

Technical Presentation

# Willow Creek Bridge No. 5 (I-40)

## ADOT Structure No. 1768

Presented to the:  
Western Bridge Engineers' Seminar

Design Team:  
Ben C. Ansley, PE  
Midhat Hassan, PE  
Christopher A. Labye, PE

**AECOM**



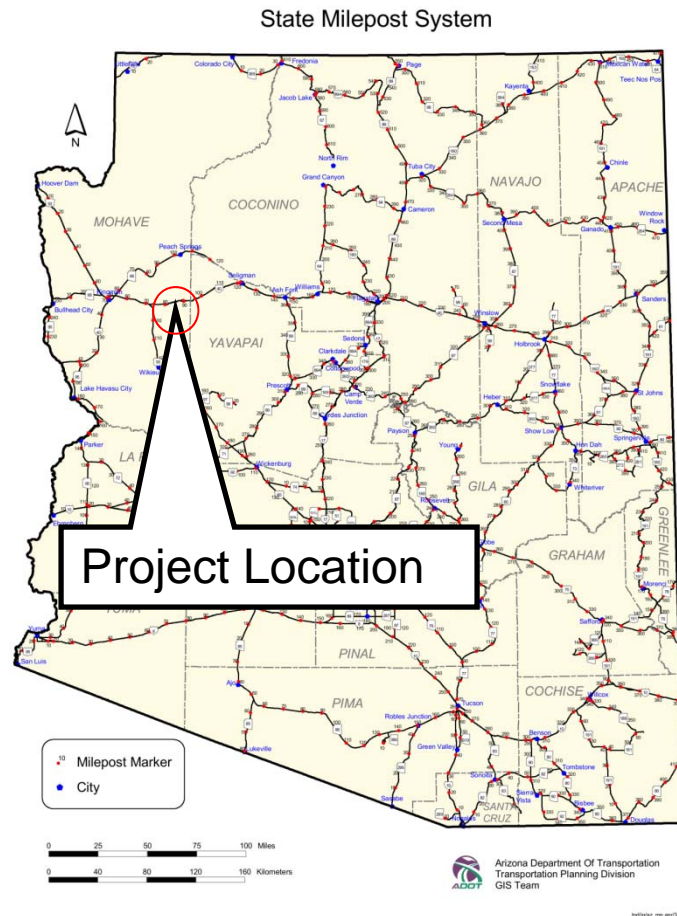
September 6, 2017

# Willow Creek Bridge No. 5: Agenda

- **Project Overview**
- **“The” Problem**
- **Solution**
- **Q&A**



# Project Overview

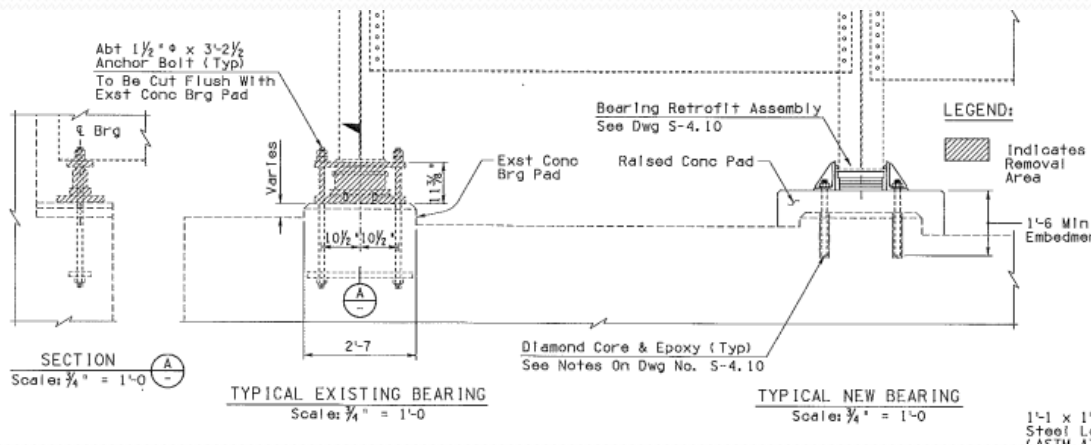


- **I-40 Overpasses Mileposts 83.20 to 85.40**
- **Project Assessment Recommended:**
  - **Bridge 1** – Joint Repair, Girder Repair, Abutment Bearing Replacements
  - **Bridge 3** – Bridge Deck Overlay, Girder Repair, Abutment Bearing Replacement
  - **Bridge 4** – Deck/Barrier/Bearing replacements, Girder Repairs
  - **Bridge 5** - Deck/Barrier/Bearing replacements, Girder Repairs

# Abutment Bearing Replacement



- Rocker bearings replaced with raised concrete pedestals, elastomeric bearing pads, and steel angles to restrain girder movement.
- Work was accomplished with temporary hydraulic jack supports.

