Oregon's Approach to Timber Pile Repair

2016 PNW Bridge Maintenance Conference

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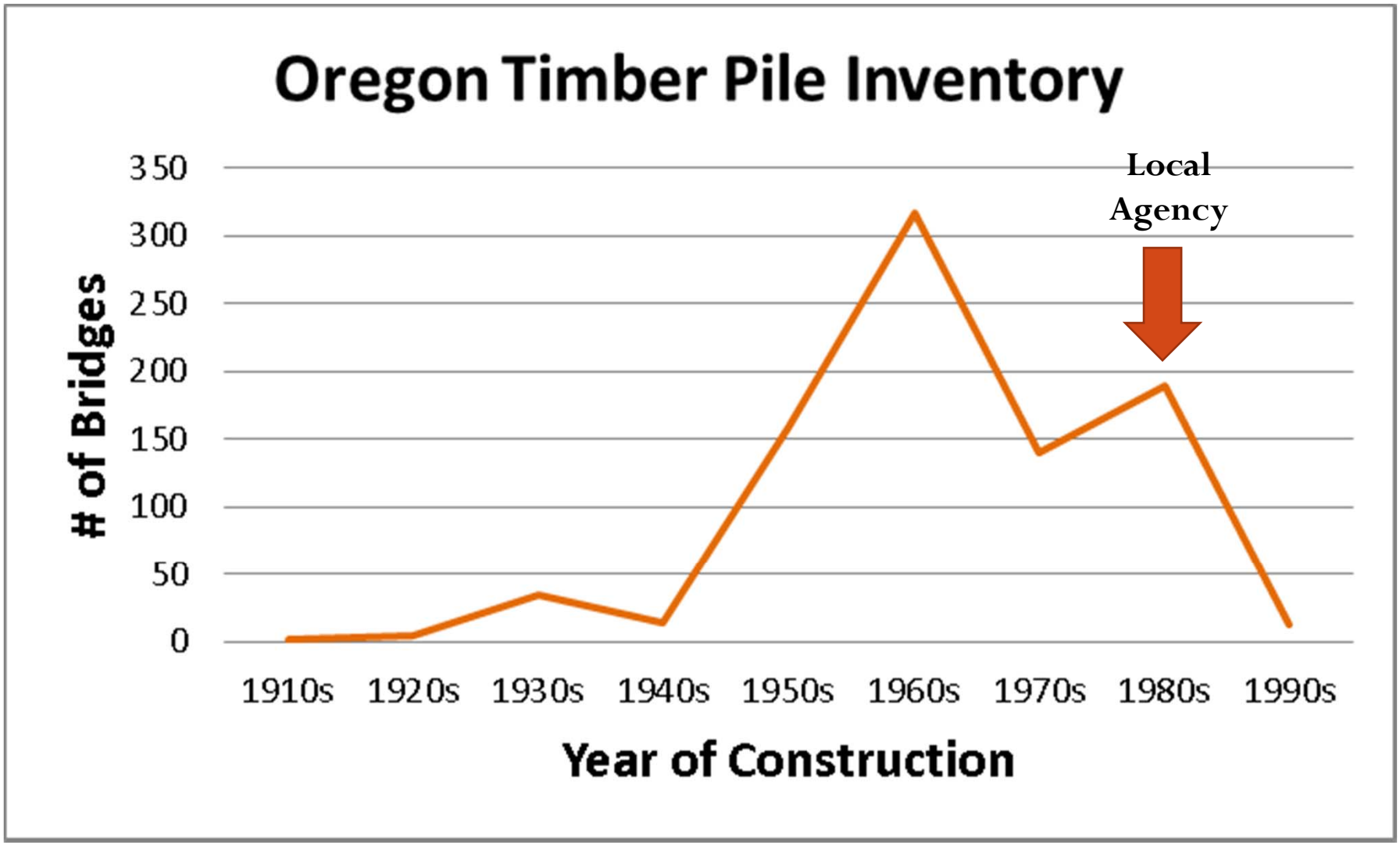
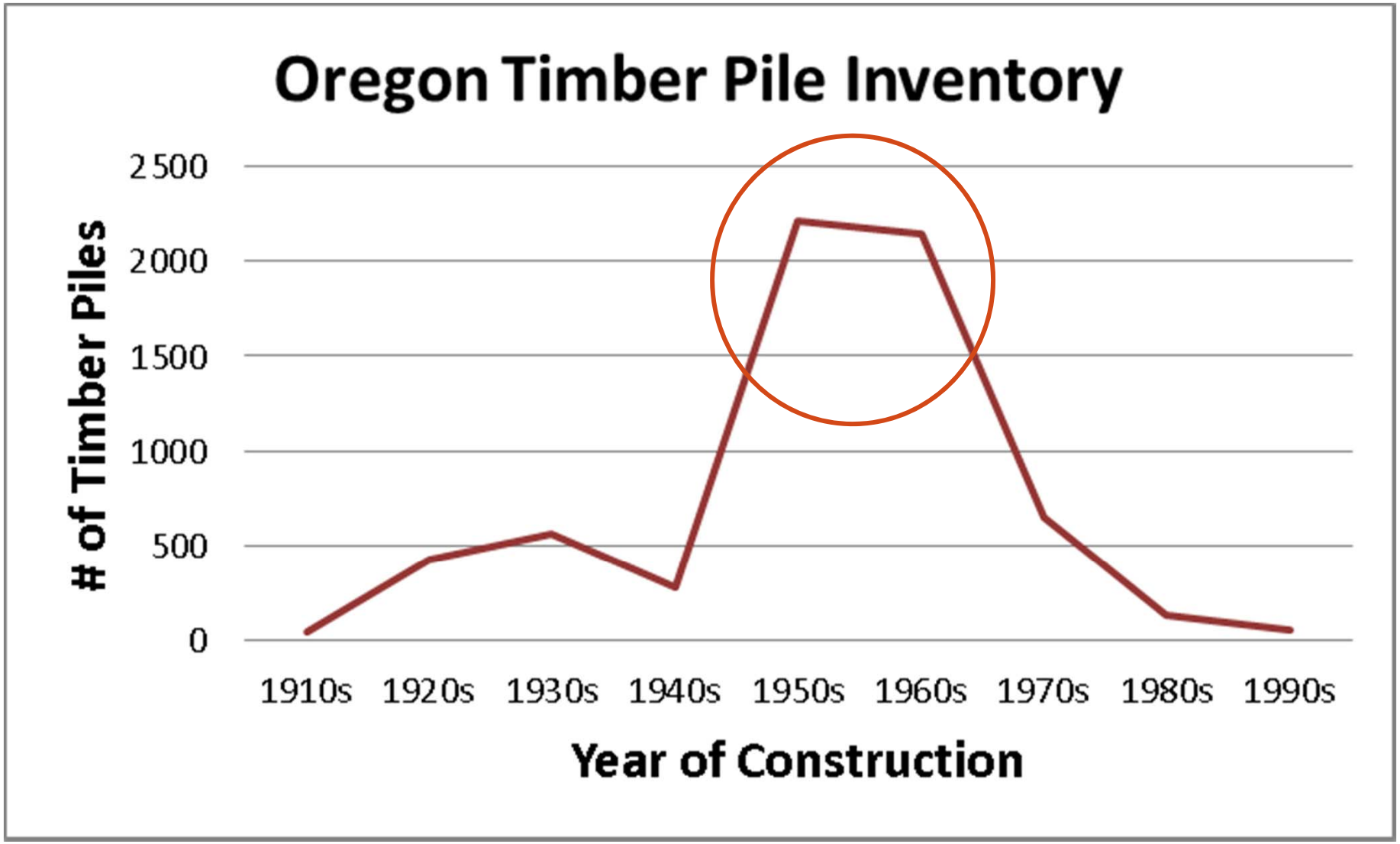
Overview

