Alaska Department of
Transportation & Public Facilities

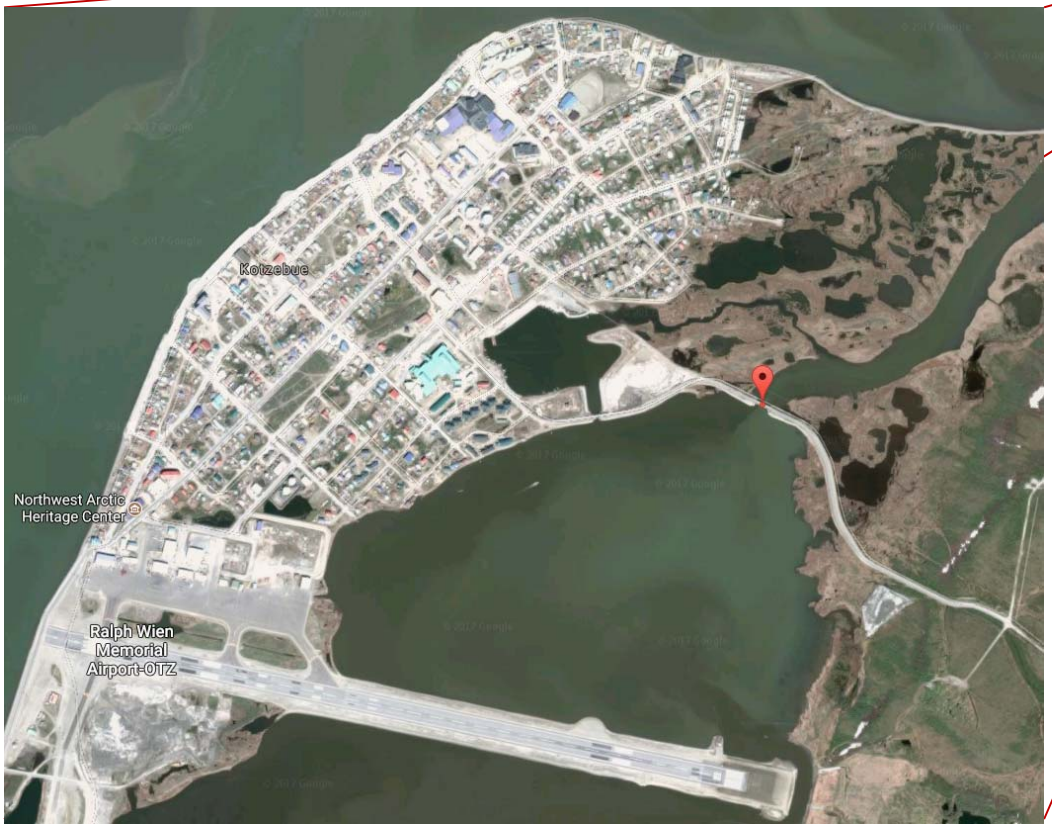
Kotzebue Slough Bridge Underwater Pile Repair in Remote Alaska

Jared Levings, P.E., S.E.

9/7/2017

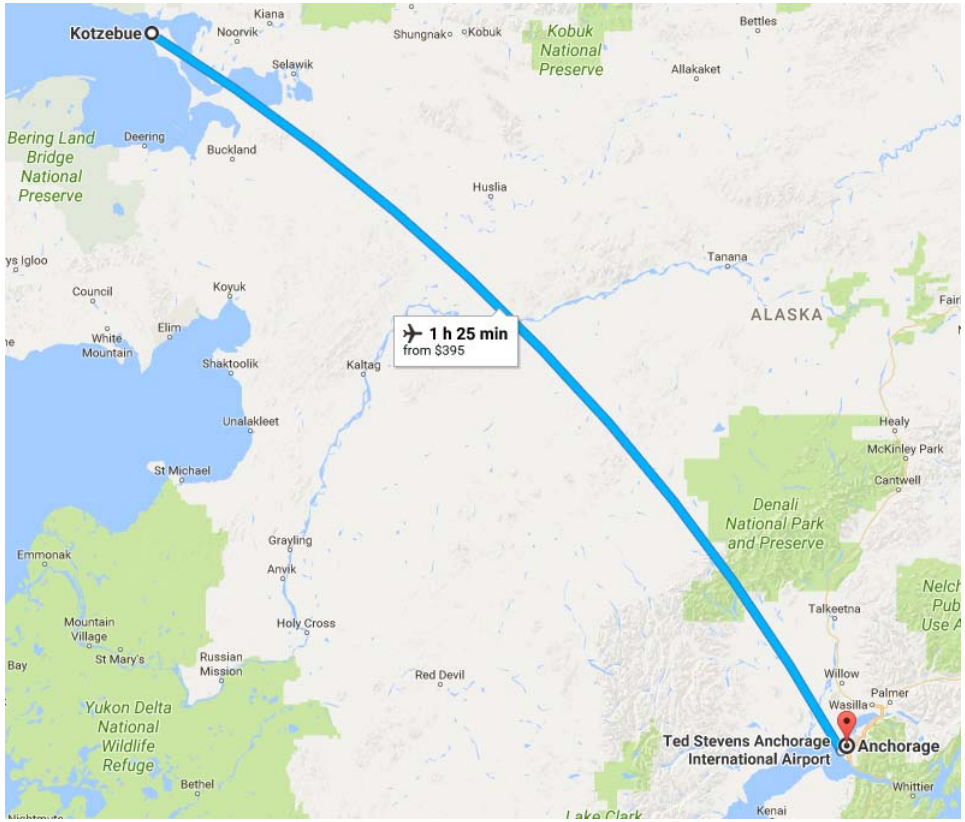
Location & Description

- Kotzebue, Alaska
- ~30 miles north of the Arctic Circle
- 3200 people



- Built 1985
- 3 span, 180-foot long bridge
- Gravel road
- ADT 495

Bridge Access Methods



Fly from Anchorage

(1.5 hours commercial airline)

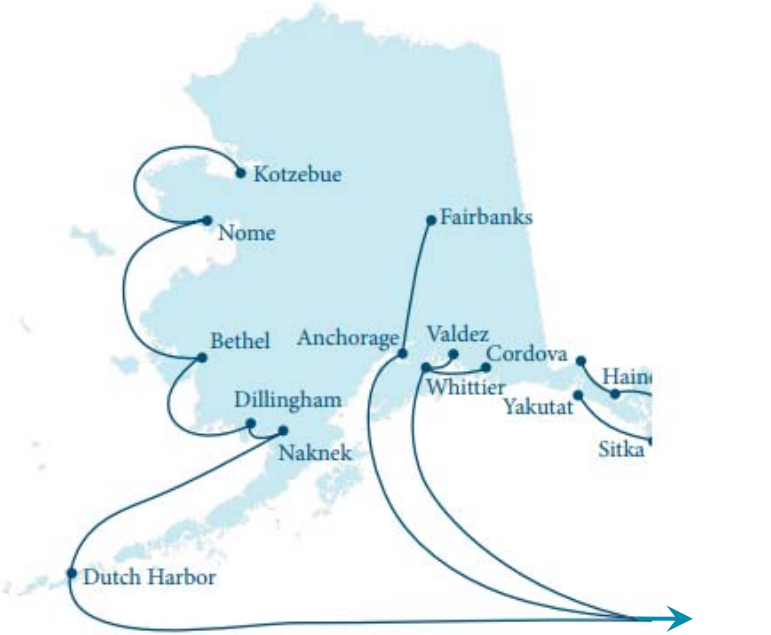
Main Barge Season

(July through August)

(up to 1 year lead time,

$4480 <19ft long,

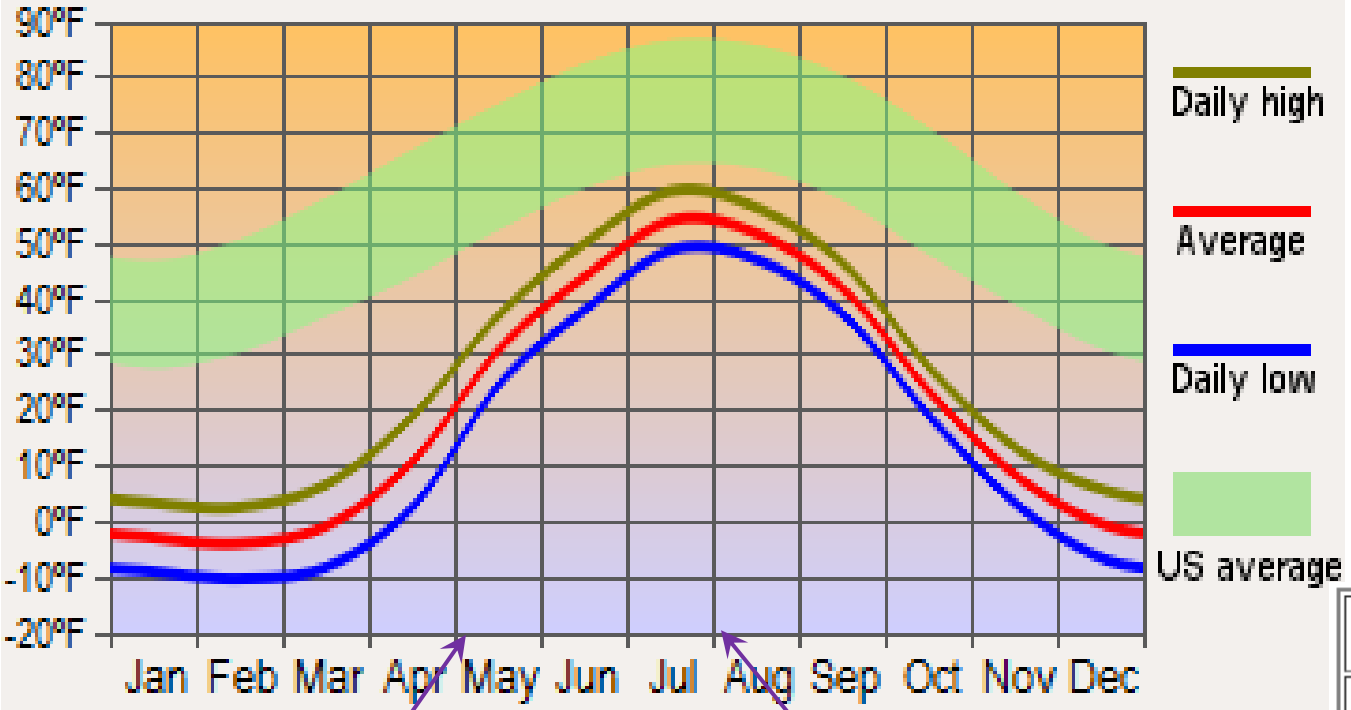
$9100 <22ft long)