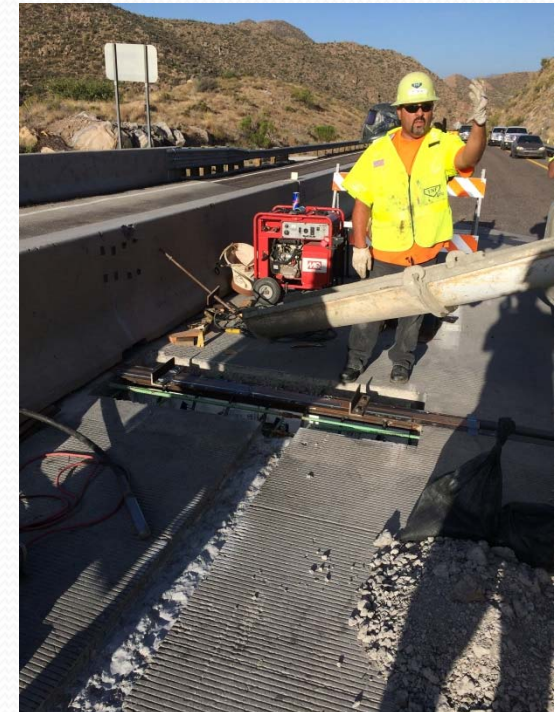
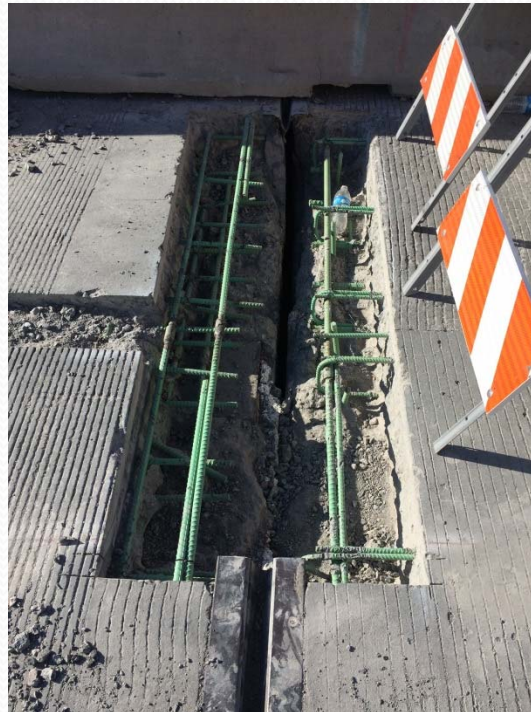


# Abutment Bearing Replacement



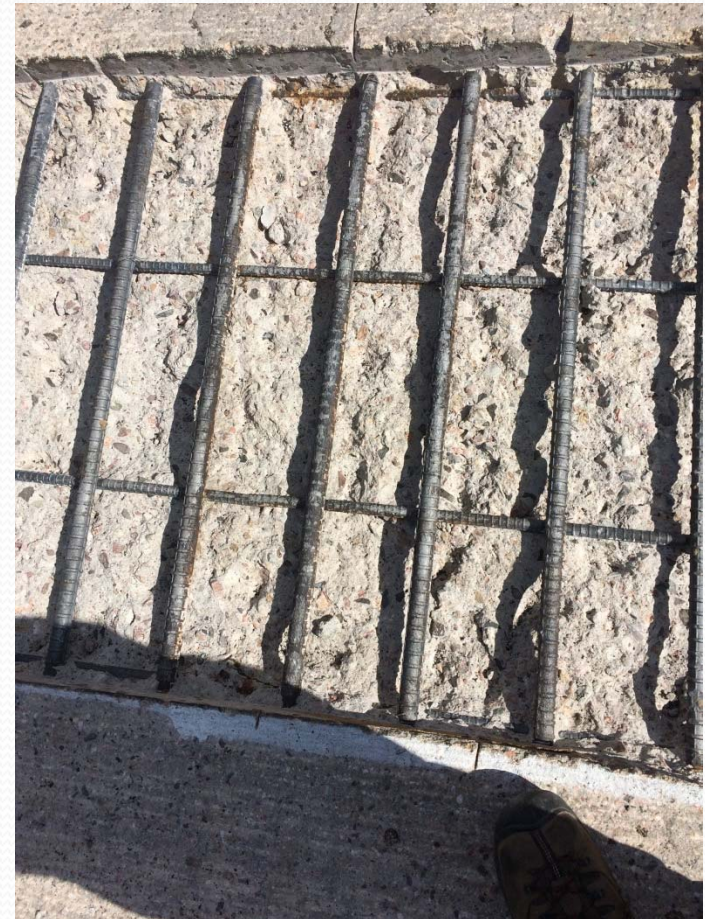
# Bridge No. 1 (Str # 1592)

