/> - Scour Critical                     | <input type="checkbox"/> - Floating Bearing Pads    |
| <input type="checkbox"/> - Element Rating 4 or Less     | <input type="checkbox"/> - Fracture Critical        | <input type="checkbox"/> - Underwater Inspection              | <input type="checkbox"/> - Box Beam w/Cracks        |
| <input type="checkbox"/> - Special Access Inspection    | <input type="checkbox"/> - Load Posting             | <input type="checkbox"/> - Vertical Clearance Sign Adjustment | <input type="checkbox"/> - Culvert blocked w/Silt   |
| <input type="checkbox"/> - Delayed Ettringite Formation | <input type="checkbox"/> - <input type="checkbox"/> | <input type="checkbox"/> - <input type="checkbox"/>           | <input type="checkbox"/> - <input type="checkbox"/> |

Bridge Inspection Follow-Up Action Worksheet (page 1 of 2)

# WHAT TYPICALLY HAPPENS NEXT?

## **The Bridge Inspection Record and Follow Up Action Worksheet are:**

- Placed in the Bridge Inspection Folder**

**OR**

- Placed as an attachment in PonTex**

**SOMETIMES WITHOUT BEING REVIEWED**

**Prior to placing the documents in the Bridge Inspection Folder or into PonTex the Bridge Inspection Record, Channel Profile, and Follow Up Action Worksheet should be reviewed to see if any significant changes have occurred that warrant action.**

# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## BRIDGE INSPECTION RECORDS SHOULD BE LOOKED OVER

 **Bridge Inspection Record**  
Modified 02-13-2009  
 6th Edition & Issue 2002

District:  County:  Cont-Sec:  Structure:  Route:

Description:   
 Feature Crossed:  Inspector's Signature:  Date:

Firm Name:

N- Not applicable  
 9- Excellent condition  
 8- Very good condition - no problems noted  
 7- Good condition - some minor problems  
 6- Satisfactory condition - minor deterioration of structural elements (limited)  
 5- Fair condition - minor deterioration of structural elements (extensive)  
 4- Poor condition - deterioration significantly affects structural capacity  
 3- Serious condition - deterioration seriously affects structural capacity  
 2- Critical condition - bridge should be closed until repaired  
 1- Failing condition - bridge closed but repairable  
 0- Failed condition - bridge closed and beyond repair

Enter a rating for each element of each component. The rating should equal or exceed the minimum rating listed to the left of each element. Component ratings should equal the lowest rating of any element of the component. Fully supportive comments are to be made hereon or on attachments for all ratings of 7 or below.

Min.	Deck (Item 58)	Rating
1	Deck - Rating	<input type="text"/>
6	Wearing Surface	<input type="text"/>
6	Joints, Expansion, Open	<input type="text"/>
6	Joints, Expansion, Sealed	<input type="text"/>
6	Joints, Other	<input type="text"/>
6	Drainage System	<input type="text"/>
6	Curbs, Sidewalks & Parapets	<input type="text"/>
6	Median Barrier	<input type="text"/>
6	Railings	<input type="text"/>
7	Railing Protective Coating	<input type="text"/>
7	Delineation (curve Markers)	<input type="text"/>
	Other	<input type="text"/>
Comments: <input type="text"/>		

Min.	Superstructure (Item 59)	Rating
0	Main Members - Steel	<input type="text"/>
0	Main Members - Concrete	<input type="text"/>
0	Main Members - Timber	<input type="text"/>
0	Main Members - Connections	<input type="text"/>
1	Floor System Members	<input type="text"/>
1	Floor System Connections	<input type="text"/>
5	Secondary Members	<input type="text"/>
5	Secondary Members Connections	<input type="text"/>
6	Expansion Bearings	<input type="text"/>
6	Fixed Bearings	<input type="text"/>
6	Steel Protective Coating	<input type="text"/>
	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Bridge Inspection Record (page 1 of 2)

District:  County:  Cont-Sec:  Structure:  Route:

Min.	Substructure (Item 60)	Rating
0	Abutment Caps	<input type="text"/>
0	Above Ground	<input type="text"/>
0	Below Ground or Foundation	<input type="text"/>
5	Backwalls & Wingwalls	<input type="text"/>
0	Intermediate Supports	<input type="text"/>
	Caps - Concrete	<input type="text"/>
	Caps - Steel	<input type="text"/>
	Caps - Timber	<input type="text"/>
	Above Ground - Concrete	<input type="text"/>
	Above Ground - Steel	<input type="text"/>
	Above Ground - Timber	<input type="text"/>
	Above Ground - Masonry	<input type="text"/>
	Below Ground or Foundation	<input type="text"/>
5	Collision Protection System	<input type="text"/>
6	Steel Protective Coating	<input type="text"/>
	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Min.	Culvert (Item 62)	Rating
0	Top Slabs	<input type="text"/>
0	Bottom Slabs or Footing	<input type="text"/>
0	Abutments & Intermediate Supports	<input type="text"/>
5	Headwalls & Wingwalls	<input type="text"/>
	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Min.	Approaches (Item 65)	Rating
0	Embankments	<input type="text"/>
4	Embankment Retaining Walls	<input type="text"/>
5	Slope Protection	<input type="text"/>
5	Roadway	<input type="text"/>
6	Relief Joints	<input type="text"/>
6	Drainage	<input type="text"/>
6	Guardence	<input type="text"/>
7	Delineation	<input type="text"/>
7	Sight Distance	<input type="text"/>
	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Min.	Channel (Item 61)	Rating
0	Channel Banks	<input type="text"/>
0	Channel Bed	<input type="text"/>
5	Rip Rap, Toe Walls & Aprons	<input type="text"/>
5	Dikes	<input type="text"/>
5	Jetties	<input type="text"/>
5	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Min.	Miscellaneous	Rating
7	Signs	<input type="text"/>
7	Illumination	<input type="text"/>
7	Warning Devices	<input type="text"/>
7	Utility Lines	<input type="text"/>
	Other	<input type="text"/>
Component Rating: <input type="text"/>		
Comments: <input type="text"/>		

Bridge Inspection Record (page 2 of 2)