- Background on timber pile inventory.
- Previous pile repair standard.
- Development and Destructive Testing.
- In field installation of repair.

Timber Pile Inventory

- Oregon has 874 bridges with exposed timber piling.
  - 296 are state owned.
  - 578 are local agency.
- Most were constructed between the 1950's and 1980's, but the range goes from 1906 to 1996.
- Local agency bridges account for the majority of these built during the 1970's and 1980s.


Oregon Timber Pile Inventory
# of Bridges
350
300
250
200
150
100
50
0
Local Agency
1910s
1920s
1930s
1940s
1950s
1960s
1970s
1980s
1990s
Year of Construction


Oregon Timber Pile Inventory
# of Timber Piles
2500
2000
1500
1000
500
0
1910s
1920s
1930s
1940s
1950s
1960s
1970s
1980s
1990s
Year of Construction

Annual Timber Repair Costs

- Over the last 5 years (2012-2016):
  - 100 Major Bridge Maintenance Projects
  - Total Cost of $4.3 Million
  - Accounts for 10% of major bridge maintenance budget

South Yamhill Bridge:

South Yamhill Bridge

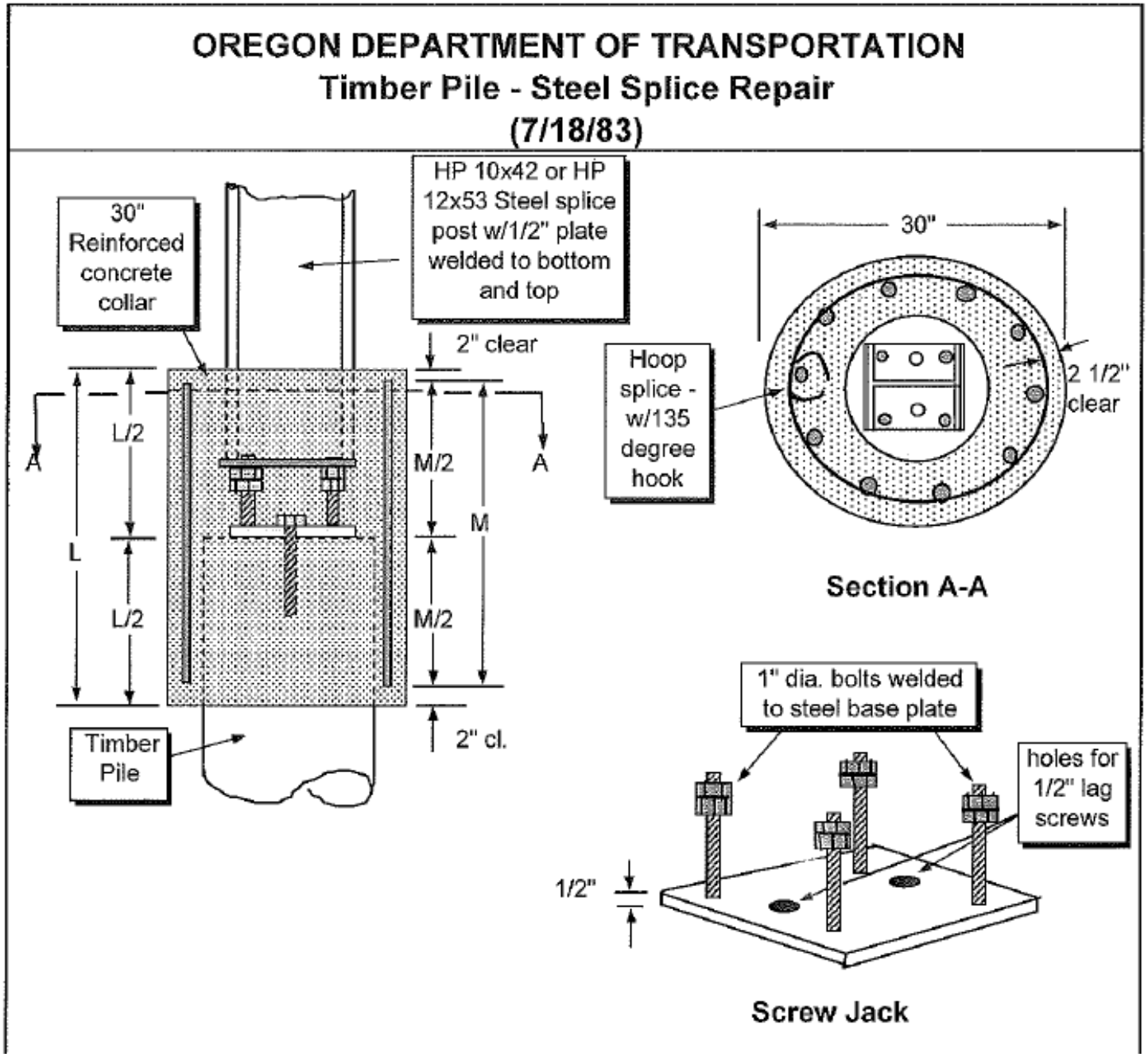
- Built in 1951.
- Located in Willamette Valley.
- Reinforced Concrete Deck Girder on Timber Pile Trestles.
- 990 ft. in length.
- 34 Timber Bents.
- 204 timber piles (As constructed).
- Estimated cost of replacement = $35 Million.

Replacing bridges 1-piece at a time

- 85 of the original 204 timber piles have been repaired.
- The remaining 119 are just waiting their turn.

Previous Standard Pile Repair

- Splice new steel H-Pile to existing timber with reinforced concrete collar.
- Standard detail provided in 1983.
- Make splice at 100% solid timber section.
- Concrete splice has a 30" diameter and is 4' in length.
- Uses 10 #6 reinforcing bars w/ #5 hoops @ 6" spacing.