- **Transverse Joint Repair**



# Bridge No. 3 (Str # 1594)

- Bridge Deck Overlay



# Bridge No. 4 (Str # 1595)

- Deck Replacement

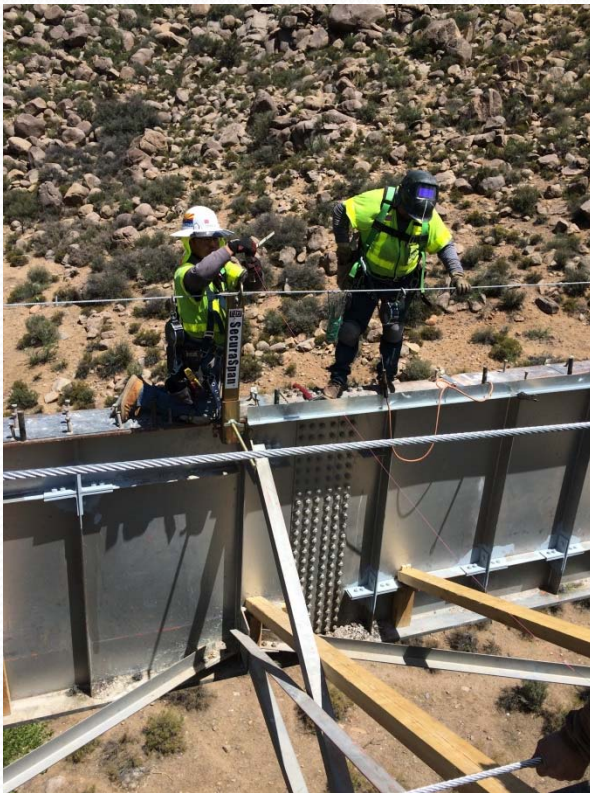




# Bridge No. 4 (Str # 1595)

- **Girder Repairs –**

- New Bearing Stiffeners
- Repair Longitudinal Stiffeners
- New Bottom Flange Cover Plate



# Project Constraints



- **Accelerated Design Schedule**
  - 11 months from Project Kick-off to PS&E Submittal
- **Limited Construction Window**
  - TCB allowed April 30 – October 15
- **Environmental impacts kept to a minimum. Limited time to obtain clearances during design.**

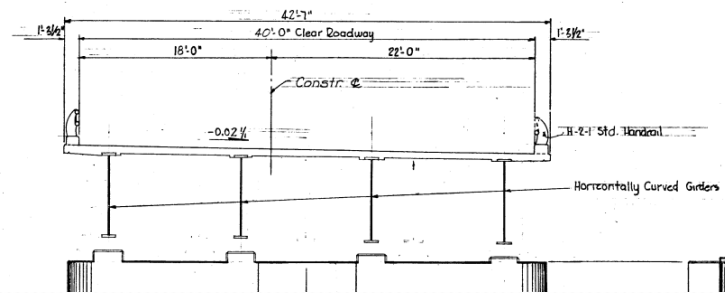
# Project Constraints



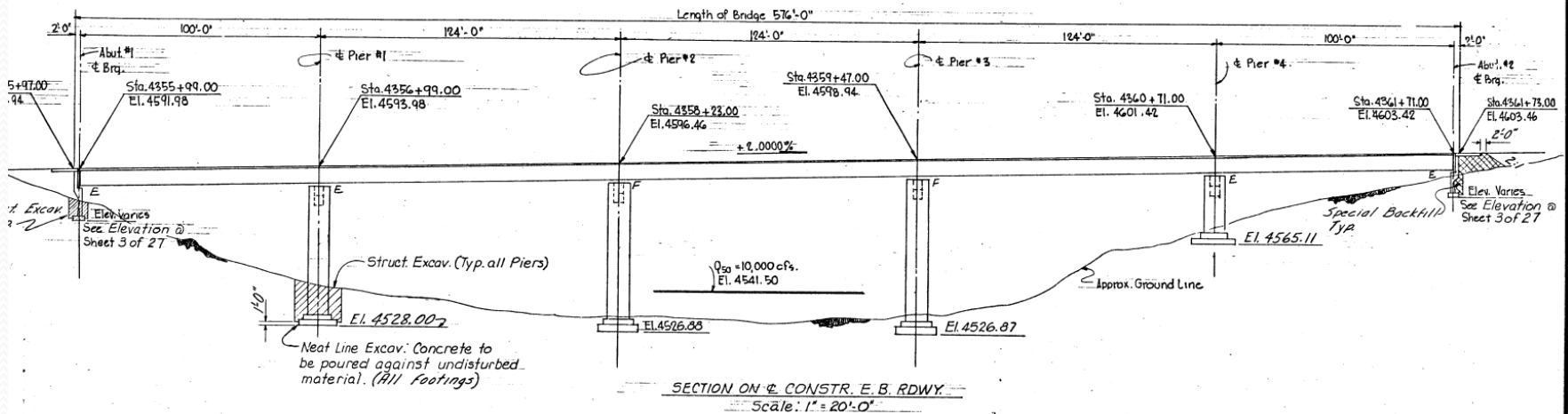
- No cross-overs allowed (7 mile footprint)
- Limited Traffic Openings