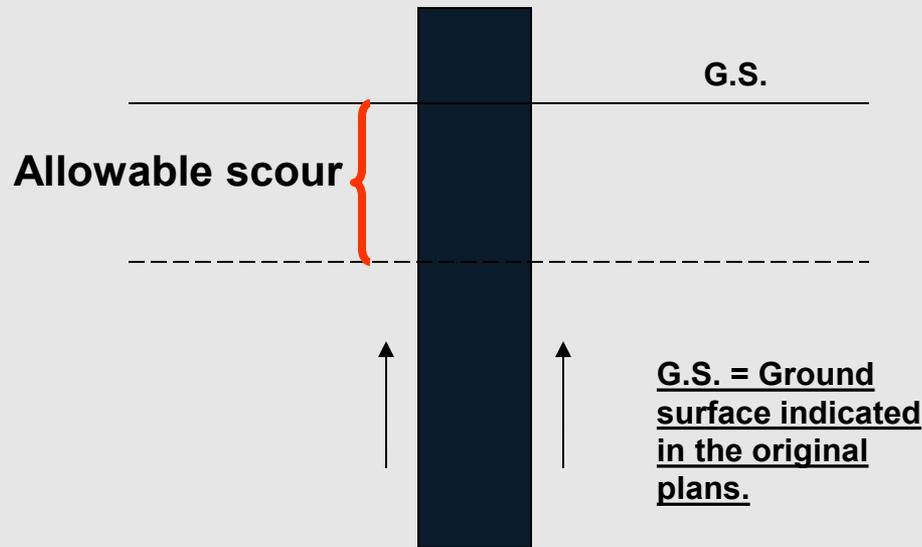
# **Before Reviewing the Channel Profile**

**If it hasn't been done, the maximum allowable scour should be determined and used to review the channel profiles**

**Reference: Texas Secondary Evaluation and Analysis for Scour (TESAS) Manual (1993)**

# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## TSEAS MANUAL –MAXIMUM ALLOWABLE SCOUR DEPTH FOR BEARING



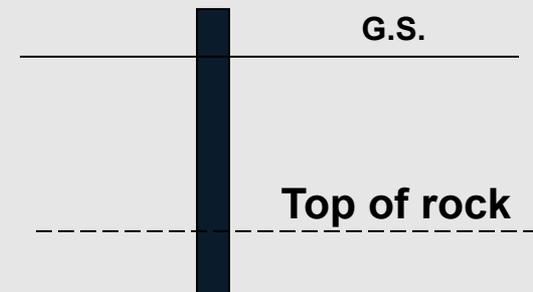
**Allowable Scour = Half of the embedment**

**Assumes**

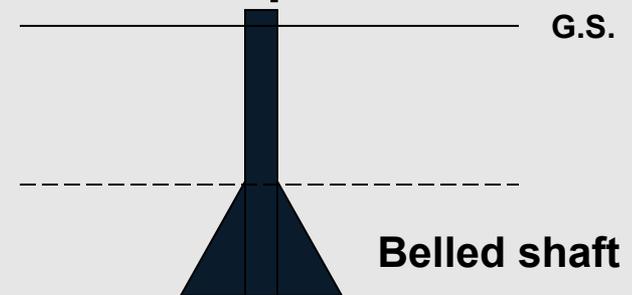
- ~ uniform strength with depth
- skin friction design

**Further analysis may be required for**

**-Foundations set in rock**

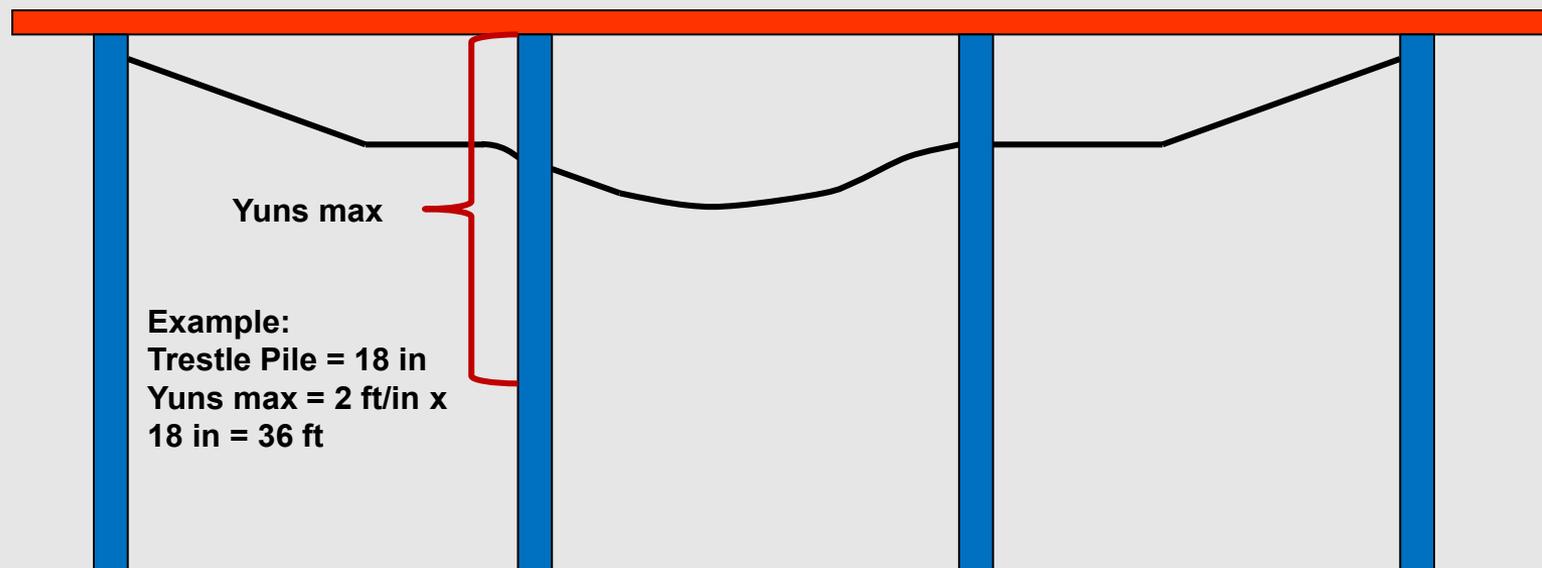


**-Belled Shaped Shafts**



# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## TSEAS MANUAL –MAXIMUM ALLOWABLE SCOUR DEPTH FOR LATERAL STABILITY