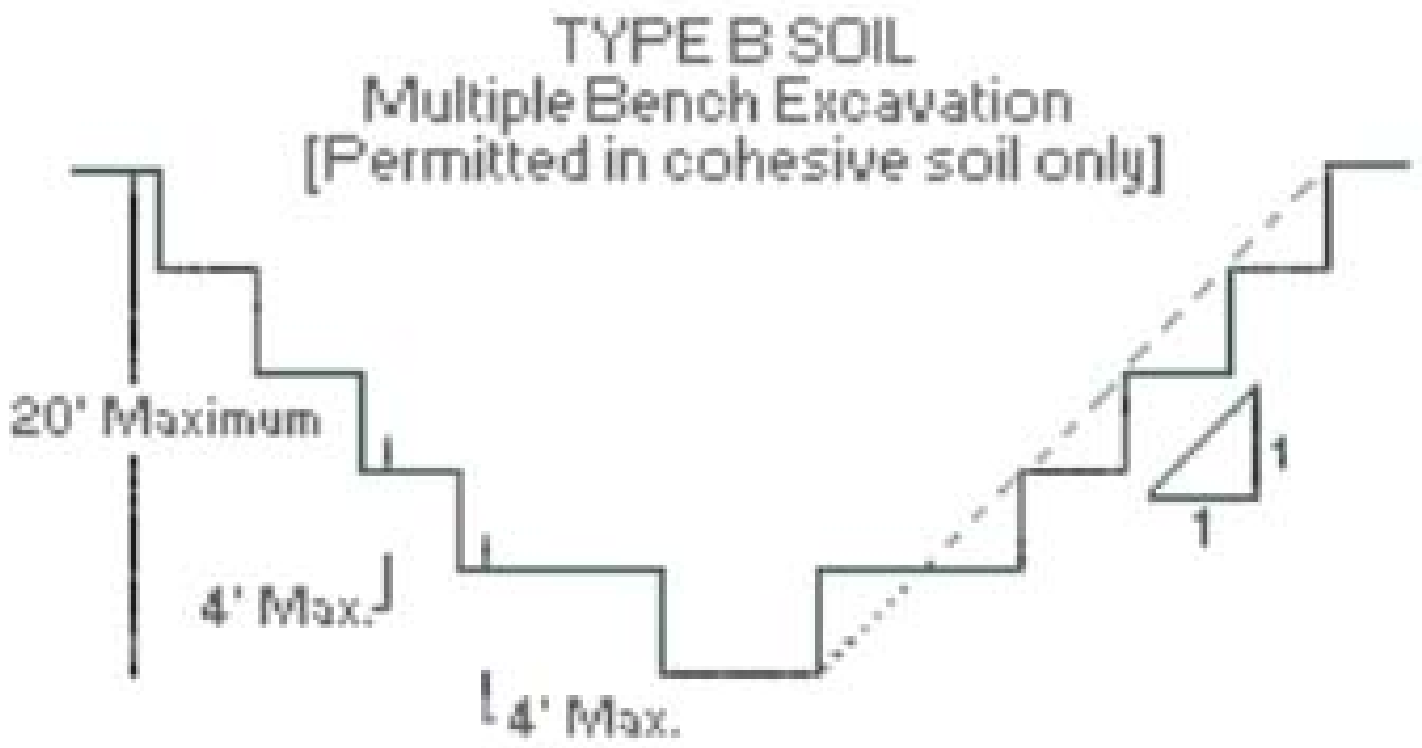

OREGON DEPARTMENT OF TRANSPORTATION
Timber Pile - Steel Splice Repair
(7/18/83)
30" Reinforced concrete collar
HP 10x42 or HP 12x53 Steel splice post w/1/2" plate welded to bottom and top
2" clear
A
A
L/2
L
L/2
M/2
M
M/2
2" cl.
Timber Pile
30"
Hoop splice - w/135 degree hook
2 1/2" clear
Section A-A
1" dia. bolts welded to steel base plate
holes for 1/2" lag screws
1/2"
Screw Jack

Drawbacks

- Difficult to install in tight spaces (abutments)
- Steel cage difficult to stage.

Drawbacks

- Required excavation to continue at least 2’ deeper than rot.
- If rot extended more than 2’ below ground level then shoring or benching excavation was required.



New Pile Repair Wish List

- Avoid the reinforced concrete splice.
- Reduce the required splice length.
- Reduce depth of excavation. (Splice at a section with less than 100% solid timber x-section).
- Use hydraulic jack to preload the pile instead the screw jacks.

Proposed Pile Repair Method

- Replace reinforced concrete collar with oversized steel pipe pile grouted to timber pile.
- Allow splice at a location with less than 100% solid timber section.
- Auger out remaining rotten timber pile core and fill cavity with high early strength concrete.

How much rot is too much to repair?

Timber Pile Splice Testing

- ODOT contracted with Oregon State University to destructively test pile splice detail.
- 6 piles in total were tested; 3 flexure and 3 compression.
- Rot was simulated to varying depths:
  - 2 feet
  - 3 feet
  - 4 feet

OSU
Oregon State
UNIVERSITY

14” dia. piles previously in-service

Removed material to leave 2” solid shell.