# Bridge No. 5 (Str # 1768)

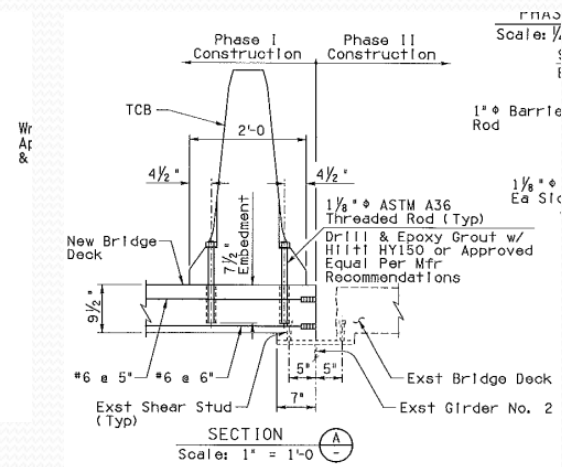
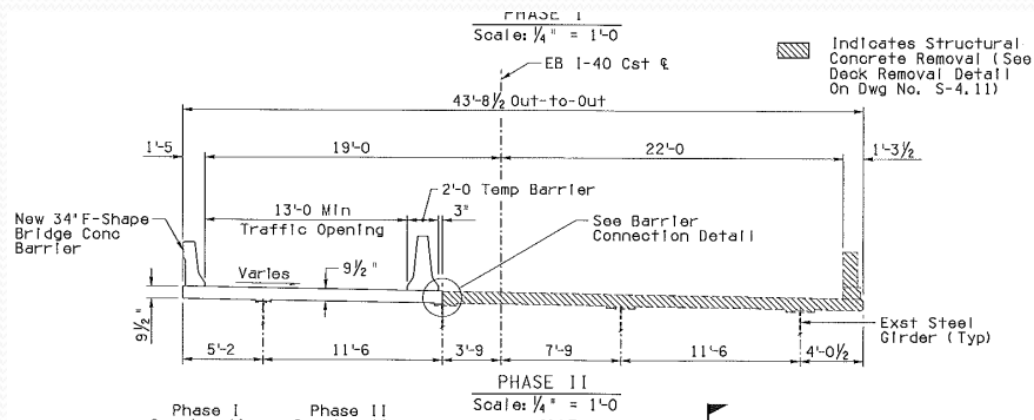


- Willow Creek Bridge No. 5 consisted of a 5-span steel girder bridge with a composite cast-in-place concrete deck built in the late 1960's. The concrete deck was experiencing severe corrosion due to deicing salt usage.



# Bridge No. 5 (Str # 1768)

- Cross-overs were not allowed due to the length of the project and the accompanying safety concerns to the travelling public, so phased deck removal/replacement was required, sometimes with as little as 3" clearance from the TCB to a deck construction joint on Willow Creek Bridge No. 5 (and as low as 1/2" on Willow Creek Bridge No. 4!).**



# “The” Problem

- Existing pier columns on Bridge No.5:



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  - Single-column piers, large cantilevers (16'-9" pier overhangs)



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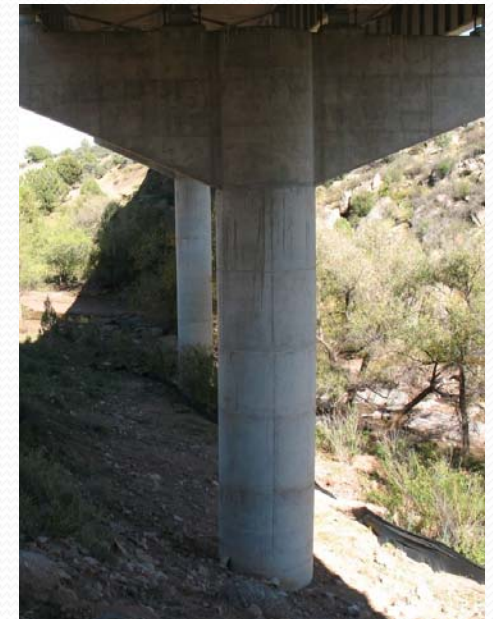
- **Existing pier columns on Bridge No.5:**
  - Single-column piers, large cantilevers (16'-9" pier overhangs)
  - Maximum height of 65'-4" (top of pier to bottom of footing) with a diameter of 7'-6"