The maximum allowable unsupported column length for lateral stability is determined as follows:

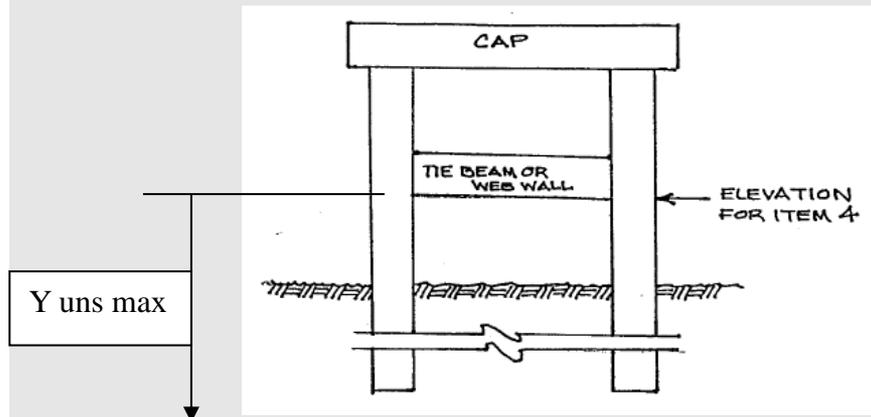
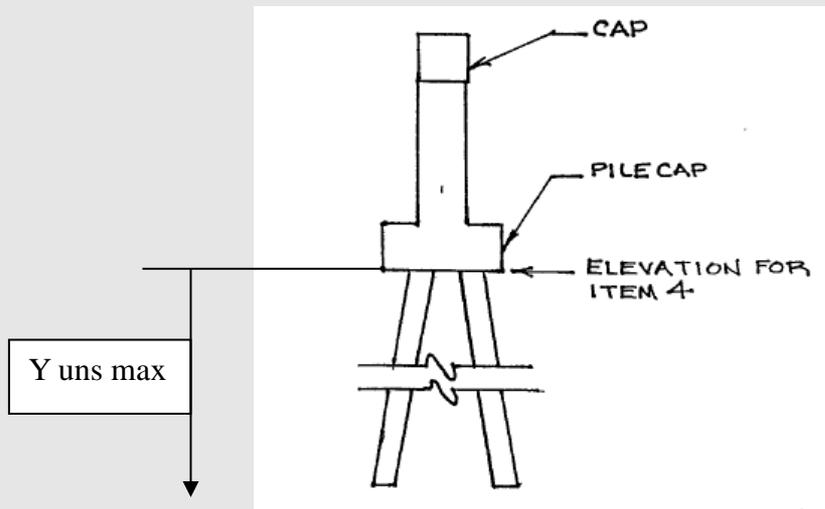
Column/Drilled Shaft	Yun's max = diameter of column/drilled shaft (inches) x 1.5 feet/inch
Trestle Pile	Yun's max = diameter of pile (inches) x 2 feet/inch
H or Square Pile	Yun's max = diameter of pile (inches) x 2 feet/inch

# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## TSEAS MANUAL –MAXIMUM ALLOWABLE SCOUR DEPTH FOR LATERAL STABILITY

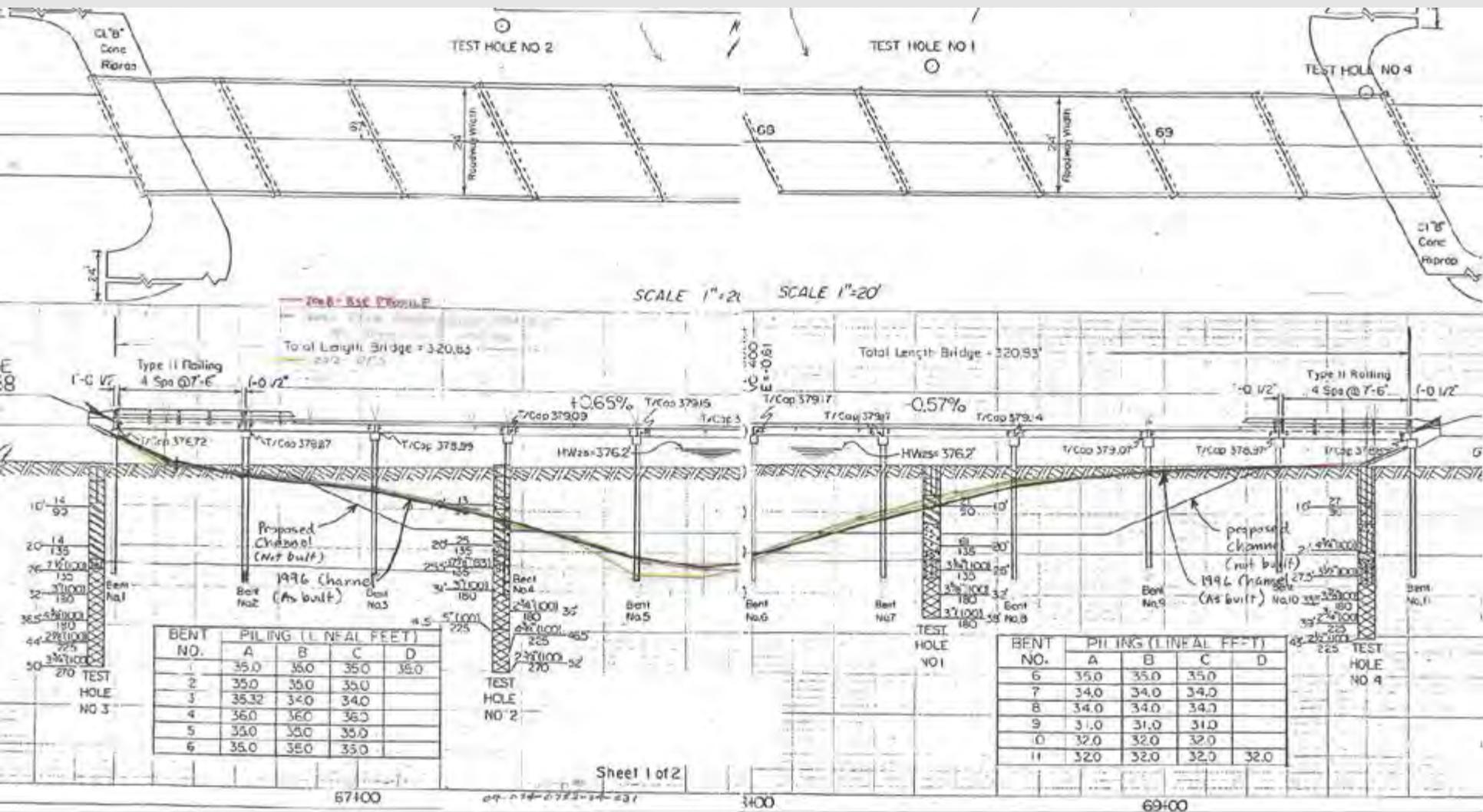
How do you calculate the maximum allowable unsupported column length in conditions where there are tie beams, web walls, pile caps, etc. (i.e. cross bracing members)?

