



Timber Substructure Repairs

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NATIONAL BRIDGE PRESERVATION PARTNERSHIP CONFERENCE 2018

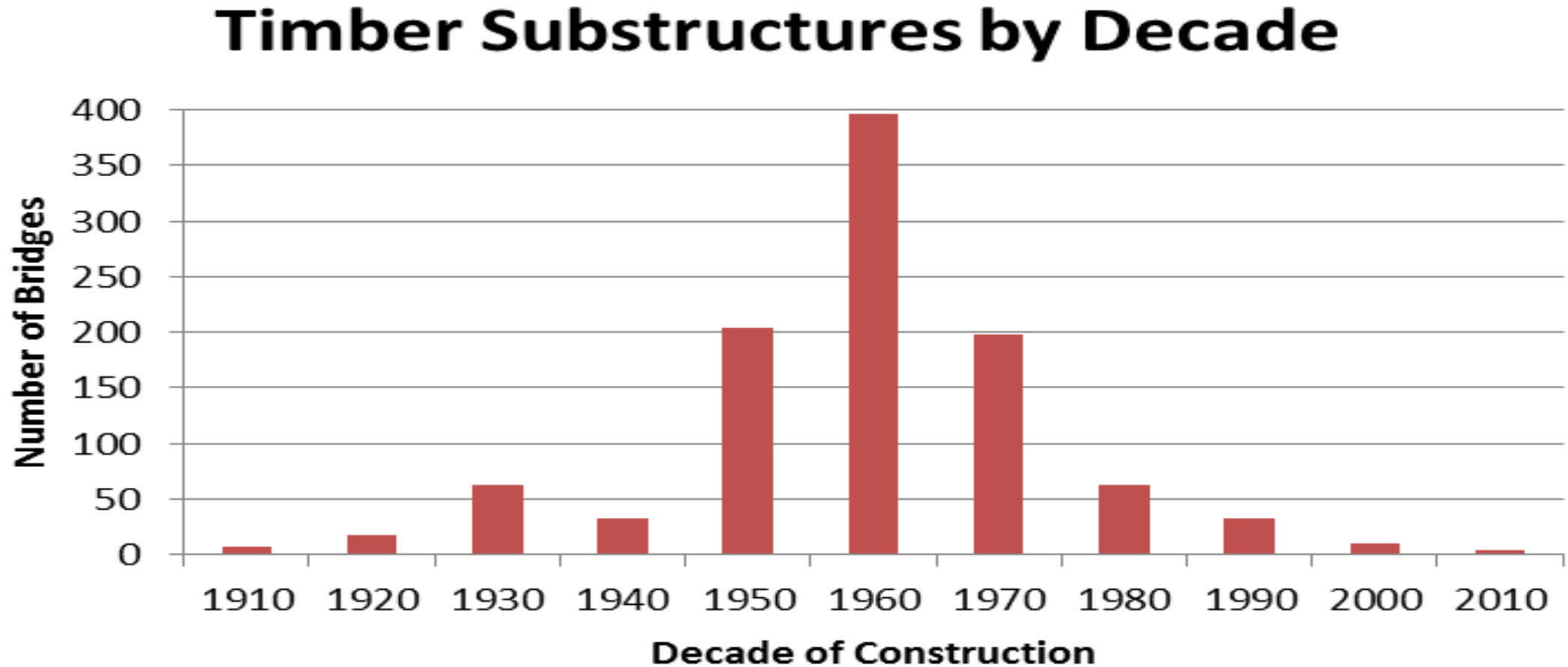
PRACTICES WE CAN NOT AFFORD TO DEFER

Overview

- Background on timber substructure inventory.
- Timber Pile Repairs
- Timber Cap Repairs