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  - 2500 psi concrete



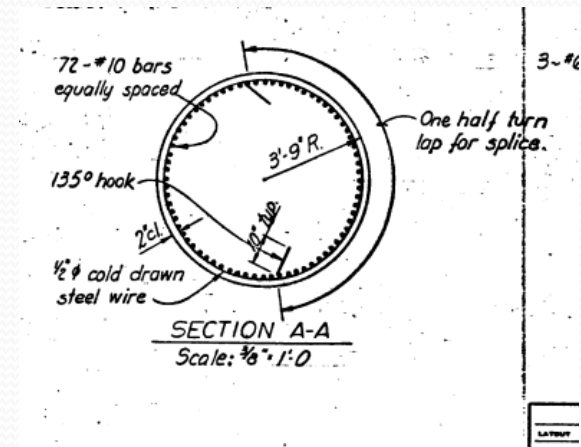
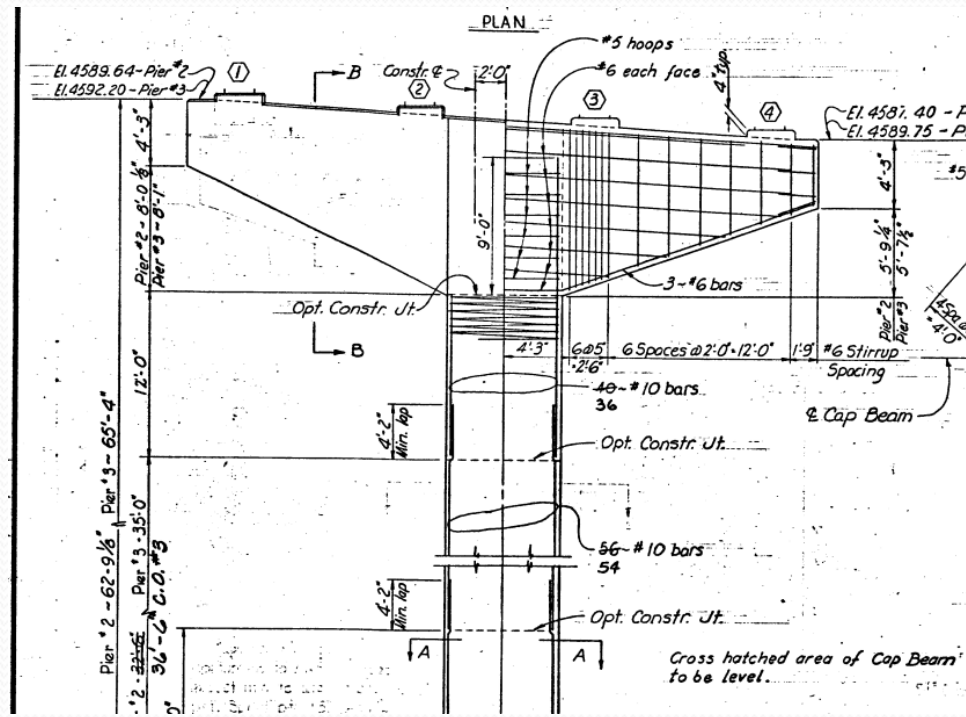
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  - 2500 psi concrete
  - Grade 40 steel



# “The” Problem

- Existing pier columns on Bridge No.5:
  - Not conducive to phased deck replacement!!





# Solutions??

- **Tiedowns into creek...**



# Solutions??

- ~~Tiedowns into creek...~~ (wanted to limit environmental impacts/construction activity in the creek – height of columns and exposure to potential wind/stream forces also led to stability concerns)



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- ~~Tiedowns into creek...~~ (wanted to limit environmental impacts/construction activity in the creek – height of columns and exposure to potential wind/stream forces also led to stability concerns)
- ~~Add counterbalance weights to pier cap...~~ (not feasible due to the weight needed as well as insufficient access from above, and wanted to limit environmental impacts to the creek)



**What next???**





# What next???

- In a traditional deck sequence placement...



# What next???

- **In a traditional deck sequence placement...we only pour positive moment portions of a deck prior to negative moment portions to avoid continuous cracking that would otherwise occur in the previously poured, cured portions of the deck.**

# What next???

- In a traditional deck sequence placement...we only pour positive moment portions of a deck prior to negative moment portions to avoid continuous cracking that would otherwise occur in the previously poured, cured portions of the deck.

**So what if we used the existing deck and remove it in a similar manner to how it was placed to provide the requisite counterbalance?**

# Welcome to the checkerboard....

FALSA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	040-B(219)T	62	74	
040 MO 083					

**TCB PLACEMENT DETAIL**  
Phase I Shown, Phase II Similar  
NTS

Number	Row	Length
③	A	50
	B	-

**DECK REMOVAL SEQUENCE**  
NTS

**TCB PLACEMENT DETAIL**  
Phase I Shown, Phase II Similar  
NTS

Number	Row	Length
①	A	40
	B	40
②	A	40
	B	40

**DECK POURING SEQUENCE**  
NTS

Keyed Cast Jt (Typ)  
See Detail On Dwg No. S-4.06

**DECK REMOVAL DETAIL**  
Scale: 1/2" = 1'-0"

**CONCRETE REMOVAL NOTES:**

- Damage to the existing girders, as a result of the contractor's operations, shall be repaired to the satisfaction of the Engineer at no additional cost to the Department.
- The contractor shall measure the depth of the concrete above the girders prior to beginning concrete removal operations.
- Dim 'B' = Maximum saw cut depth within Dim 'D'.
- The contractor shall mark the top of deck with paint where shown in the Deck Removal Detail prior to beginning concrete removal operations.