For these conditions the maximum allowable unsupported column length would be calculated from the bottom of the tie beam, web wall, pile cap, etc.



# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## CHANNEL PROFILES SHOULD BE LOOKED OVER

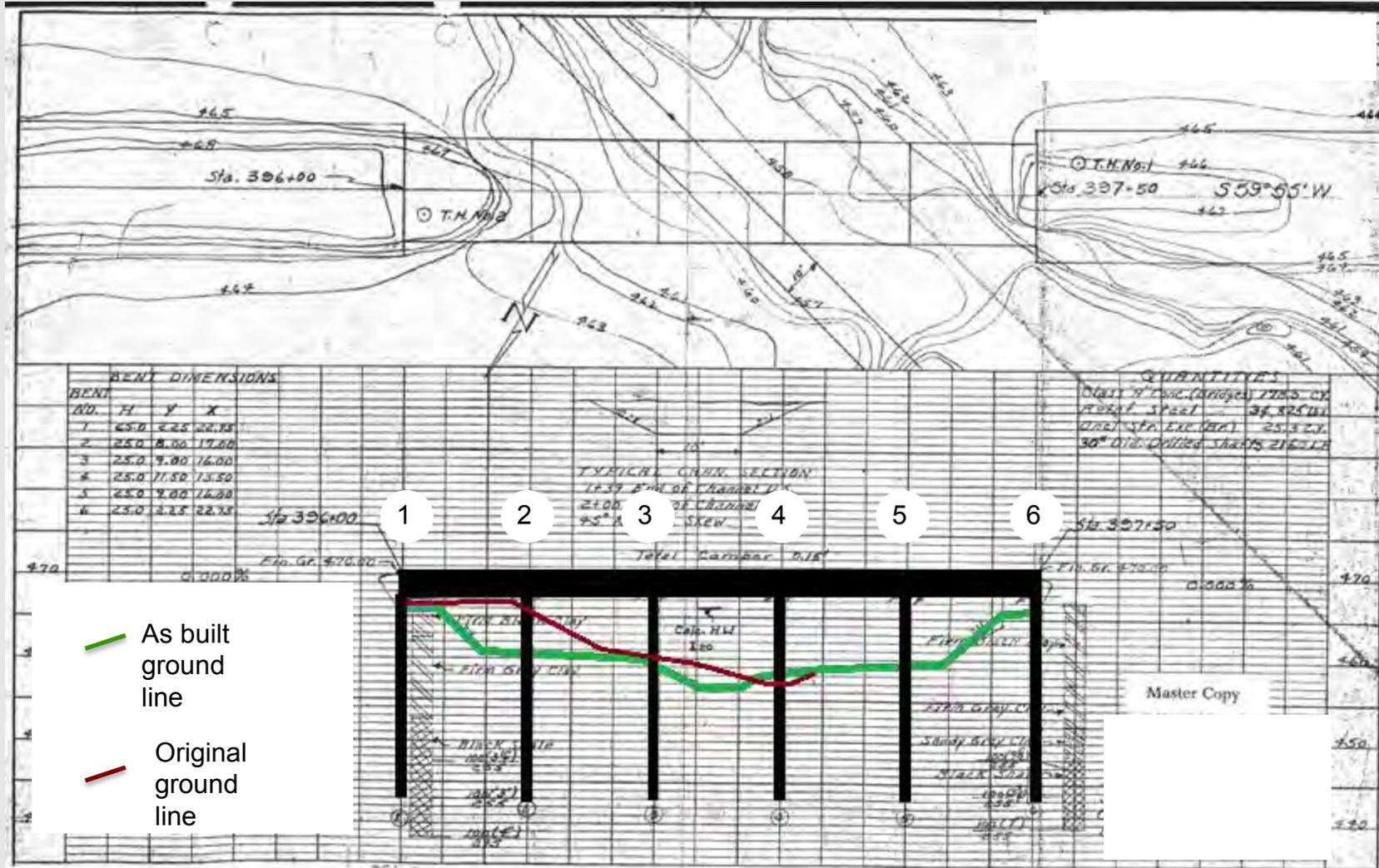


**SOME EXAMPLES OF PROBLEMS  
THAT SLIPPED THROUGH SEVERAL  
INSPECTION CYCLES**

## EXAMPLE #1

# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

Bridge was built in 1957 with sufficient embedment of the drilled shafts



# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

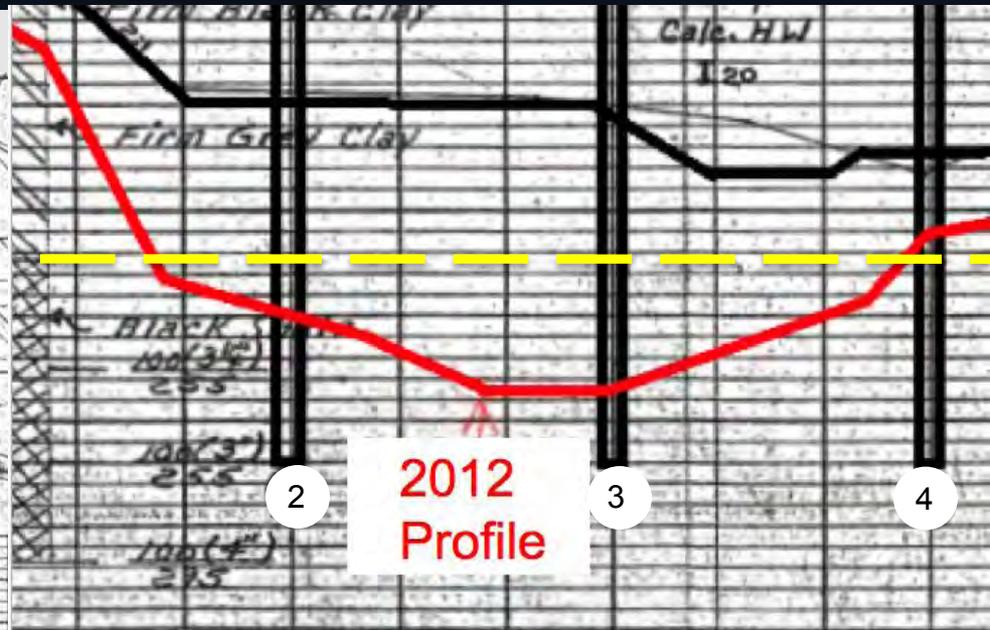
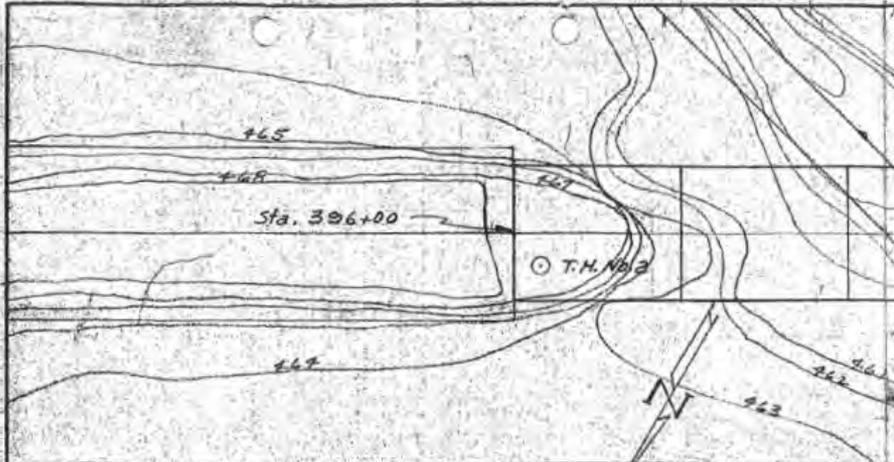
## 2004 Photo of Bents 1 and 2



Bent 2



# Bridge Scour: Procedures, Coding, and Documentation



# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## 2014 Photo of Bents 1 and 2

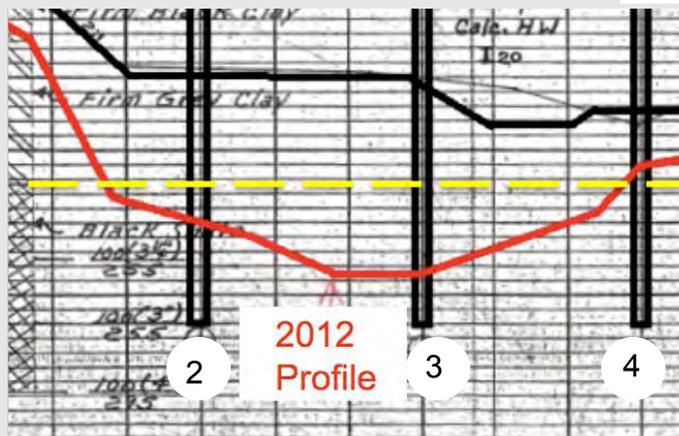


Bent 2

## 2014 Photo of Bents 2 and 3



Bent 3



# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## March 2014 Inspection Findings