to Seattle

Conditions

Average Temperatures

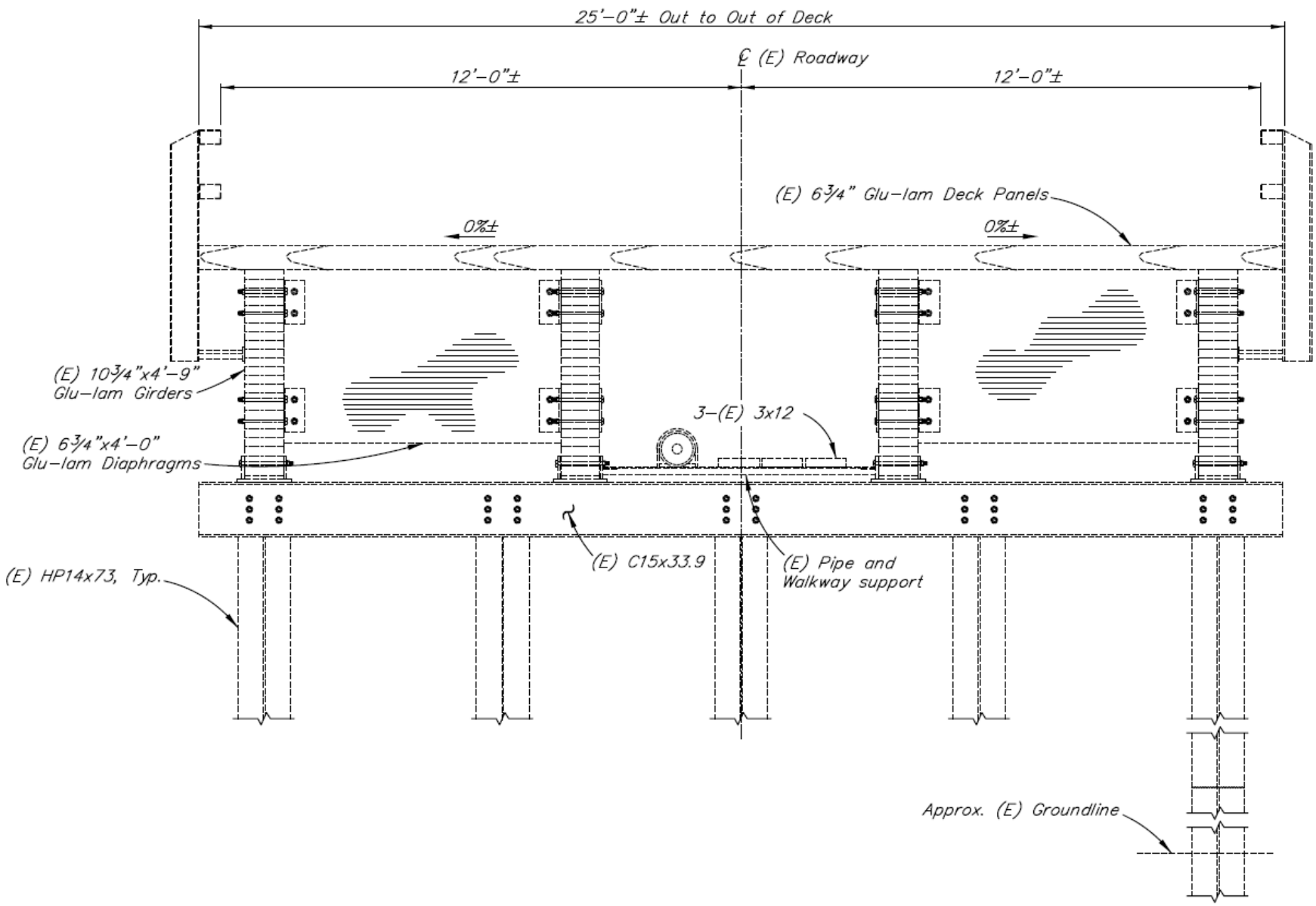


24 hours of sunlight

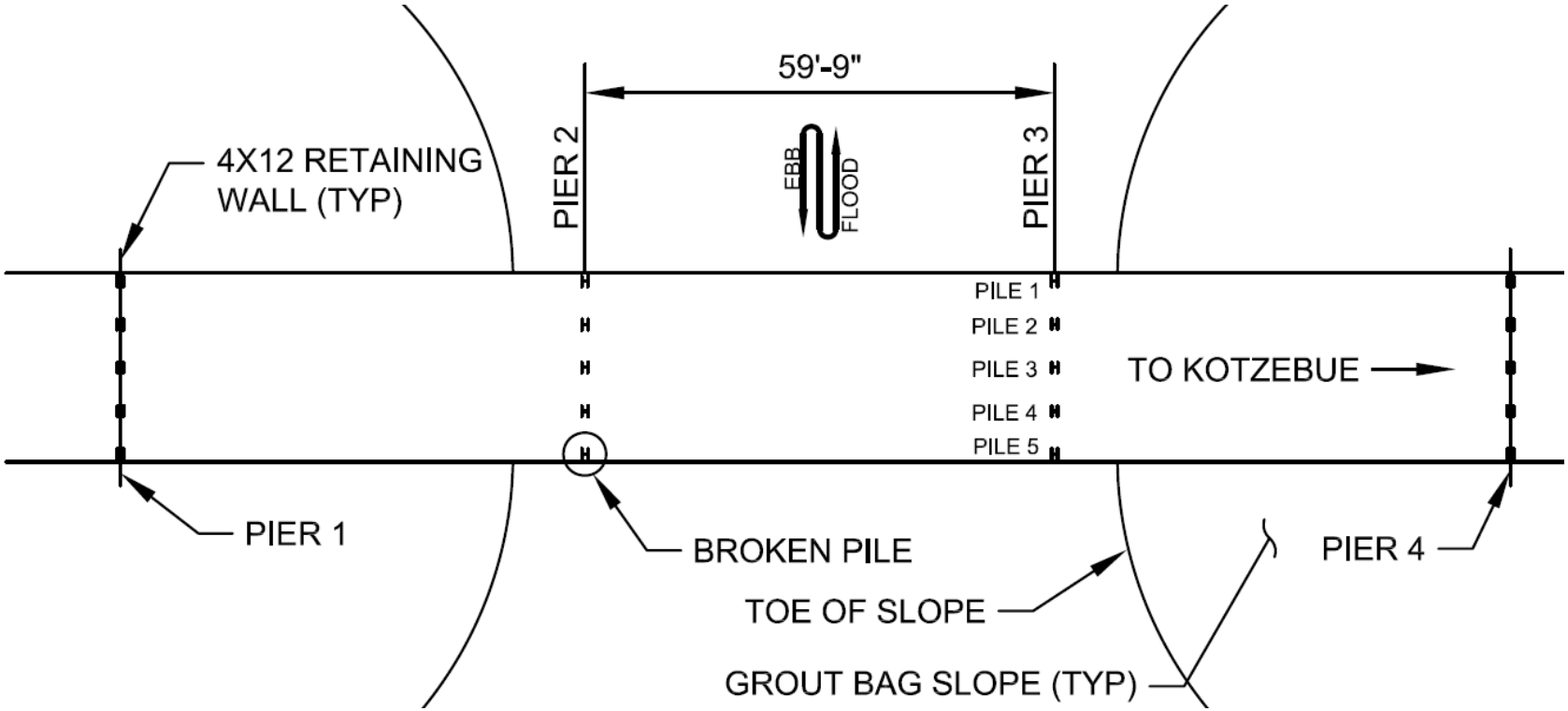
2011	Kotzebue	Fairbanks
Bananas	$2.89	$0.99/lb
Oranges (Naval)	$2.69/lb	$1.49/lb
Gatorade 32oz	$5.15	$1.37
Whole Kernel Corn	$2.65	$0.69
Milk Whole Gallon	$11.39	$3.69
Soda 12pk	$13.99	$7.89