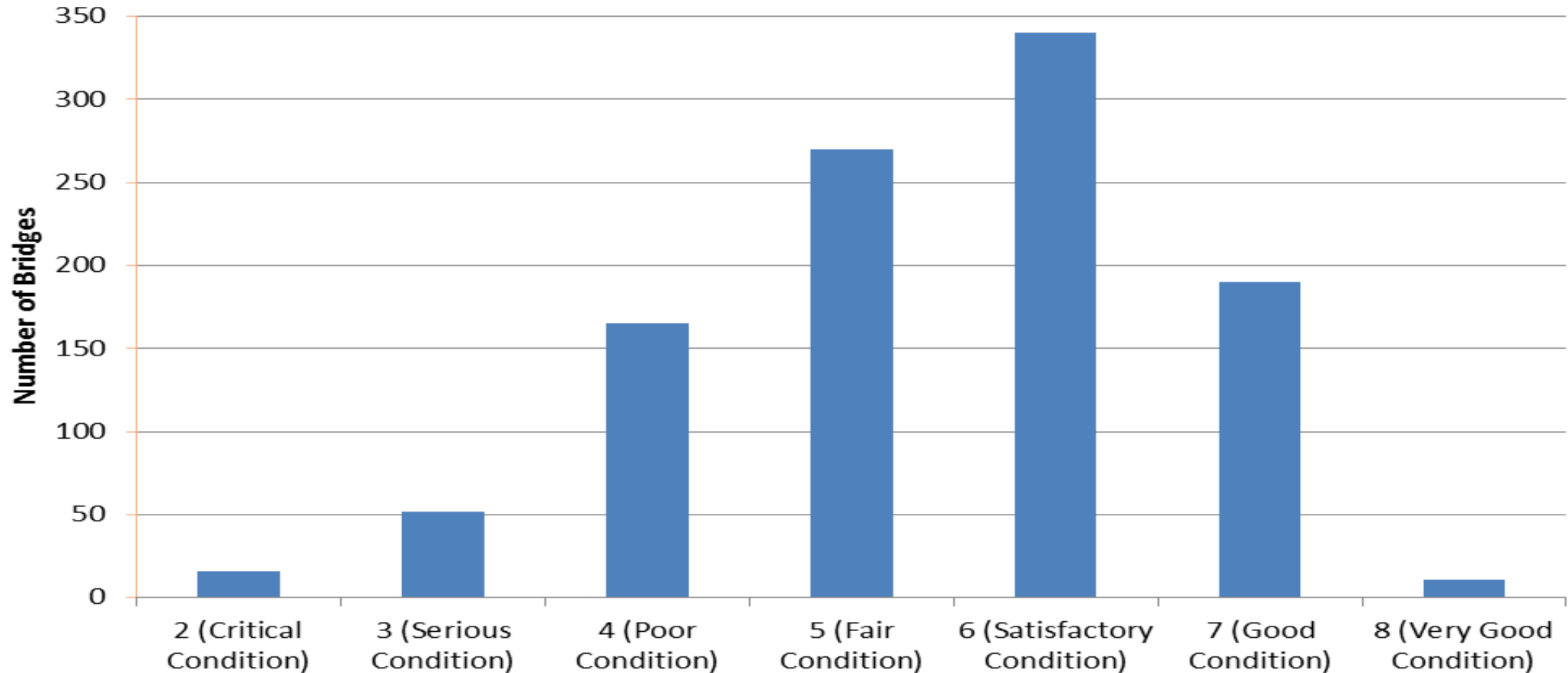


547 BRIDGES ARE MORE THAN 50 YEARS OLD!

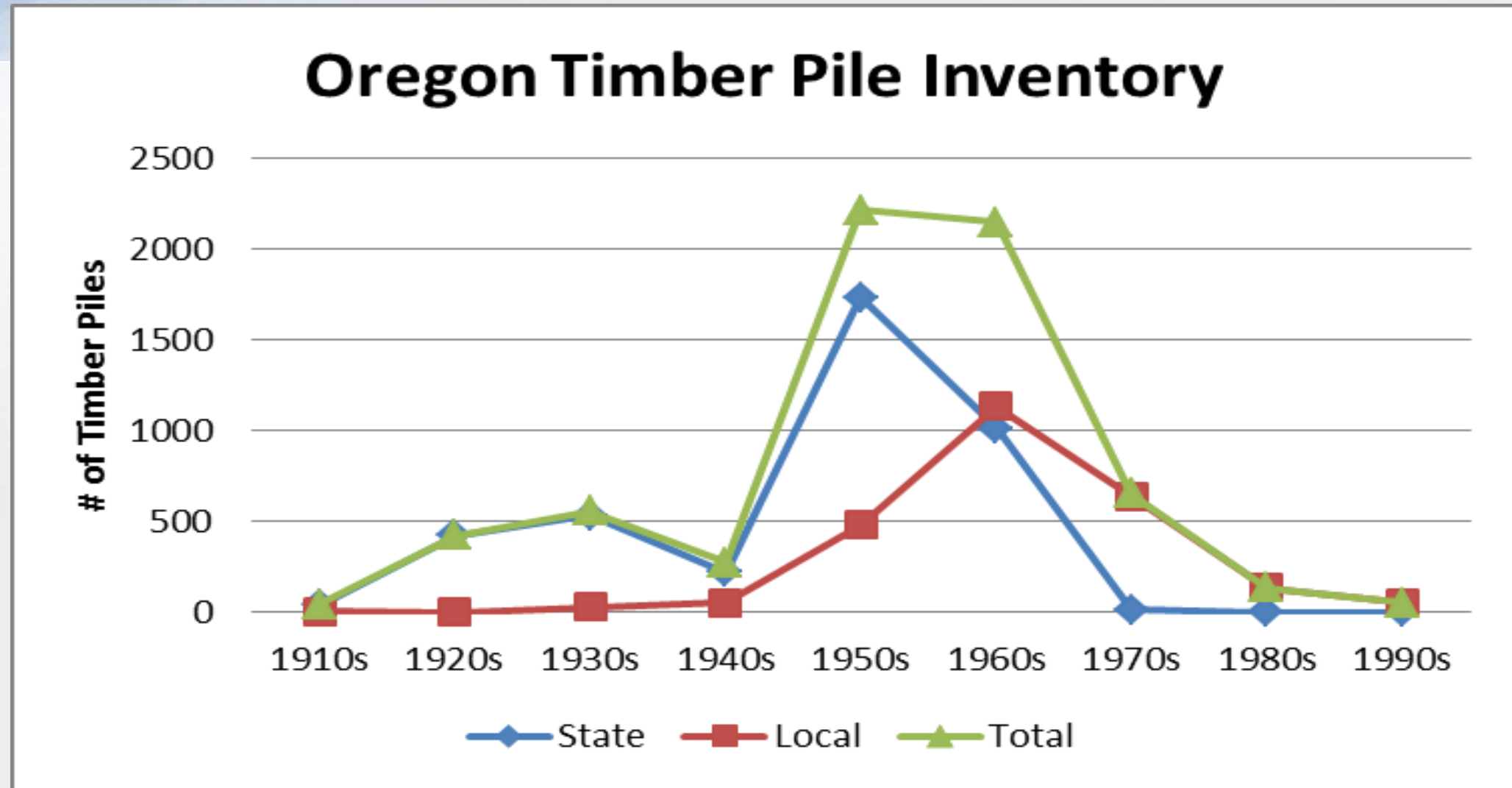


233 Bridges with SD Substructures

Timber Substructure Condition Ratings



5,600 PILES ARE MORE THAN 50 YEARS OLD!