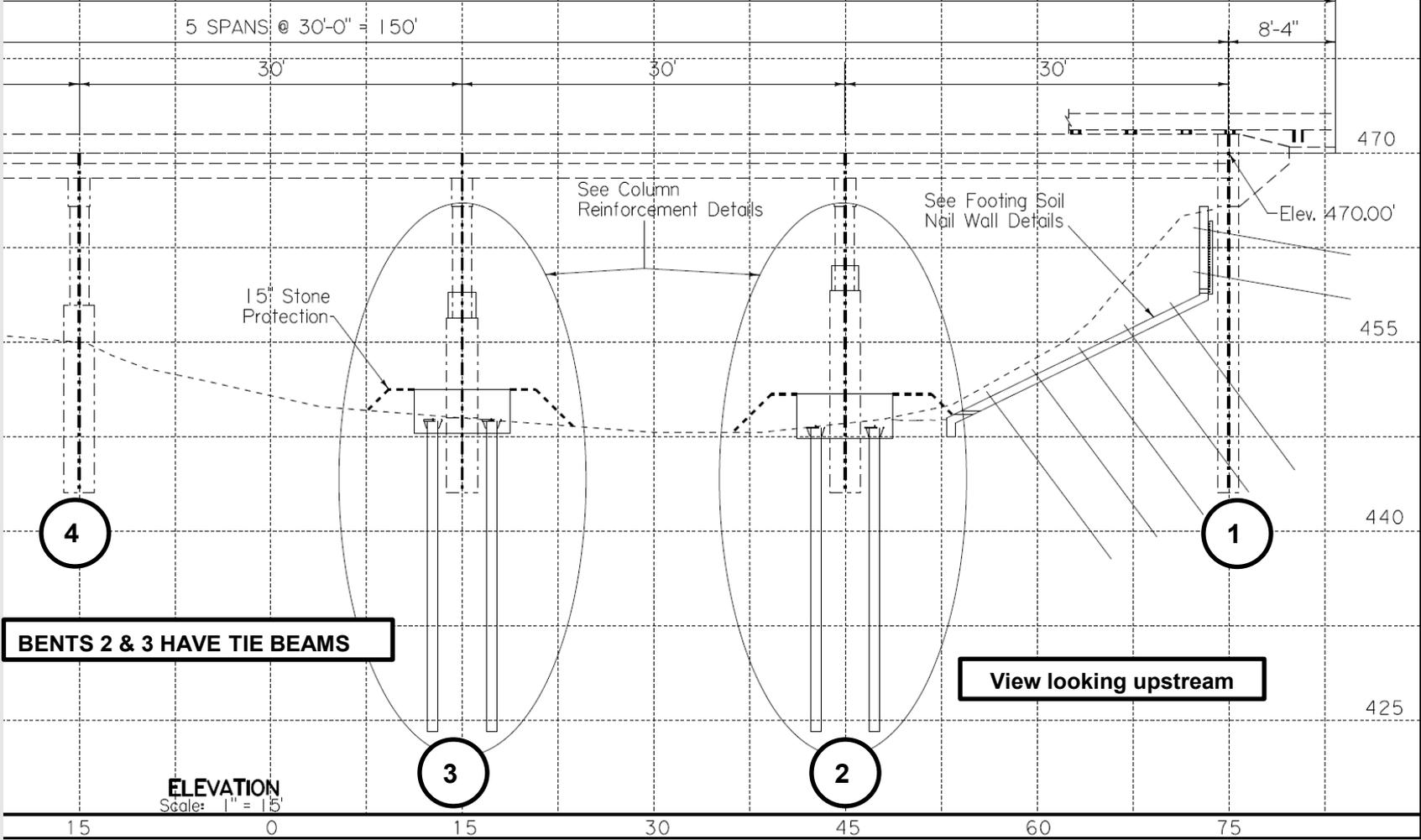
Substructure (Item 60)		Rating	Comments:
Min.			
0	Abutment Caps	8	<p>(1) SW abutment cap is undermined exposing tops of drilled shafts up to approximately 10". NE abutment cap is undermined allowing erosion of embankment and exposing drilled shafts up to approximately 4.5'.                      (2) NE bent cap has a minor delamination at SE end.                      (3) Bent columns have minor to moderate honeycombing at their bottoms.                      (4) Drilled shafts at bent columns are exposed as follows: bent 2 from NE up to ~ 10', bent 3 from NE up to ~ 9', bent 4 from NE up to ~ 30", bent 5 from NE up to ~ 10".</p>
0	Above Ground	-	
0	Below Ground or Foundation	(1) 6	
0	Backwalls & Wingwalls	8	
0	Intermediate Supports		
	Caps - Concrete	(2) 7	
	Caps - Steel	-	
	Caps - Timber	-	
	Above Ground - Concrete	(3) 7	
	Above Ground - Steel	-	
	Above Ground - Timber	-	
	Above Ground - Masonry	-	
	Below Ground or Foundation	(4) 6	
5	Collision Protection System	-	
6	Steel Protective Coating	-	
	Component rating	6	

Rating of 6 =  
Satisfactory  
Condition

Rating of 5 =  
Fair Condition

Channel (Item 61)		Rating	Comments:
Min.			
0	Channel Banks	(1) 5	<p>(1) Erosion of NE bank is actively erosive undermining abutment cap and allowing erosion of embankment. Bank erosion and channel degradation have exposed drilled shafts of bent columns from ~ 10" to ~ 10'. Channel is migrating NE and attacking NE abutment.                      (2) Erosion of NE bank is actively erosive undermining abutment cap and allowing erosion of embankment. Bank erosion and channel degradation have exposed drilled shafts of bent columns from ~ 10" to ~ 10'. Channel is migrating NE and attacking NE abutment.</p>
0	Channel Bed	(2) 5	
5	Rip Rap, Toe Walls & Apron	-	
5	Dikes	-	
5	Jetties	-	
	Other	-	
	Component rating	5	