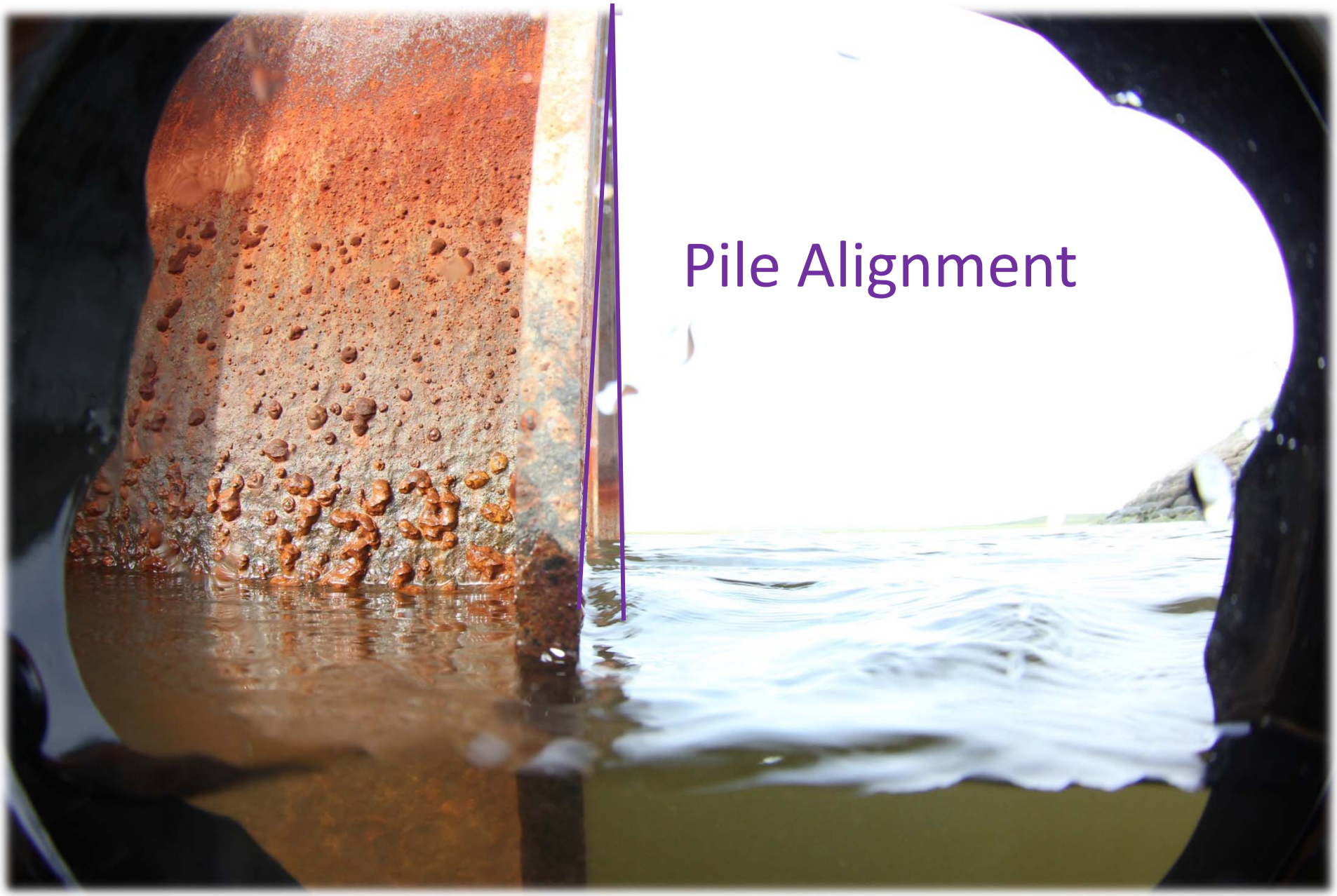
Bridge Details

Bridge Details

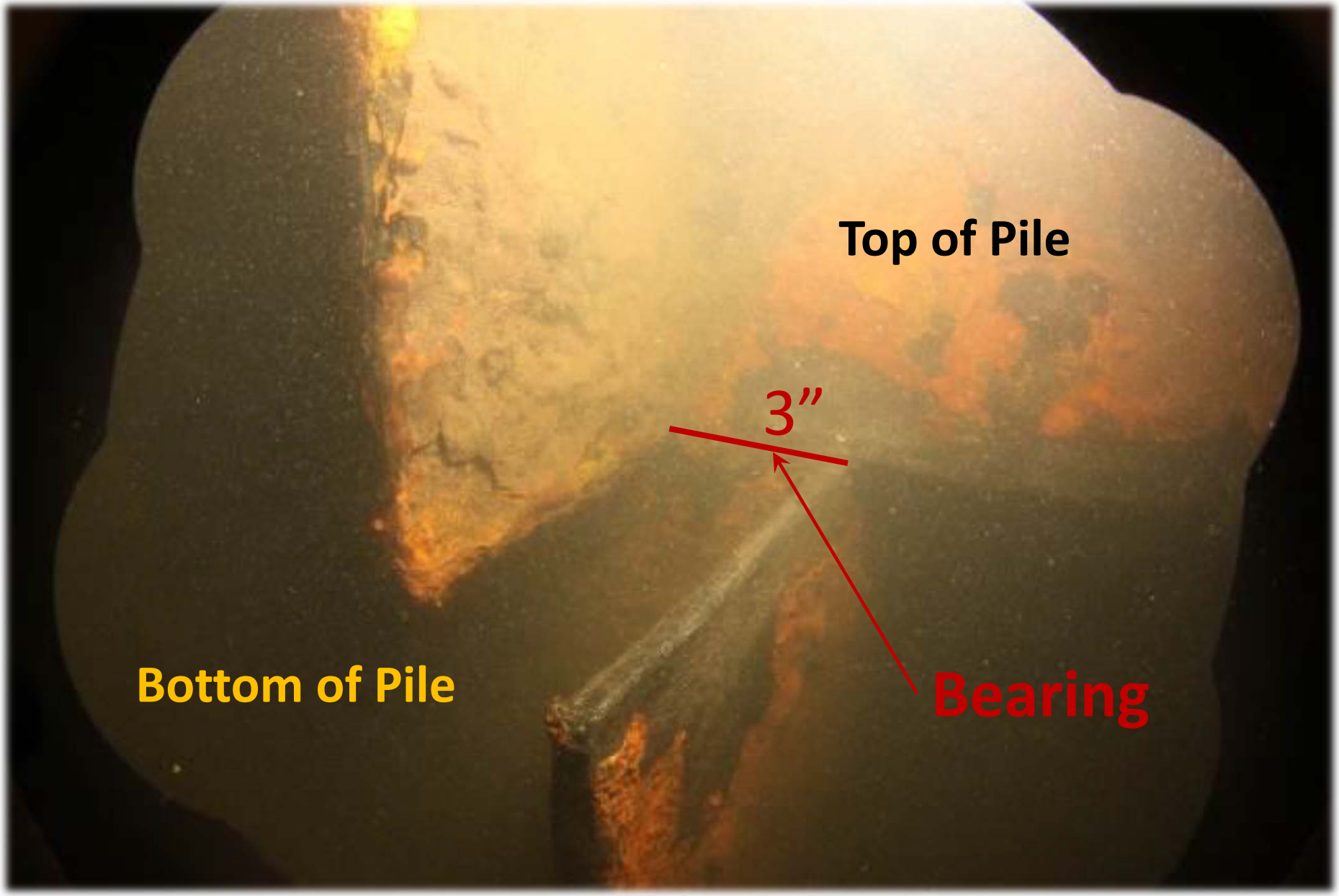

25'–0"± Out to Out of Deck
℄ (E) Roadway
12'–0"±
12'–0"±
(E) 6¾" Glu–lam Deck Panels
0%±
0%±
(E) 10¾"x4'–9"
Glu–lam Girders
3–(E) 3x12
(E) 6¾"x4'–0"
Glu–lam Diaphragms
(E) C15x33.9
(E) Pipe and
Walkway support
(E) HP14x73, Typ.
Approx. (E) Groundline