**DECK REMOVAL & POURING SEQUENCE NOTES:**

- Numbers ①, ② & ③ indicate removal & placing sequence of deck concrete. The existing bridge deck shall be removed in sequence shown to avoid excessive unbalanced loads on the piers. Temporary concrete barrier shall be placed on ③ prior to removal of any portion of bridge deck. ① & ② shall be removed in their entirety & replaced per the Deck Pouring Sequence shown. Temporary concrete barrier shall be placed on ① & ② & removed from ③ a minimum of 7 days after ① & ② deck pour. ③ shall be removed in its entirety & replaced per the Deck Pouring Sequence shown.
- Phase I sequencing shown above. Phase II similar.
- Temporary concrete barrier shall be centered in ② & ③. In ①, temporary concrete barrier shall be placed with edge 2'-0" maximum from removal limit adjacent to ③.
- The contractor shall submit a Deck Removal/Deck Pouring Schedule to the Engineer for approval prior to removal/placing concrete.
- The cost of temporary concrete barrier used for temporary balancing load for deck removal/pouring sequence & all work associated with phasing of deck removal/pouring sequence shall be considered to be included in the cost of Item No. 6010005 - Structural Concrete (Class S) (F'c = 4500). No separate measurement or payment will be made under Item No. 7015010 - Temporary Concrete Barrier (Installation & Removal) or Item No. 7016020 - Temporary Concrete Barrier (In Use).
- The cost of temporary concrete barrier used for traffic control shall be paid for under Item No. 7015010 & Item No. 7016020.

DESIGN	DATE	10/15
DRAWN	DATE	10/15
CHECKED	DATE	10/15
AECOM		
PROJECT NO.	1768	STRUCTURE NO.
ROUTE	85,40	BRIDGE
WILLOW CREEK BRIDGES		

ARIZONA DEPARTMENT OF TRANSPORTATION INTERNAL TRANSPORTATION DIVISION BRIDGES GROUP	
STA 4358+ MISCELLANEOUS DETAILS (2 OF 2)	
WILLOW CREEK BRIDGES	
DWG NO. S-4.11	

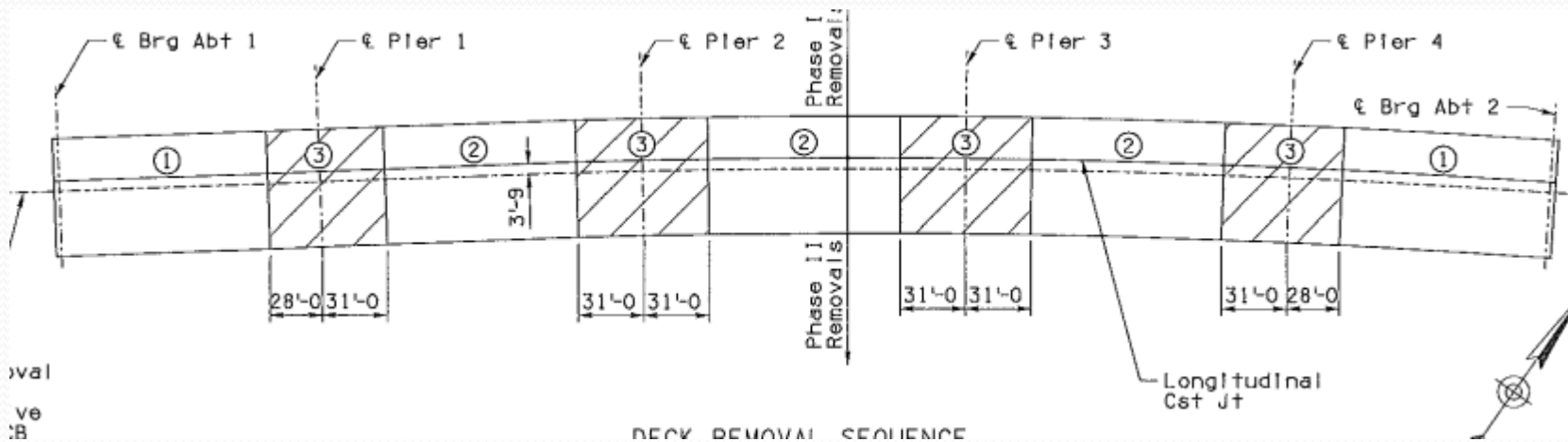
TRACS NO. H8613 OIC

040-B(219)T

OF

# Welcome to the checkerboard....

- The checkerboard utilized the following concept to provide the required counterbalance:
  - Portions of the deck (positive moment areas up to contraflexure points) were removed...