## EXAMPLE #1 – Repair Details

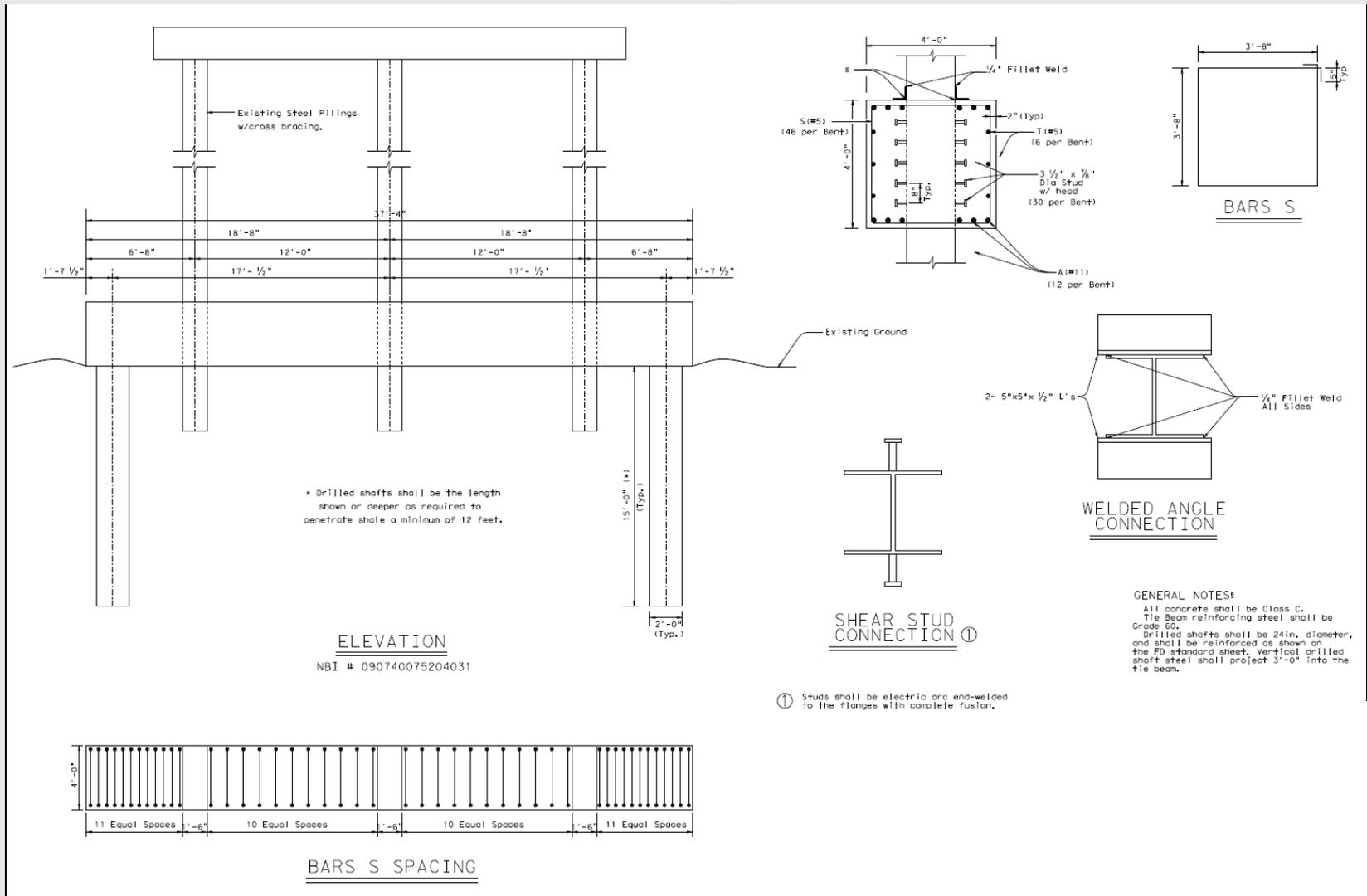


## EXAMPLE #2



# Bridge Scour: Procedures, Coding, and Documentation

## EXAMPLE #2 – Repair Details



# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

## 2012 Photo of Bents 5 and 6



## OTHER EXAMPLES

# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY



## CODING AT TIME OF PHOTO

ITEM 113 = 5