When auger isn't deep enough…

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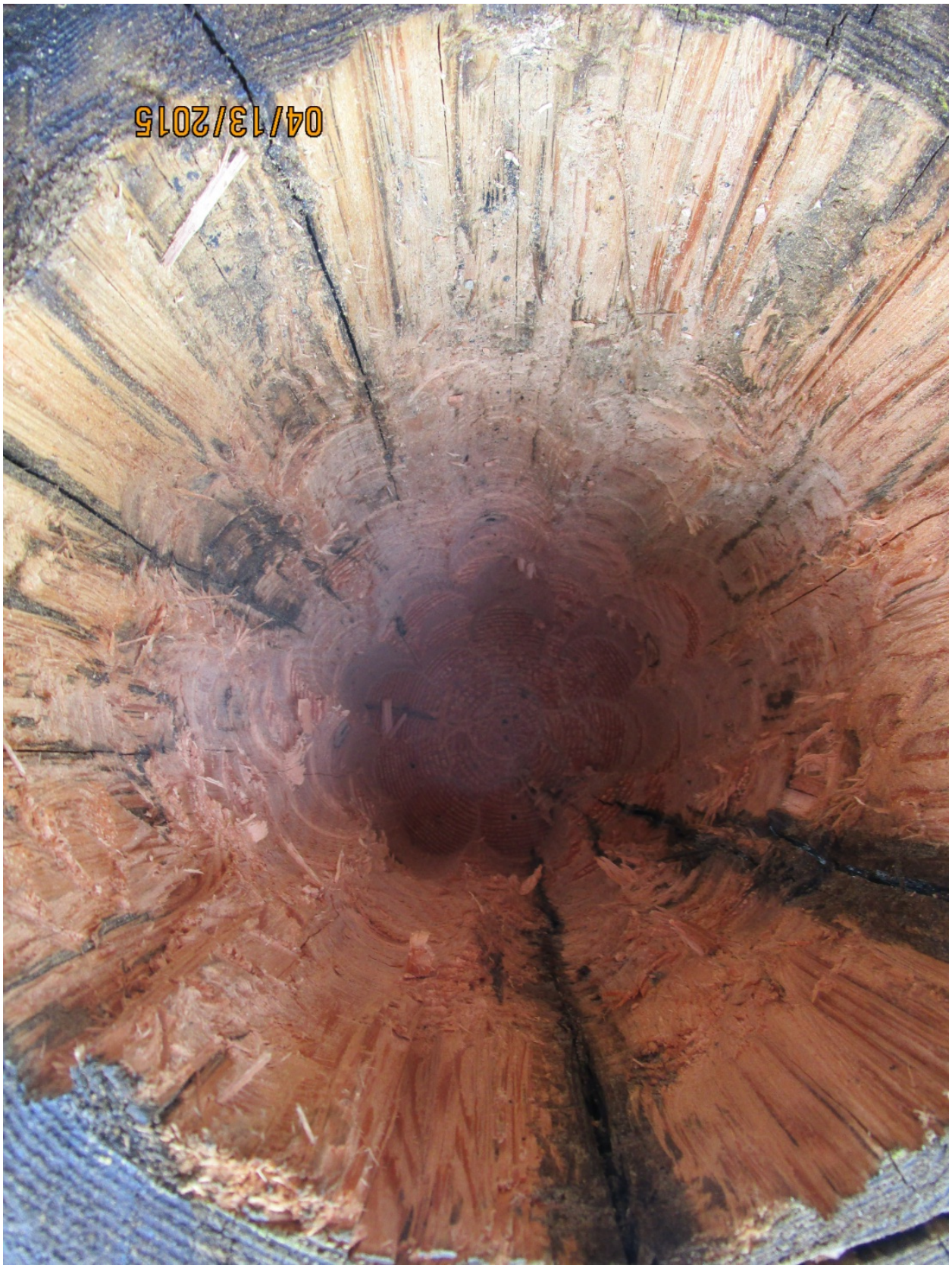