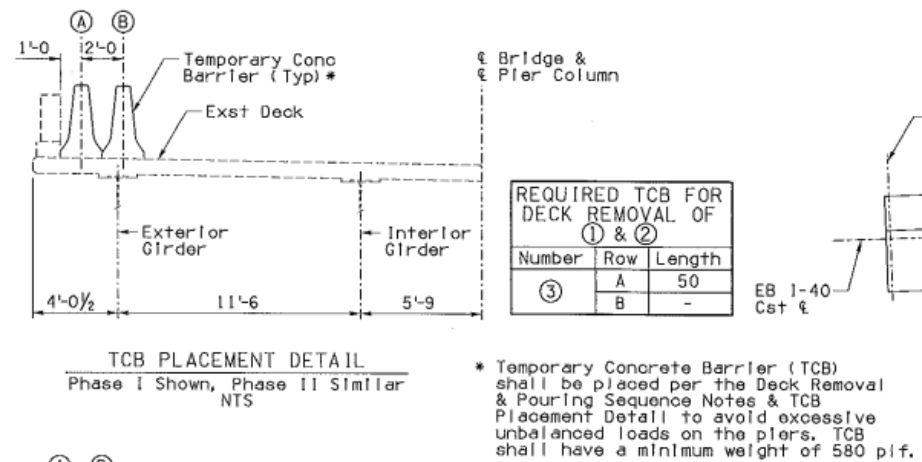


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- **The checkerboard utilized the following concept to provide the required counterbalance:**
  - Portions of the deck (positive moment areas up to contraflexure points) were removed; however, this load was not **QUITE** enough to provide the requisite counterbalance.

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  - Once the new positive deck portions were poured and cured, TCBs were shifted to the cured sections while negative moment sections were removed then poured.



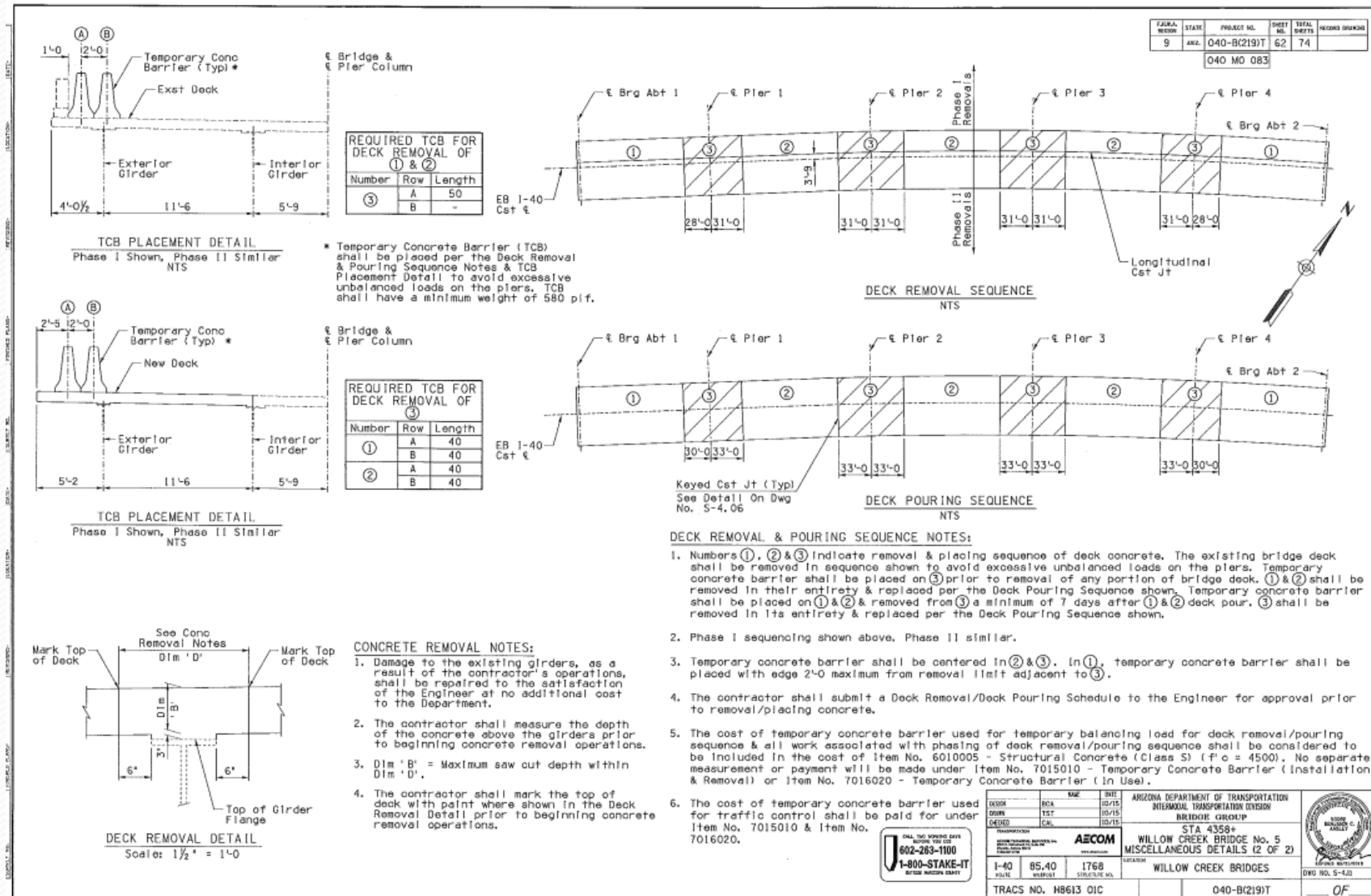
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  - Once the new positive deck portions were poured and cured, TCBs were shifted to the cured sections while negative moment sections were removed then poured.
  - Lengths of TCBs required for counterbalance were computed depending on the deck sequence.