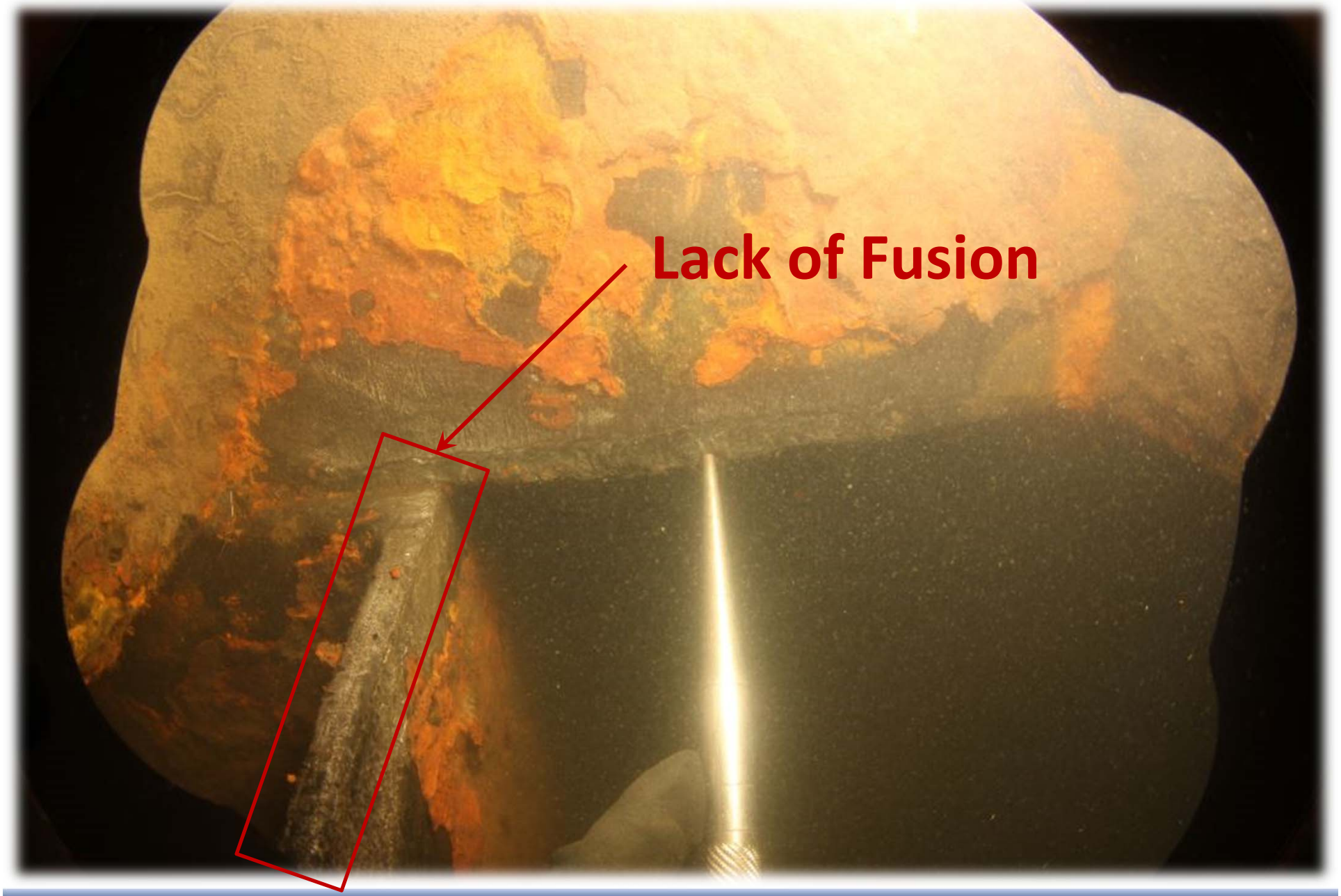
Pile Damage – 8/2014

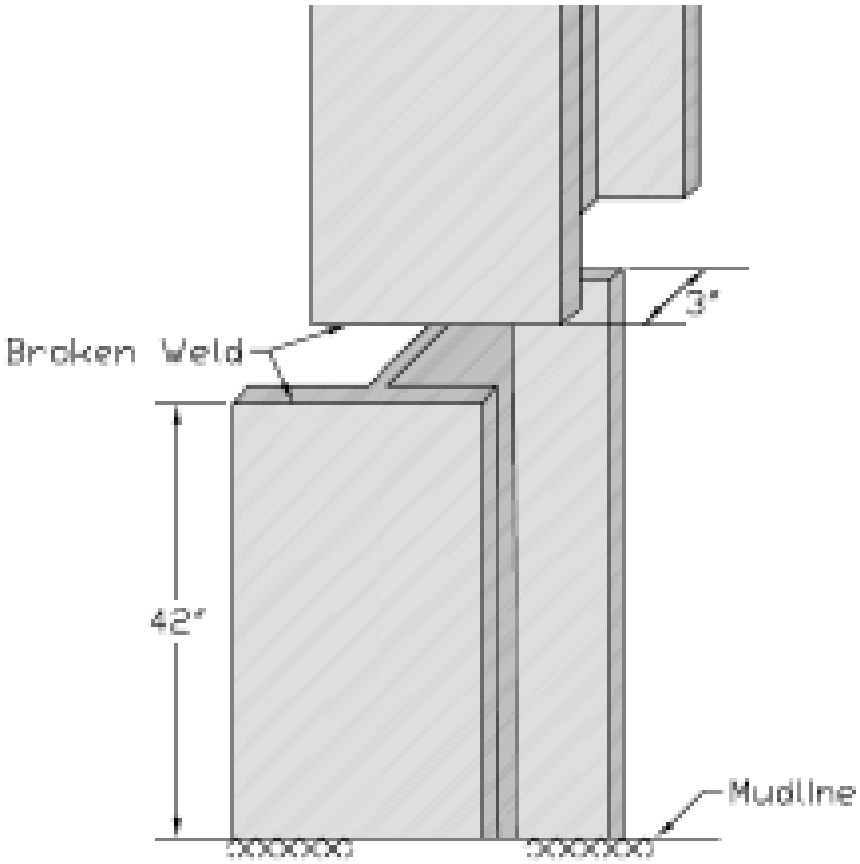


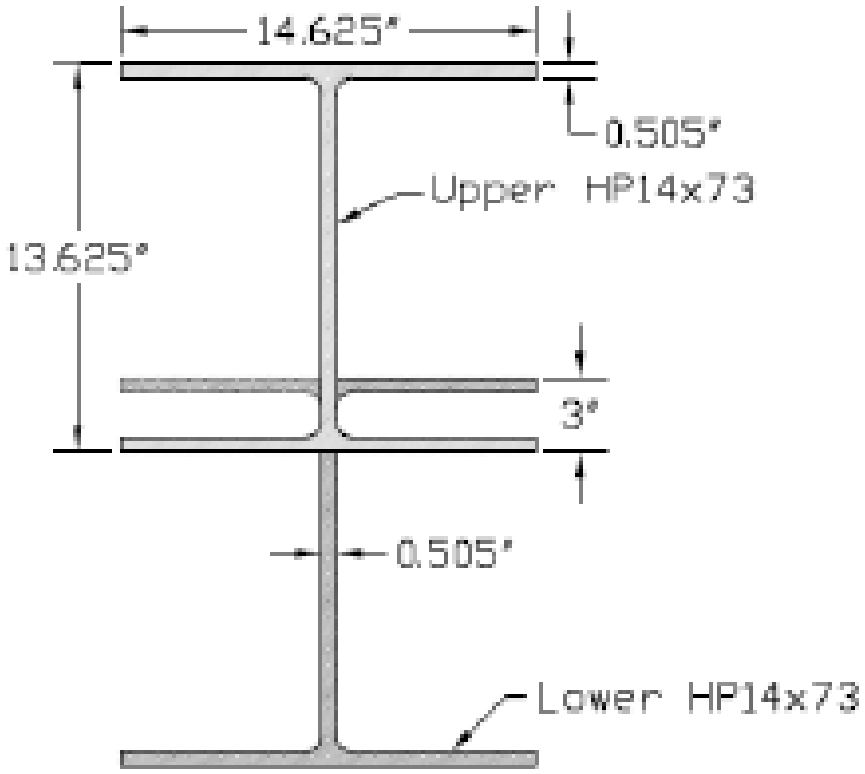


Pile Alignment


Top of Pile
3”
Bottom of Pile
Bearing


Lack of Fusion

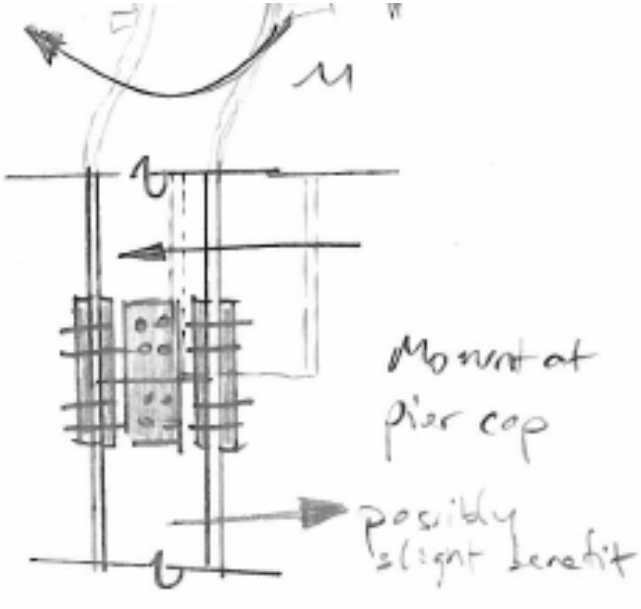

Broken Weld
3"
42"
Mudline

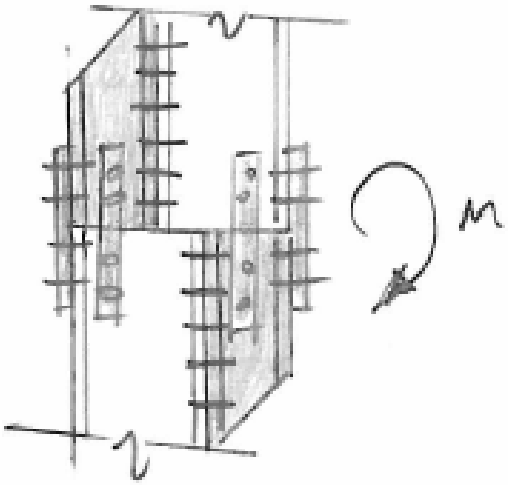

14.625"
0.505"
Upper HP14x73
13.625"
3"
0.505"
Lower HP14x73

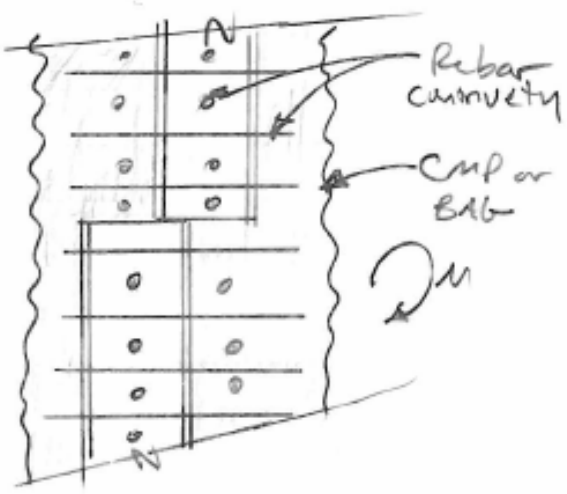
Concepts

- Drive outboard pile – Expensive, Lead Times
- **Reestablish Bearing**
  - Concrete Encasement
  - Steel Bracket
  - Steel Corbel
  - **Pile Realignment**
  - Other?
- Do Nothing, Permanent Lane Restriction