STIHL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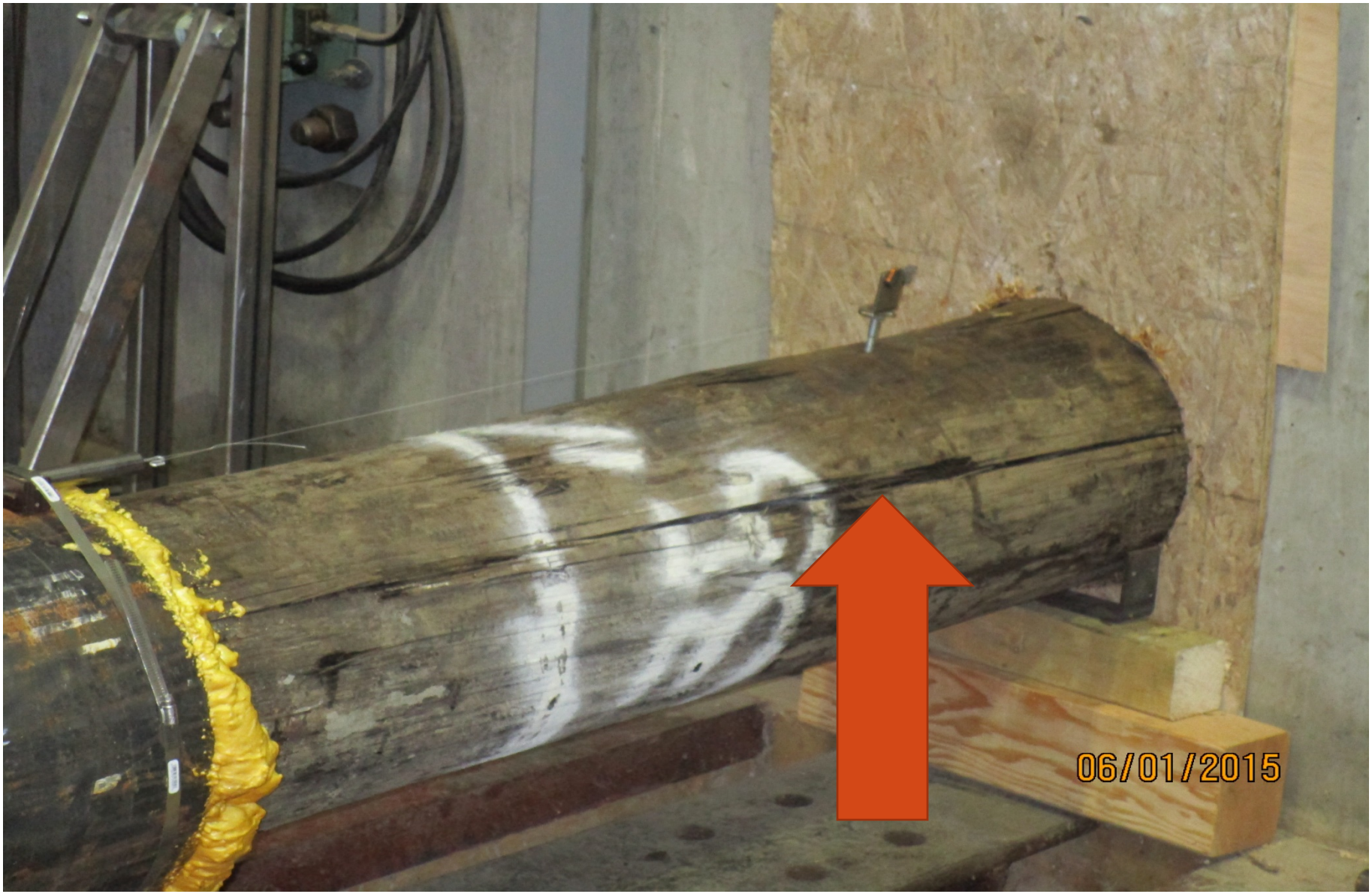
Compression Test