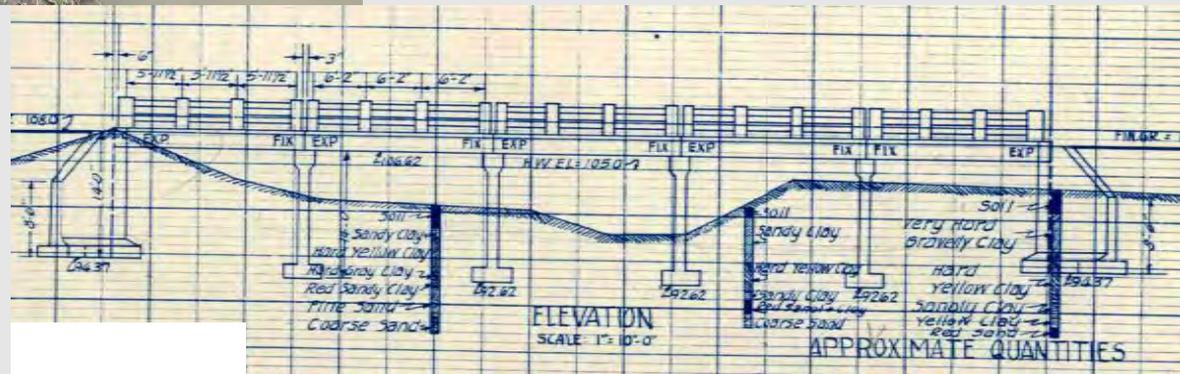
Bridge foundations determined to be stable for assessed or calculated scour condition. Scour is determined to be within the limits of footing.

## CODING SHOULD BE

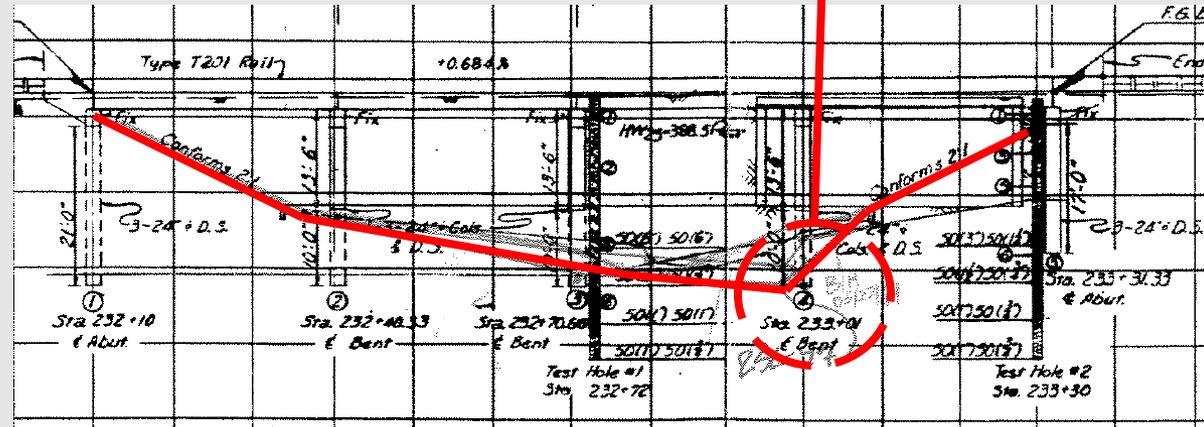
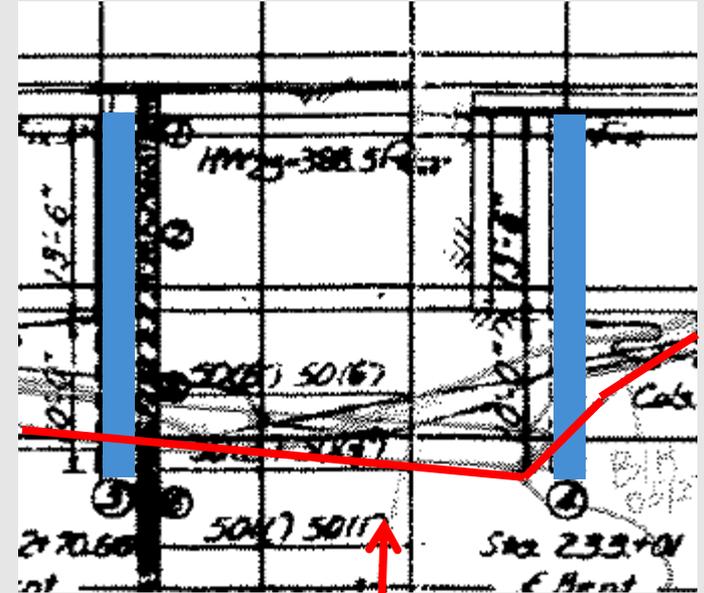
ITEM 113 = 2

Bridge is scour critical; extensive scour has occurred at bridge foundations. Immediate action is required.