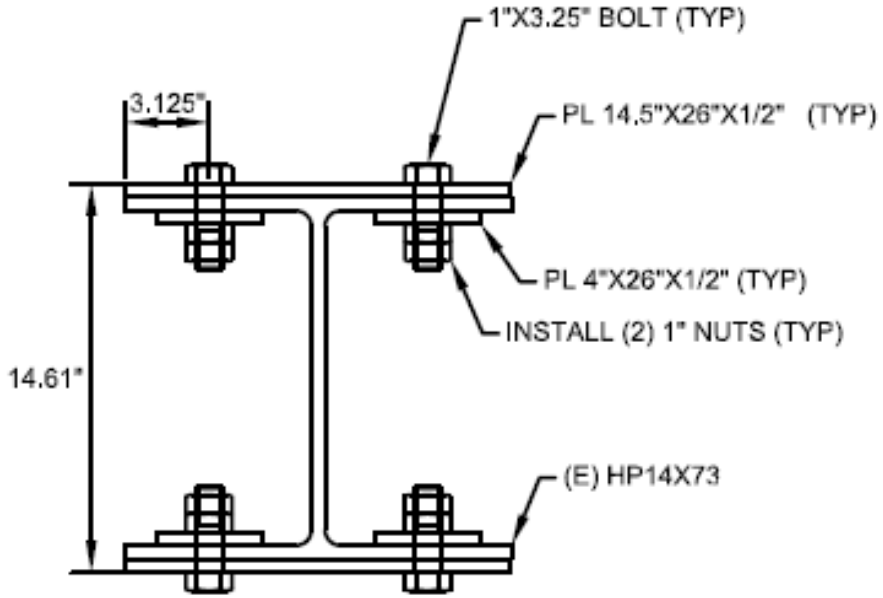
Concepts

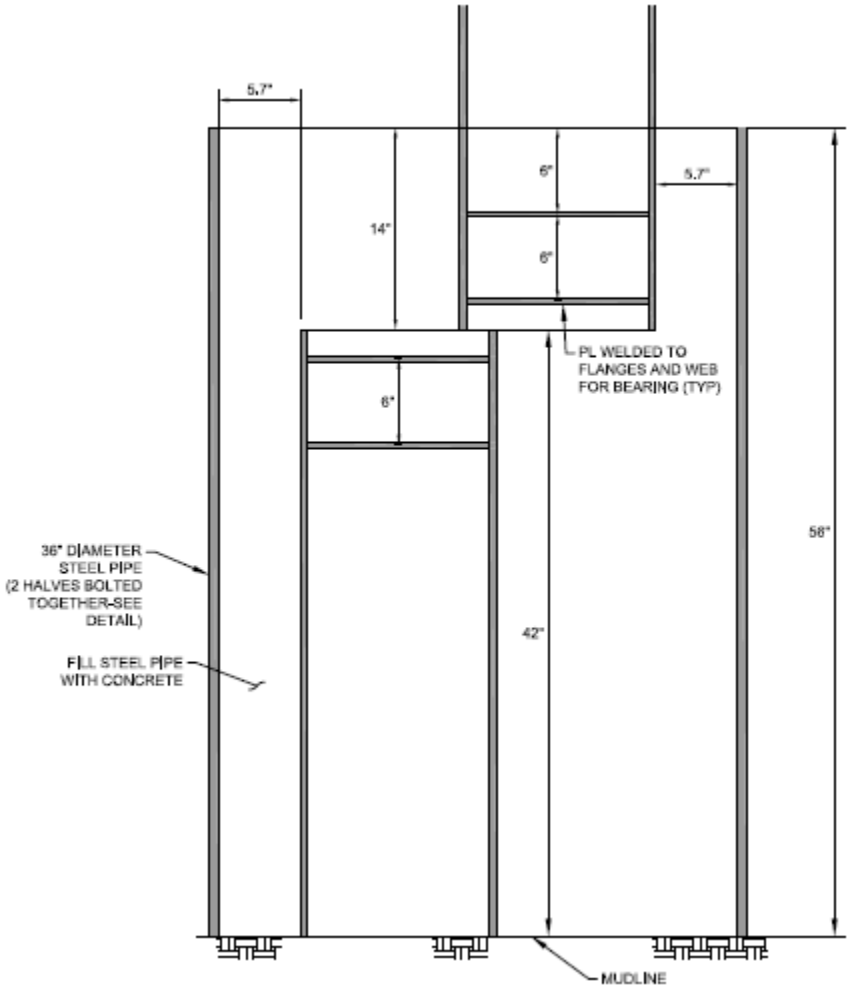

M
Moment at
pier cap
possibly
slight benefit


M


N
Rebar
continuity
CMP or
BAR
M

Concepts


1"X3.25" BOLT (TYP)
3.125"
PL 14.5"X26"X1/2" (TYP)
PL 4"X26"X1/2" (TYP)
INSTALL (2) 1" NUTS (TYP)
14.61"
(E) HP14X73


5.7"
6"
5.7"
14"
6"
6"
PL WELDED TO FLANGES AND WEB FOR BEARING (TYP)
58"
36" DIAMETER STEEL PIPE (2 HALVES BOLTED TOGETHER-SEE DETAIL)
FILL STEEL PIPE WITH CONCRETE
42"
MUDLINE

Construction Considerations

- Welds
  - Issue with original welded splice
  - V-notch grooves – pneumatic tools
  - CWI Welding Inspector
  - How to realign piles?
- Bolts
  - Numerous Bolts (66 in final repair)
  - Bolt Tightening Clearances
  - Pneumatic tools
  - Easier to inspect (bolt tension readings)
  - Bolt Hole Errors?

Construction Considerations

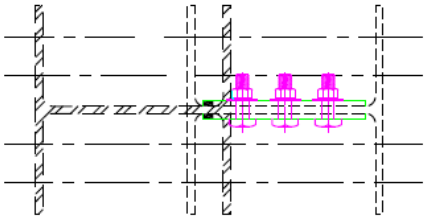
- Regional Bridge M&O Discussion
  - Feasibility based on Sketches
    - Methods
    - Material weights
  - Man-hour estimate
  - Extrapolate to underwater conditions
    - Current
    - Visibility
    - Diving Equipment

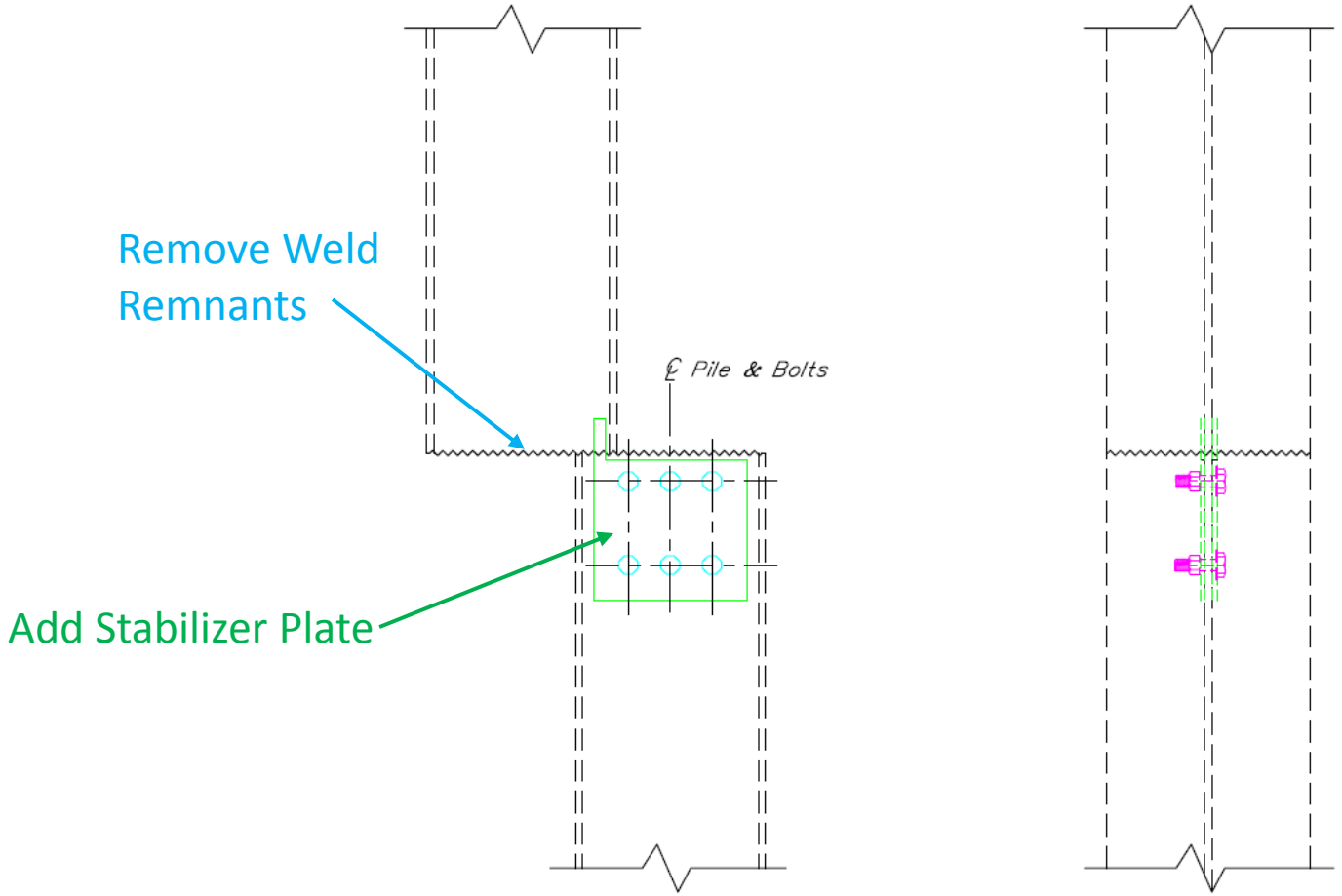
Construction Considerations

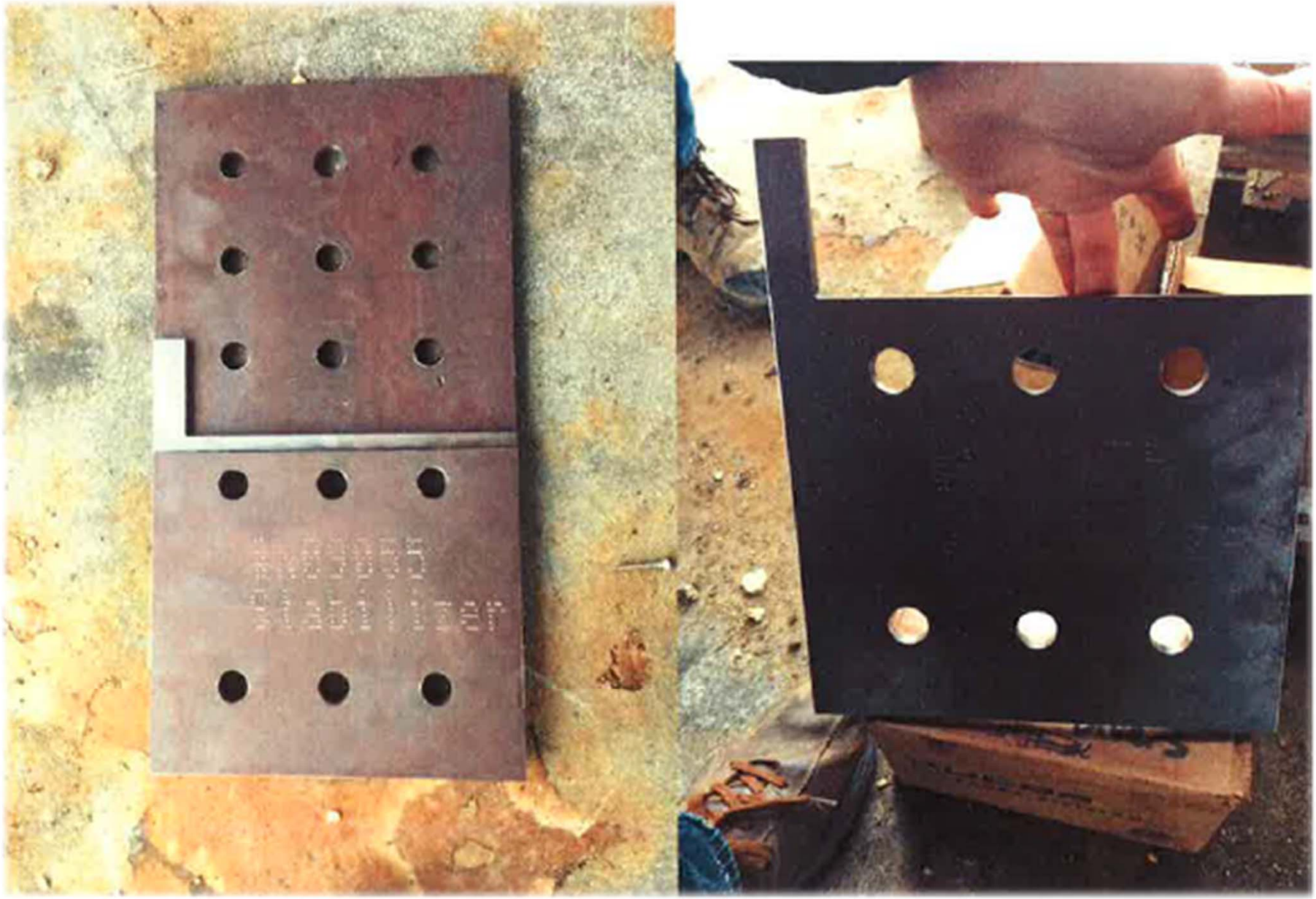
- Underwater Work Discussion
  - Feasibility
  - Welding
  - Bolting
  - Equipment

- Result ⇨ Contingency Plan Modifications
  - Room for pile modifications
  - Field-drilled holes