- 13”-14” diameter piles with 2” core.
- 8’ in length.
- Steel pipe pile Circular HSS 16”x 3/8” (ASTM A500 Gr B)
- Goal was to determine how the pile fails around the spliced area.
- Test used 150 ton jack.

Compression Test Setup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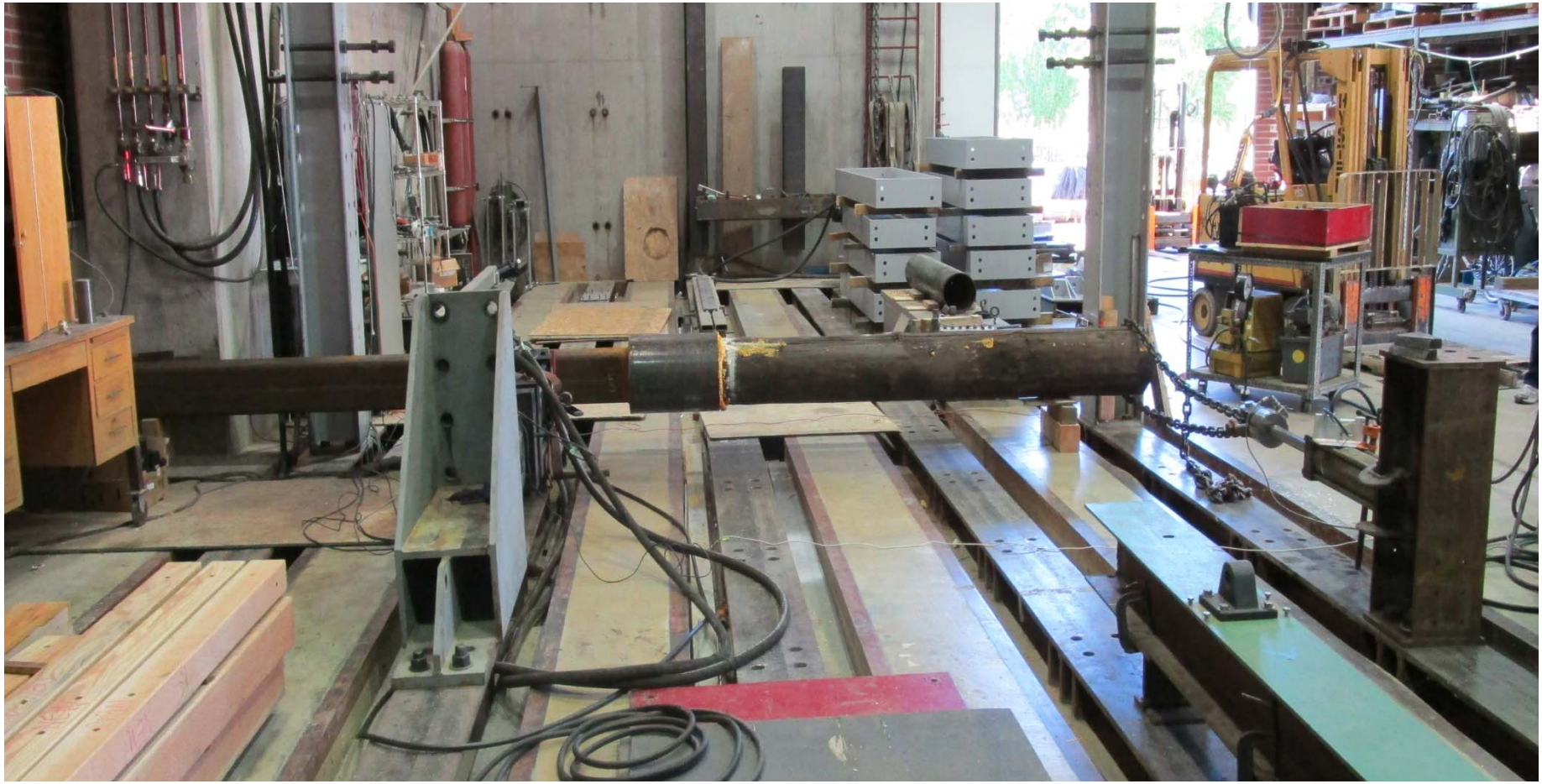
Compression Test Results:

- The jack wasn't big enough!

- No piles failed at maximum load of 300,000 lbs.

Lateral Test Setup

Lateral Test Setup



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Bending Test Results

- All three failed at the base of the splice.
- Loading at failure was about what you'd expect for an unrepaired pile with 2" shell.
- Load remained about constant through 12" – 24 " of deflection

Testing Summary:

- New pile repair can be used to fully restore axial capacity for short columns.
- Lateral demand and remaining capacity should be evaluated as part of repair plan.
- May need to add some bracing depending on application, or make the splice at a section with no rot.

Step 1: Install shoring as required by jacking plan

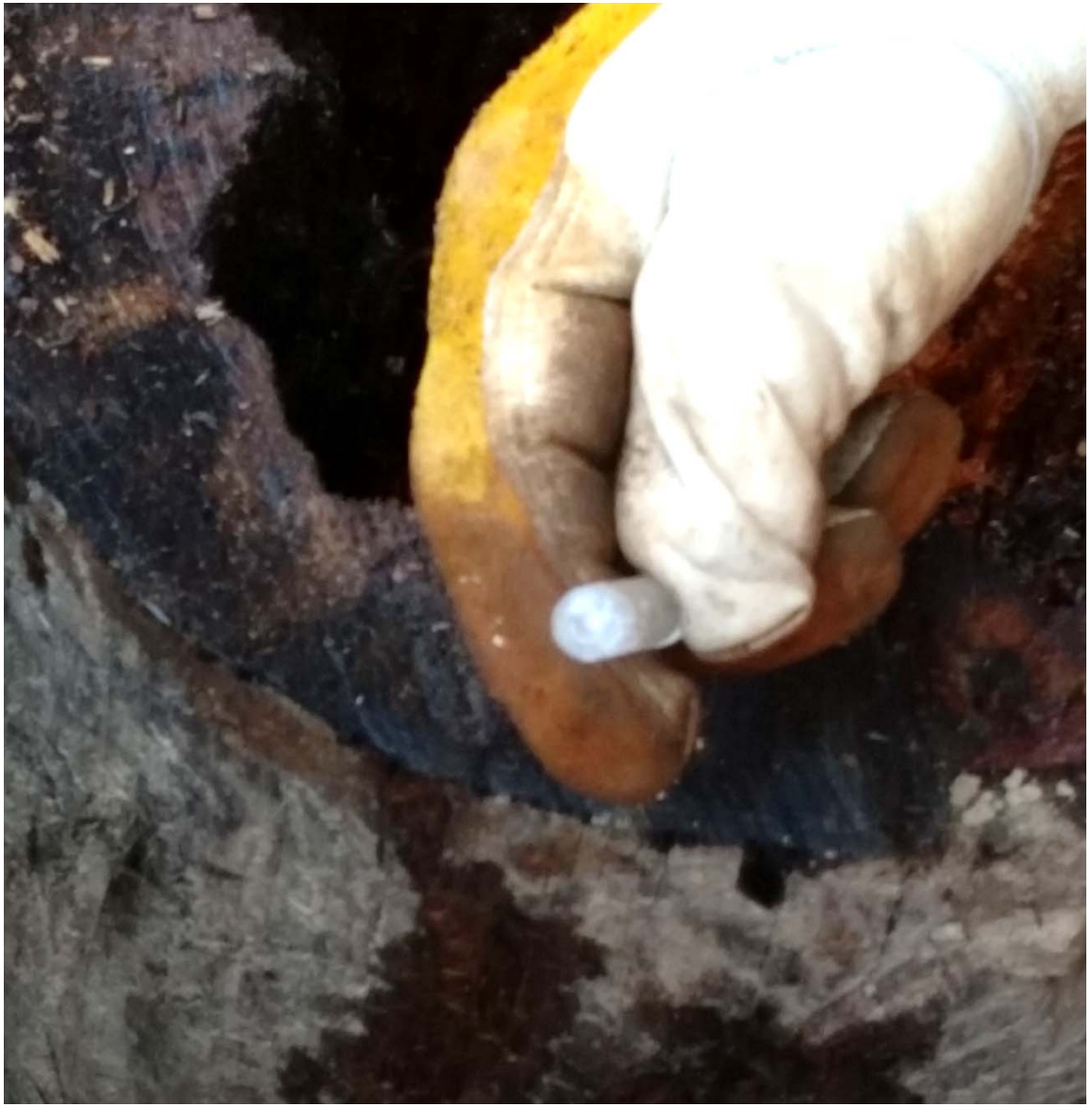
Step 2: Excavate 2’ below Ground Line

Step 3: Cut out section of rotted pile

Step 4: Remove remaining rotten core

Clean out the hole

Step 5: Install borate rods or other preservative

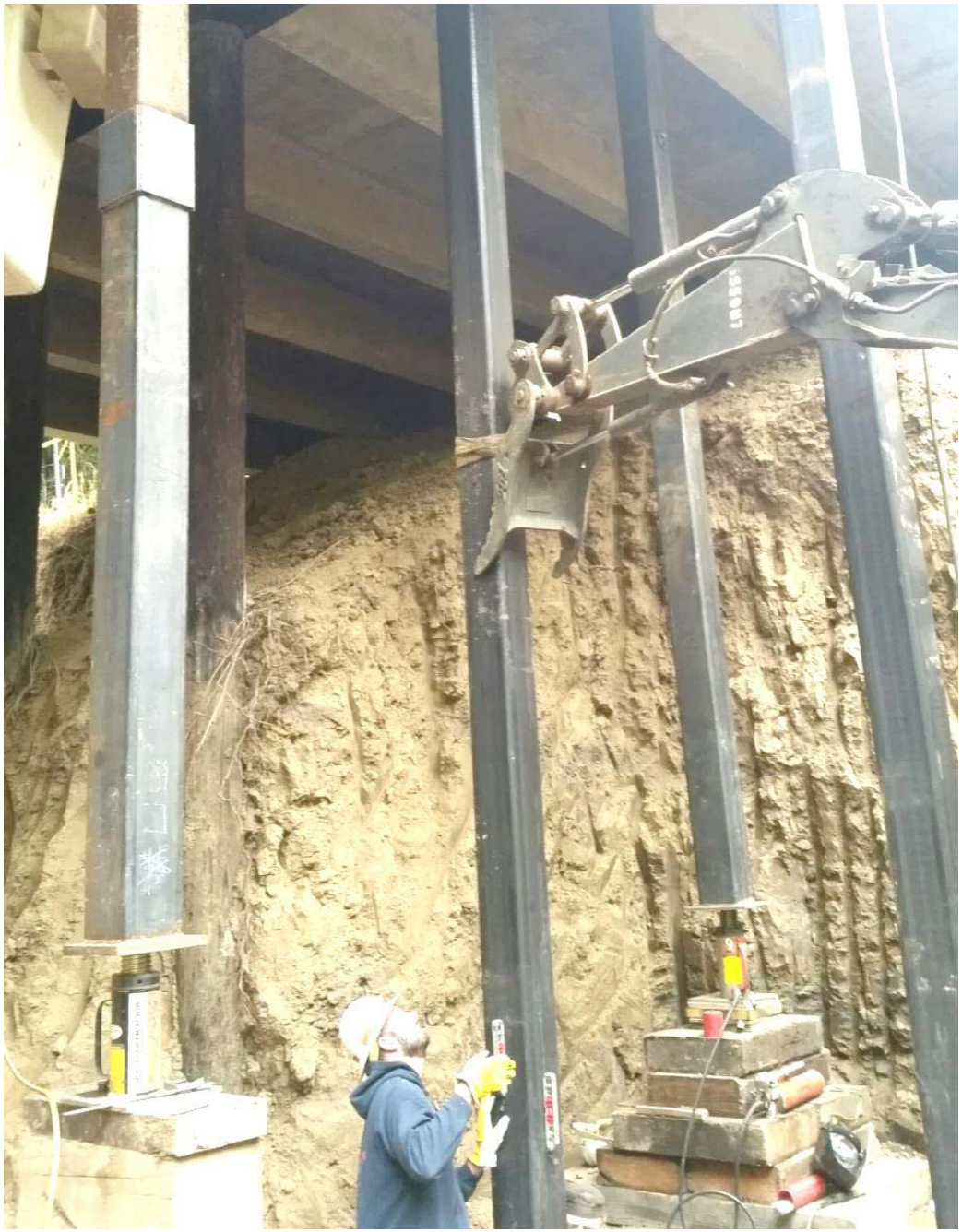


Step 6: Fill cavity with high early strength concrete.

Step 7: Weld cover plate in place

Step 8: Use vent holes to finish pour

Step 9: Position Steel Pile.



Step 10: Preload with 20 ton hydraulic jack

Step 11: Cut shims to fit and weld in place

Welding Channel and Plate Shims

Completed Splice

Step 12: Back fill to existing ground level

Modifications: “Dumbbell Repair”

Modifications: “Square post”

Questions

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