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  - Once the new positive deck portions were poured and cured, TCBs were shifted to the cured sections while negative moment sections were removed then poured.
  - Lengths of TCBs required for counterbalance were computed depending on the deck sequence.
  - The same process was repeated during Phase II.

# Welcome to the checkerboard...



# Welcome to the checkerboard....

- What about debris in the wash?

# Welcome to the checkerboard....



- What about debris in the wash?

# Welcome to the checkerboard....



- What about debris in the wash?
- The contractor prevented debris from entering the wash successfully by placing plywood between bottom girder flanges.
- Overhangs were removed gradually using a bucket to catch debris off to the side as it was removed as shown in the next slide.

# Welcome to the checkerboard....



# Welcome to the checkerboard....







# Special Design Notes

**There was some initial concern about variable girder deflections utilizing this construction methodology. Girder deflections were anticipated to be minimal. However, the following precautions were taken:**

- Contractor was requested to provide extensive survey shots along deck edges and girder centerlines before deck removals and after deck removals. Top of girder elevations were also shot.
- This extensive survey enabled us to confirm our minimal girder deflection assumptions because of the stiffness provided by remaining portions of the deck (longitudinally and transversely) as well as cross-bracing.

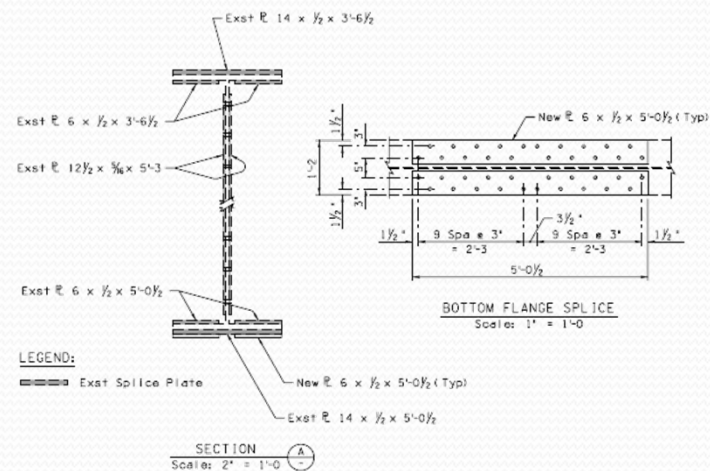
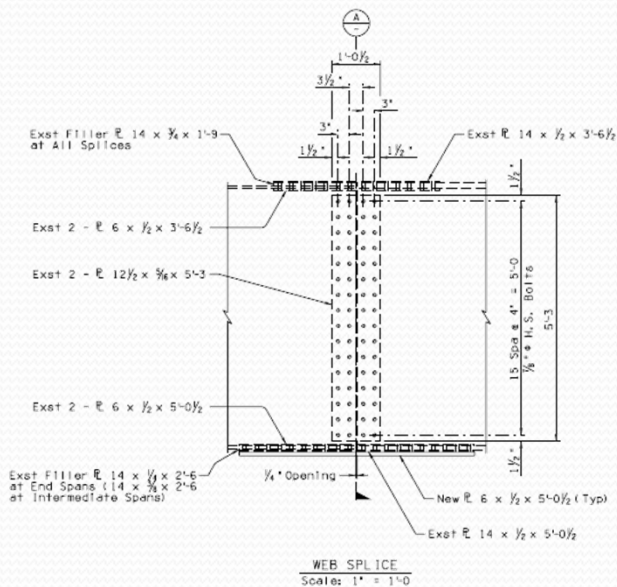
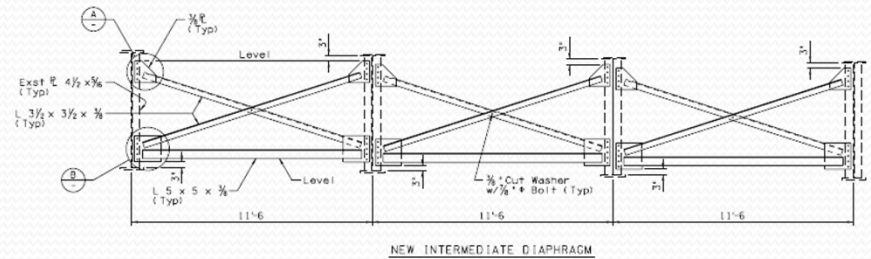


## Special Design Notes (cont'd)

- Also, this extensive survey allowed us to better accommodate and tie into existing superelevation transitions to minimize any awkward roadway-bridge transitions experienced by the traveling public.
- This survey also helped us to confirm the magnitude of the new build-ups on the girders.

# Bridge No. 5 (Str # 1768)

- Girder Repairs -
  - Bottom Flange Splice Plate Repair
  - New Bottom Flange Cover Plate
  - New Intermediate Cross Bracing



# Questions?