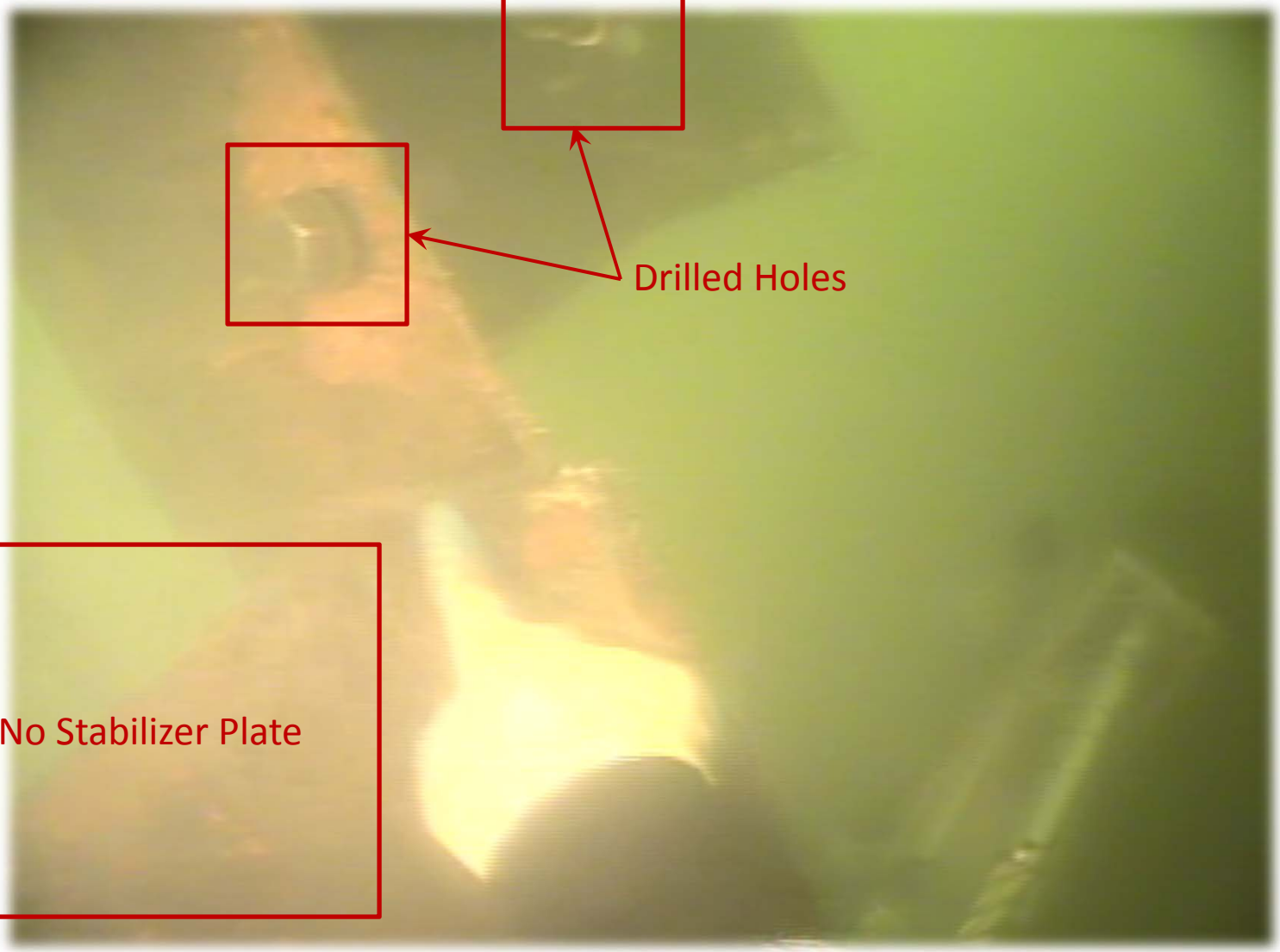
Realignment Plan




Remove Weld Remnants
℄ Pile & Bolts
Add Stabilizer Plate



Complications

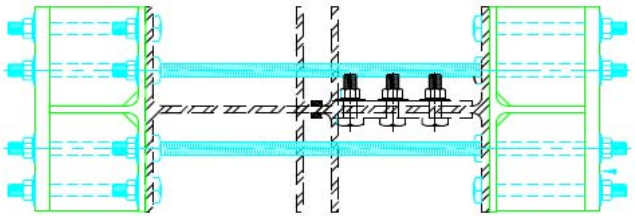


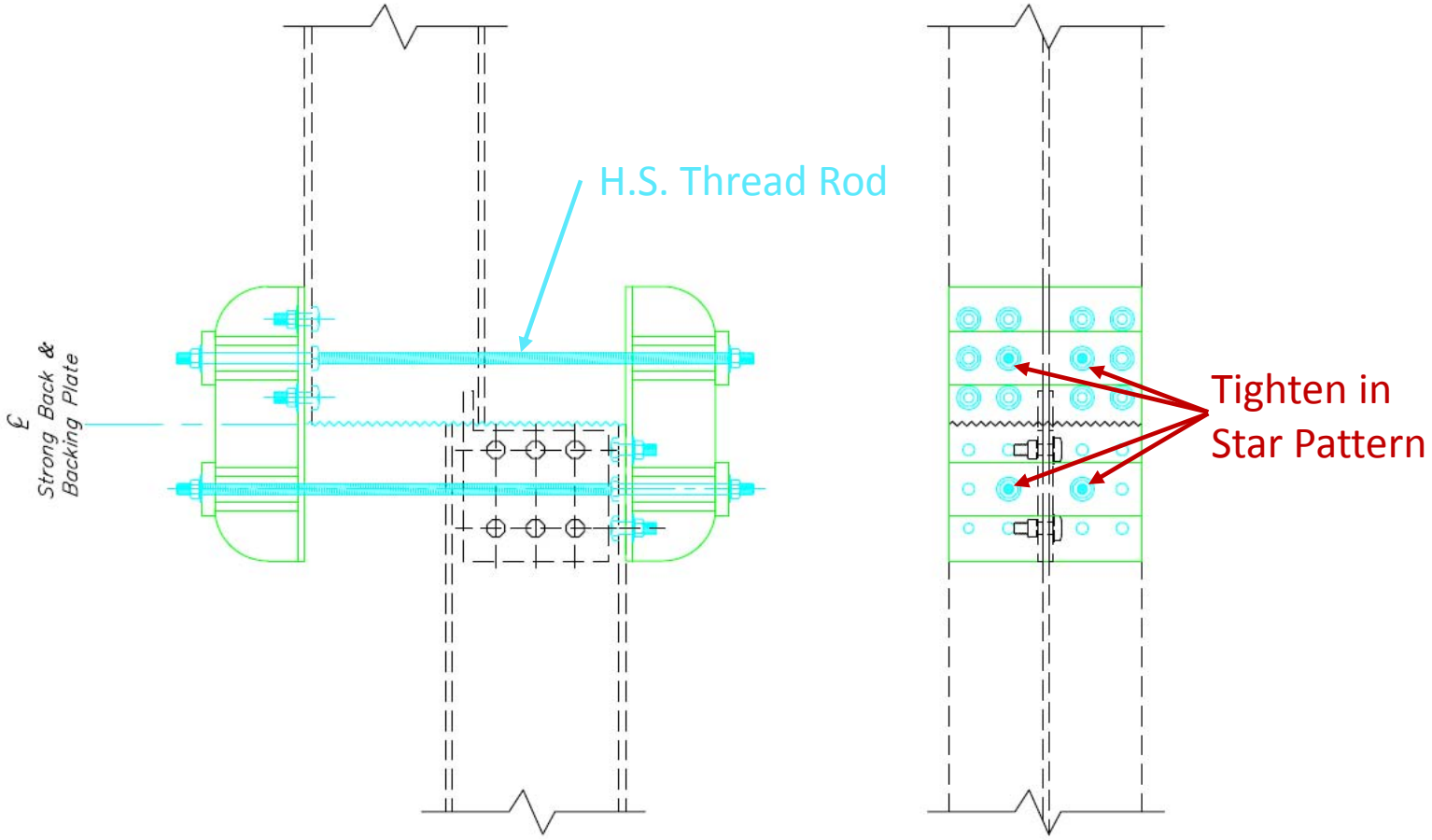
Solution

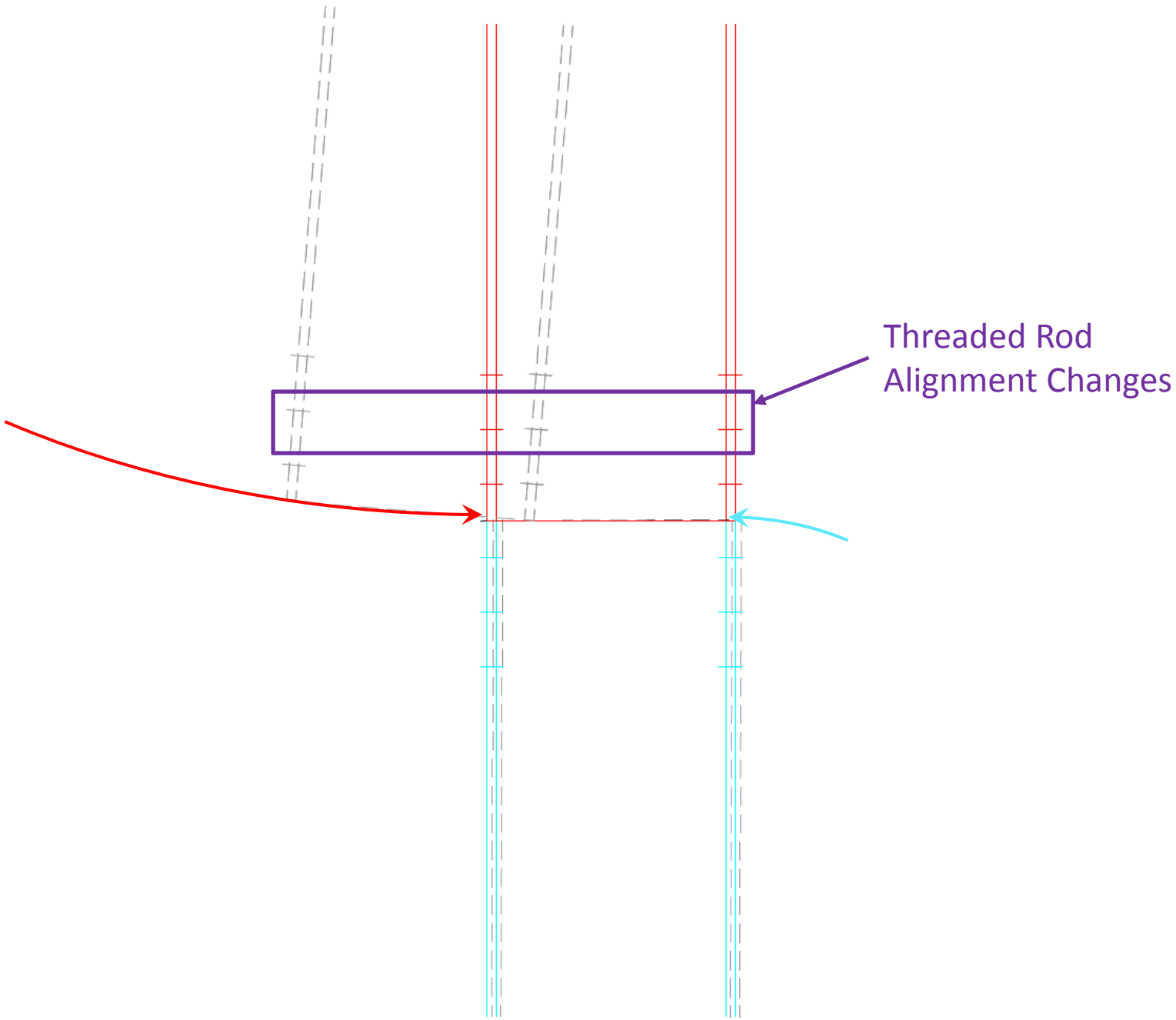
Quick Solution:

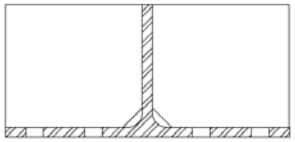
-Chain used to realign pile

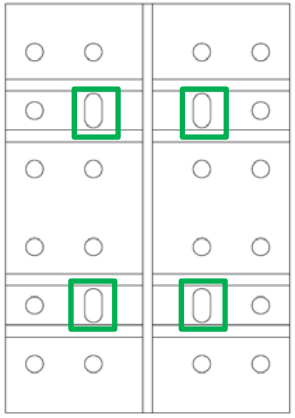
-Minimal pile load

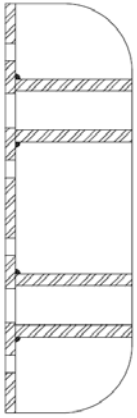


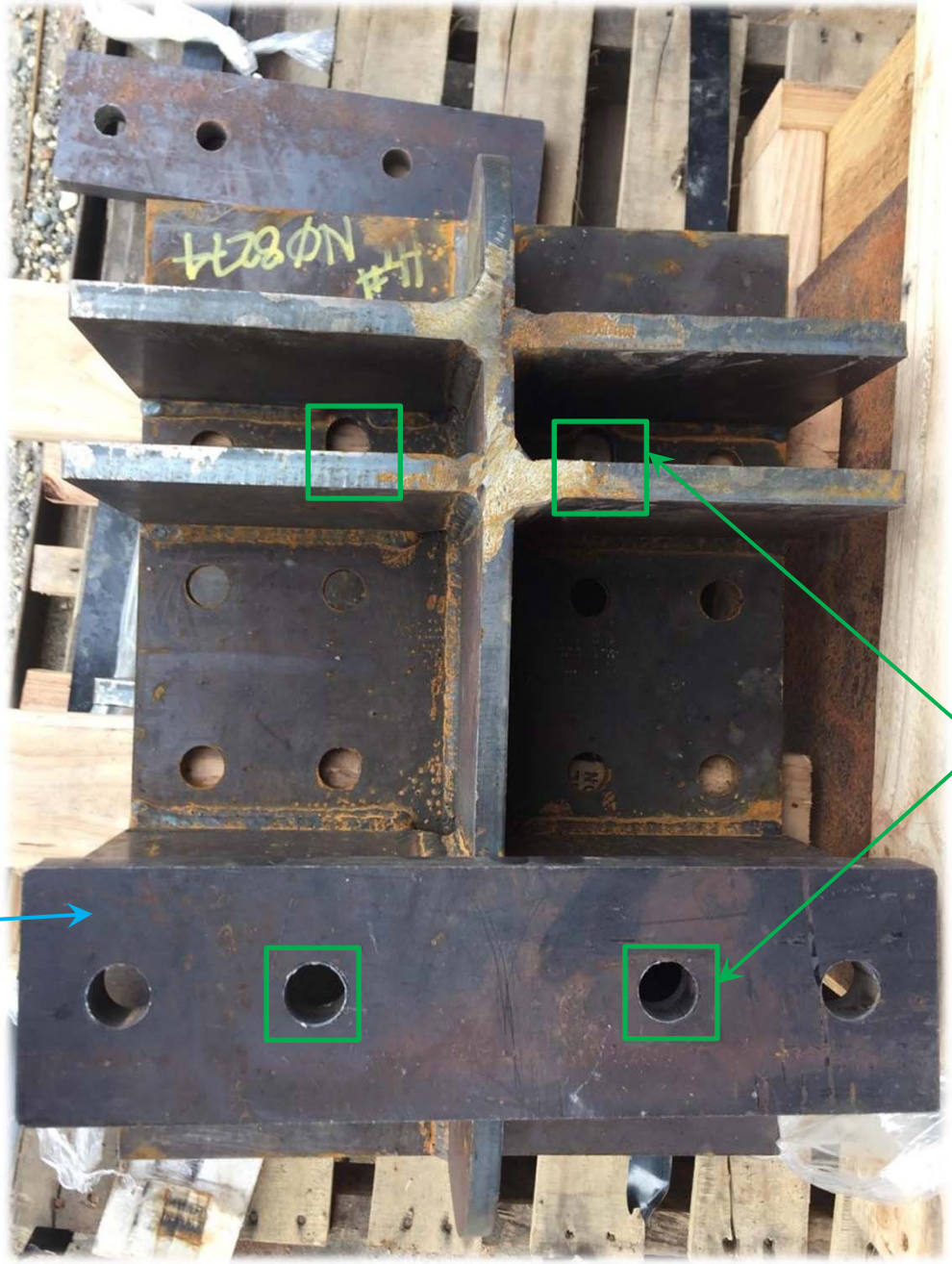

H.S. Thread Rod
℄
Strong Back &
Backing Plate
Tighten in
Star Pattern


Threaded Rod
Alignment Changes

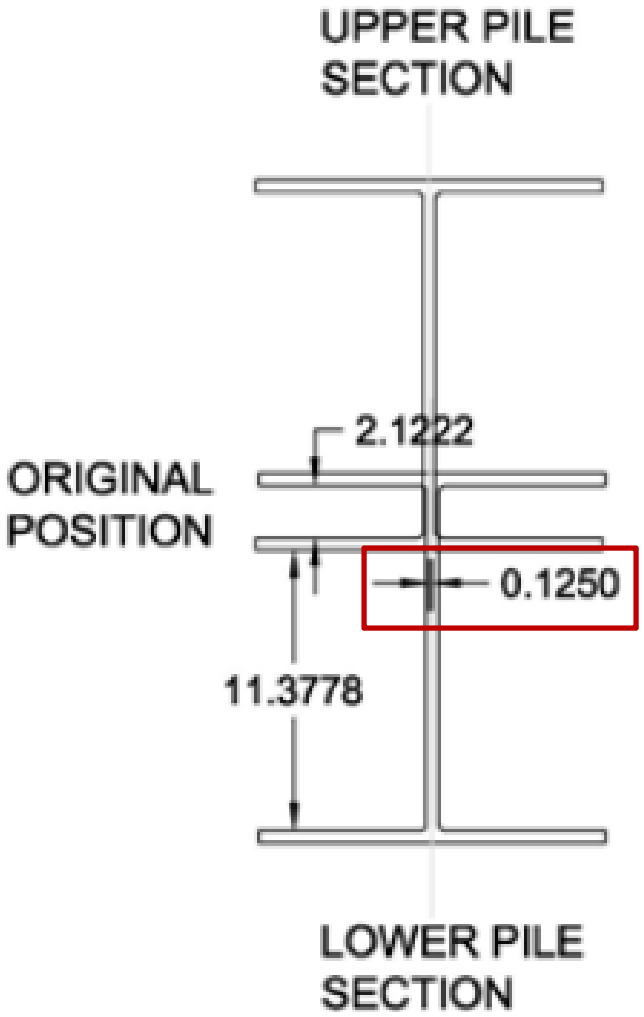


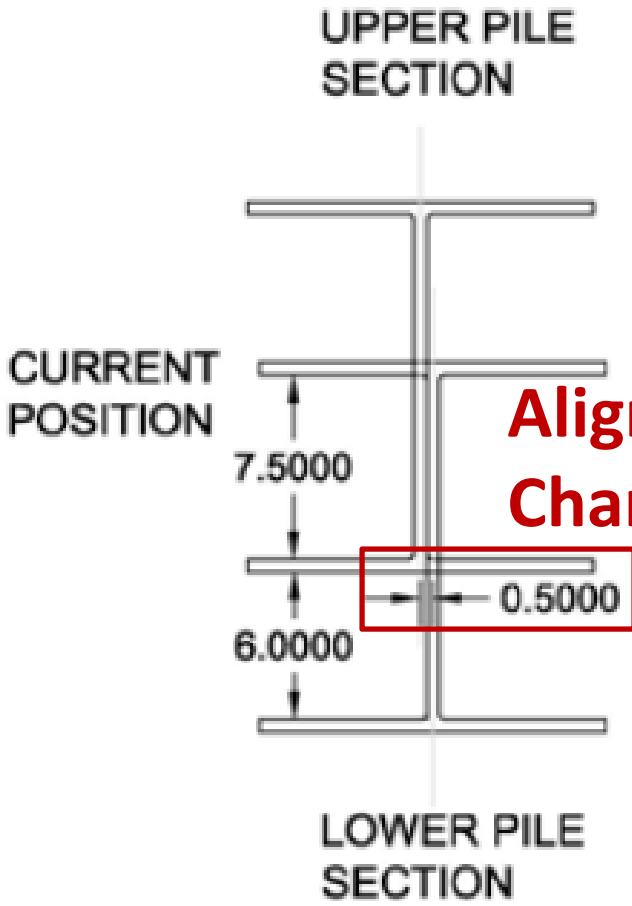





Slotted Holes
Oversized
Bearing Plate

Complications





Alignment Change

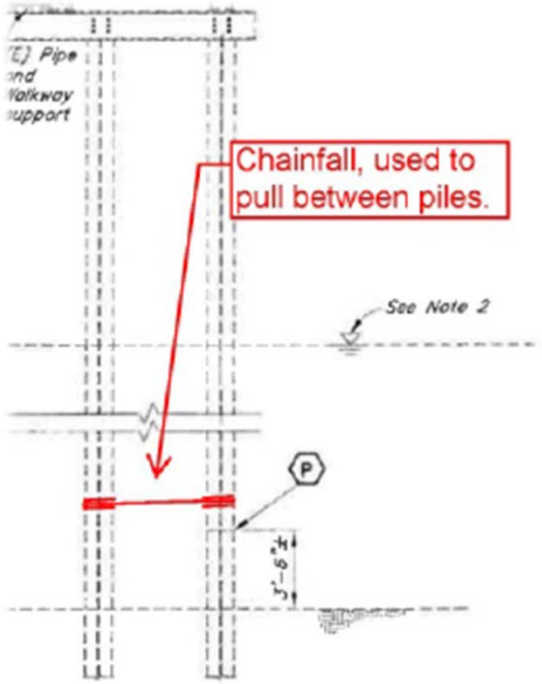
Complications

- Description
  - Rods not bowed/bent
  - Stabilizer Plate “stub” bent ⇒ Cause?
  - Incorrect hole location? ⇒ Project Failure?