ORIGINAL PROFILE



# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY



## CODING AT TIME OF PHOTO/CHANNEL PROFILE

ITEM 113 = 8

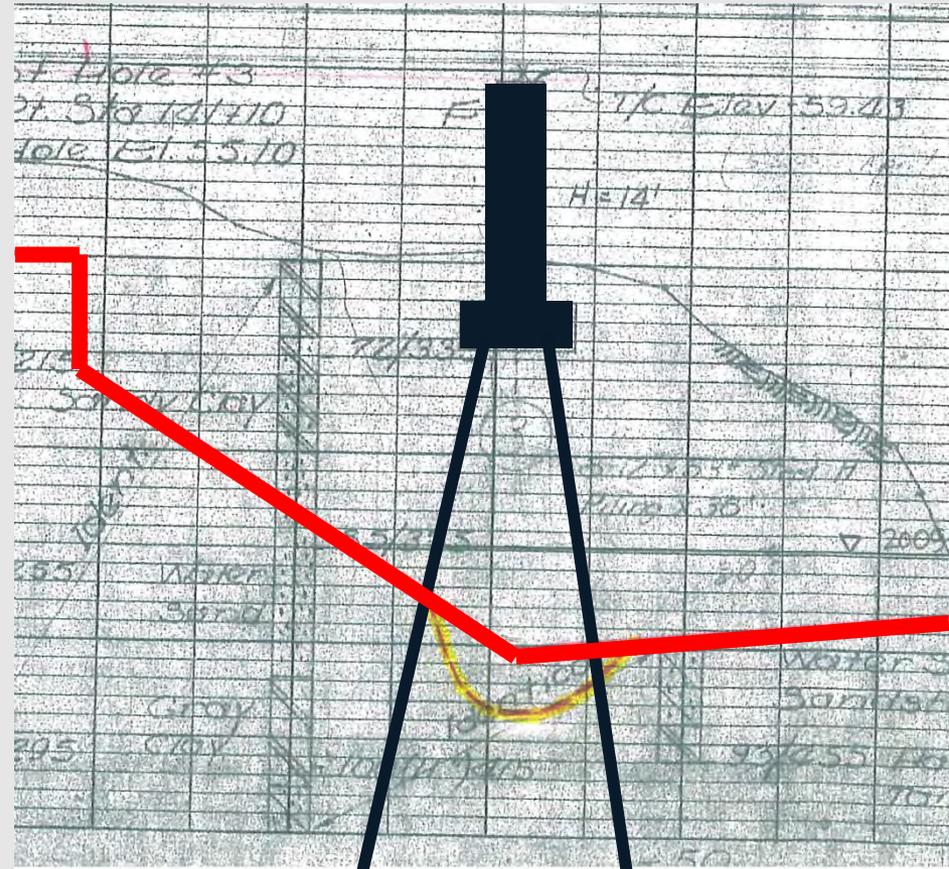
Bridge foundations determined to be stable for the assessed or calculated scour condition.

## CODING SHOULD BE

ITEM 113 = 2

Bridge is scour critical; extensive scour has occurred at bridge foundations. Immediate action is required..

# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY



## **CODING AT TIME OF PHOTO/CHANNEL PROFILE**

ITEM 113 = 3    ITEM 113.1 = P

Bridge is scour critical and a Plan of Action is in place.  
Plan of Action called for monitoring of the structure.

**BRIDGE IS RAPIDLY BECOMING CRITICAL**  
(i.e. ITEM 113 = 2), WHERE IMMEDIATE ACTION  
WOULD BE REQUIRED. NOW IS THE TIME TO START  
THE REPAIRS ON THE BRIDGE.

**Problems can also occur at bridge class culverts**



# **SCOUR DOCUMENTATION**

# Bridge Scour: Procedures, Coding, and Documentation

## Scour Summary Sheet for Known Foundations

DISTRICT		COUNTY	
PSN		HIGHWAY	
CROSSING		CSJ	

Date: 3/3/08

Recommended Item 113 Code: 8

### Basis of Coding:

A scour analysis for the above referenced structure was performed by John Delphia, P.E. on March 3, 2008. The results of the analysis were:

- 1) The maximum calculated pier scour depth is 1.31 feet;
- 2) The calculated contraction scour was found to be 3.19 feet;
- 3) The total calculated scour is 4.50 feet;
- 4) The maximum allowable scour is based on bearing and is 14.50.
- 5) The structure is stable for the calculated scour, as the total calculated scour is less than the maximum allowable scour.

### Future Action:

The Bridge Division has evaluated the foundation and determined that if the channel profile drops below Elev. 435 feet, the structure needs to be re-evaluated for stability.

## SCOUR SUMMARY SHEET

Future Action describes a change in channel profile that would be considered significant enough to warrant an additional evaluation.

This provides Bridge Inspectors an elevation beyond which a review is required.

This was included to avoid the problems previously discussed.

# ROUTINE INSPECTION FINDINGS AND SCOUR CRITICALITY

We want to avoid the potential for failures to occur



## SUMMARY

- **A review should be made of the Bridge Inspection Record, Channel Profile, and Follow Up Action Worksheet to see if any significant changes have occurred that warrant action.**
- **If changes have occurred these should be addressed. It is cheaper to address conditions before it becomes critical.**
- **Completing a Scour Summary Sheet will assist in determining when changes are significant enough to be reviewed again and assists the Bridge Inspectors.**

**FOR ASSISTANCE CONTACT:**

**John Delphia, P.E.**

**TxDOT Bridge Division – Geotechnical Branch**