- Proposed Solutions
  - Install larger stabilizer plate ⇒ Pile Shift?
  - Transverse pile jacking ⇒ Pile Damage?
    ⇒ Adjacent Pile Splice?

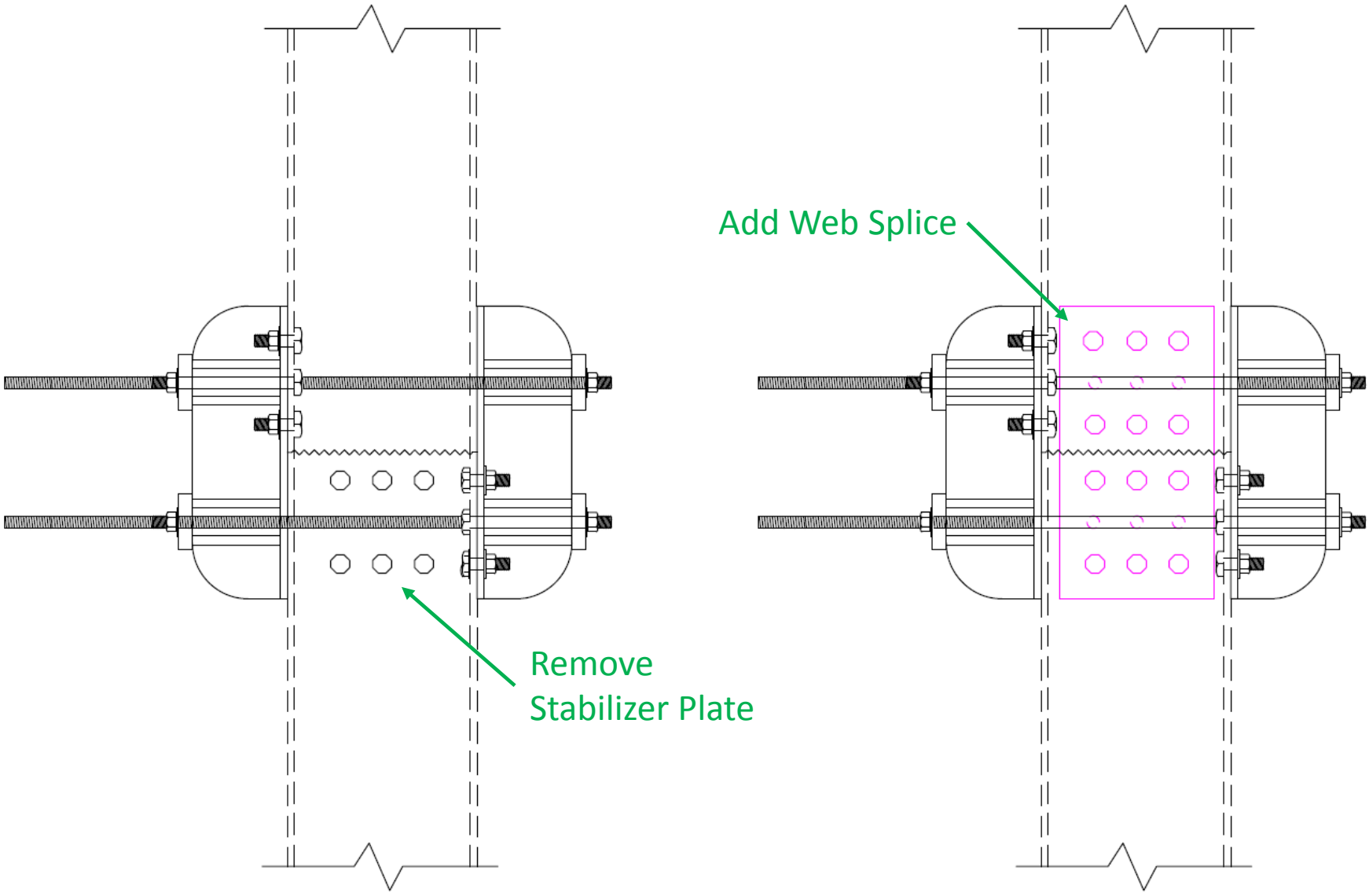
Solution

- Loosen threaded rods
- Tighten in reverse star pattern
- Chain as last resort
  - Avoid Pile Damage

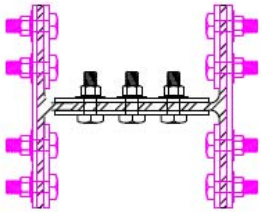


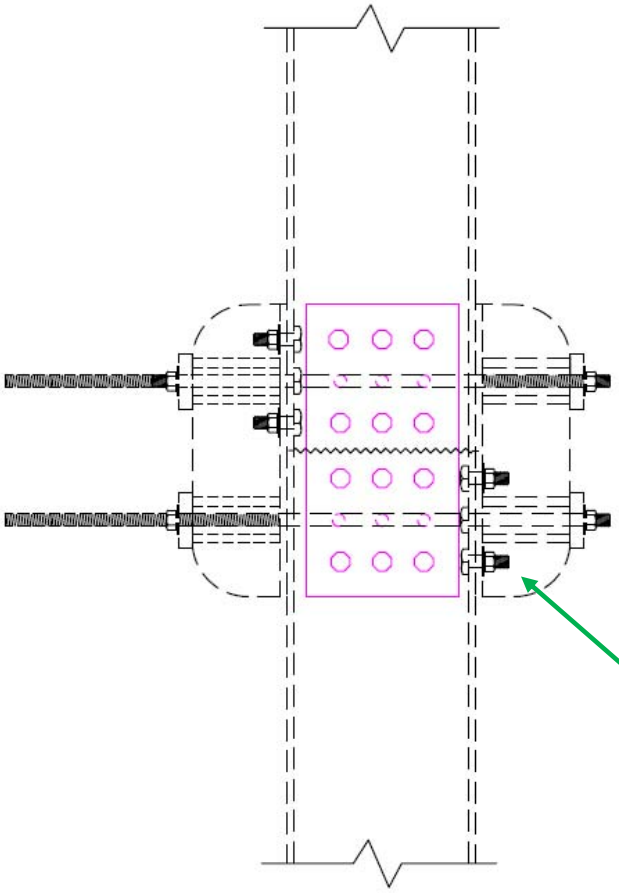
⇒ Loosening Realigned Piles

⇒ No Further Problems


Add Web Splice
Remove
Stabilizer Plate


9055

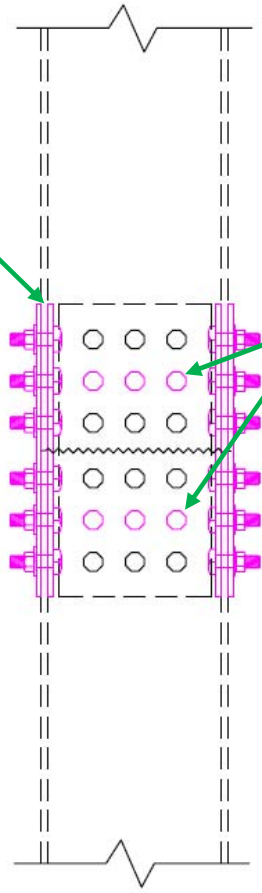




Remove Strongbacks

Add Flange Splices

Add Remaining Web Bolts




Front Face


Back Face

Flange Right Face

Final Inspection – 7/2016

- Design
  - Repair anywhere along the pile length
- Inspection
  - Investigate for signs of similar damage
  - Repair other locations
    - Paid for “by each”
  - No further damage found

Basic Bid		ENGINEER'S ESTIMATE		LOW BIDDER		BIDDER 2	
Item No.	*Description*						
Quantity	*Pay Unit*	*Unit Price*	*Amount*	*Unit Price*	*Amount*	*Unit Price*	*Amount*
504(1)	Structural Steel						
All Required	Lump Sum	L.S.	10,000.00	L.S.	8,640.00	L.S.	16,732.94
512(104)	Pile Repair						
1	Each	150,000.00	150,000.00	77,100.00	77,100.00	191,660.85	191,660.85
640(1)	Mobilization and Demobilization						
All Required	Lump Sum	L.S.	50,000.00	L.S.	56,000.00	L.S.	62,915.71
640(4)	Worker Meals and Lodging, or Per Diem						
All Required	Lump Sum	L.S.	50,000.00	L.S.	12,925.00	L.S.	20,773.08
641(108)	Pollution Control						
All Required	Lump Sum	L.S.	5,000.00	L.S.	5,076.00	L.S.	10,494.68
643(2)	Traffic Maintenance						
All Required	Lump Sum	L.S.	20,000.00	L.S.	17,132.00	L.S.	56,501.09
644(1)	Field Office						
All Required	Lump Sum	L.S.	10,000.00	L.S.	24,710.00	L.S.	5,318.25
644(6)	Vehicles						
All Required	Lump Sum	L.S.	5,000.00	L.S.	22,110.00	L.S.	21,774.19
652(1)	Interim Work Price Adjustment						
All Required	Contingent Sum	C.S.	0.00	C.S.	0.00	C.S.	0.00
Total Basic Bid							**386,170.79**

$300,000

Engineer's Estimate

$223,690

Low Bidder

Questions

Contacts

- Jared Levings, P.E., S.E.
  - Bridge Engineer
  - jared.levings@alaska.gov
  - 907-465-6945