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

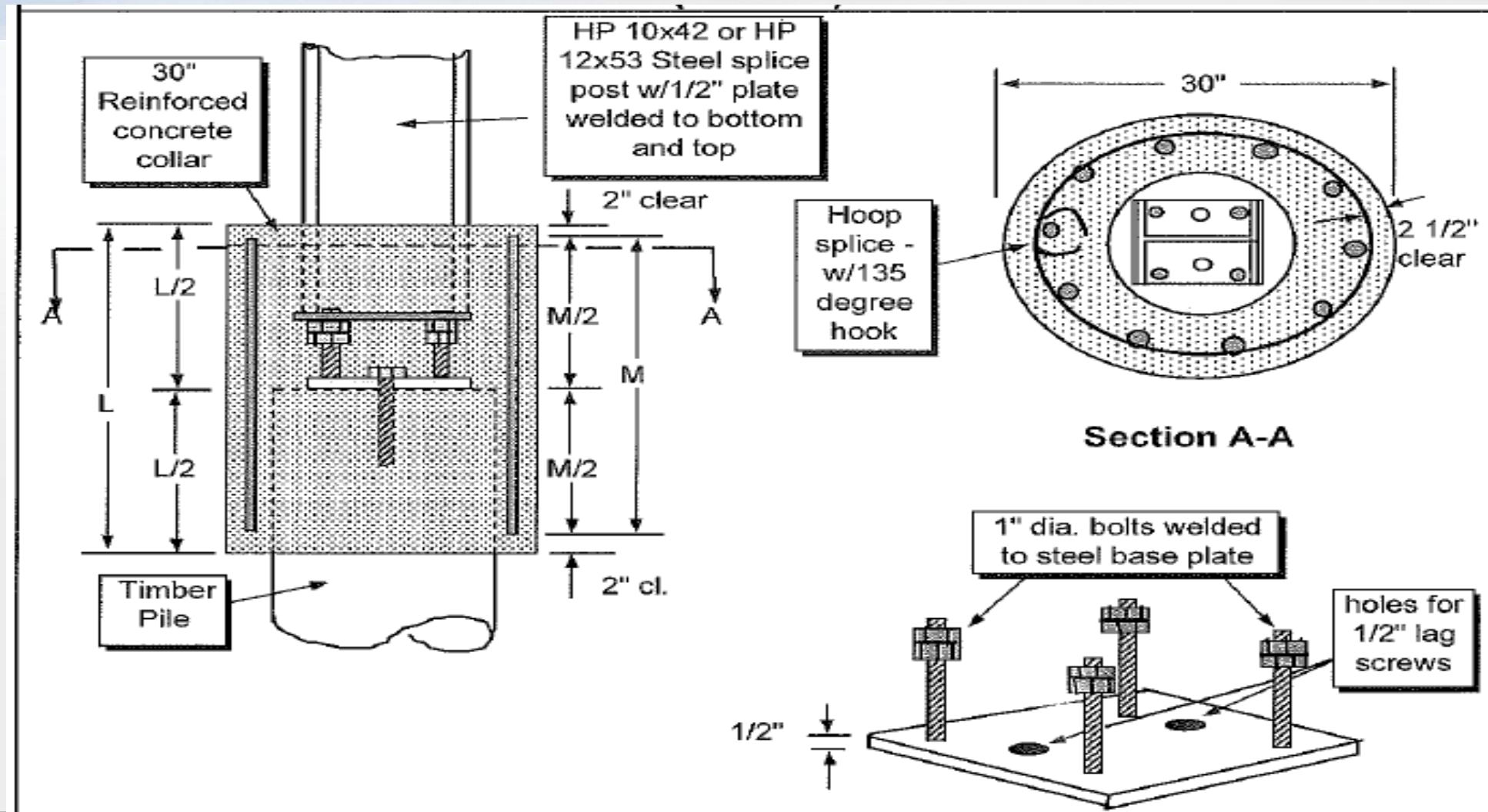
- 85 of the original 204 timber piles have been repaired.
- 16 of the Original 34 Timber caps have been replaced.



Timber Pile Repair Options:

- Drive new piles.
- Install a spread footing
- FRP Wrap and Epoxy Injection
- Encapsulation
- Posting

Previous Posting Detail:



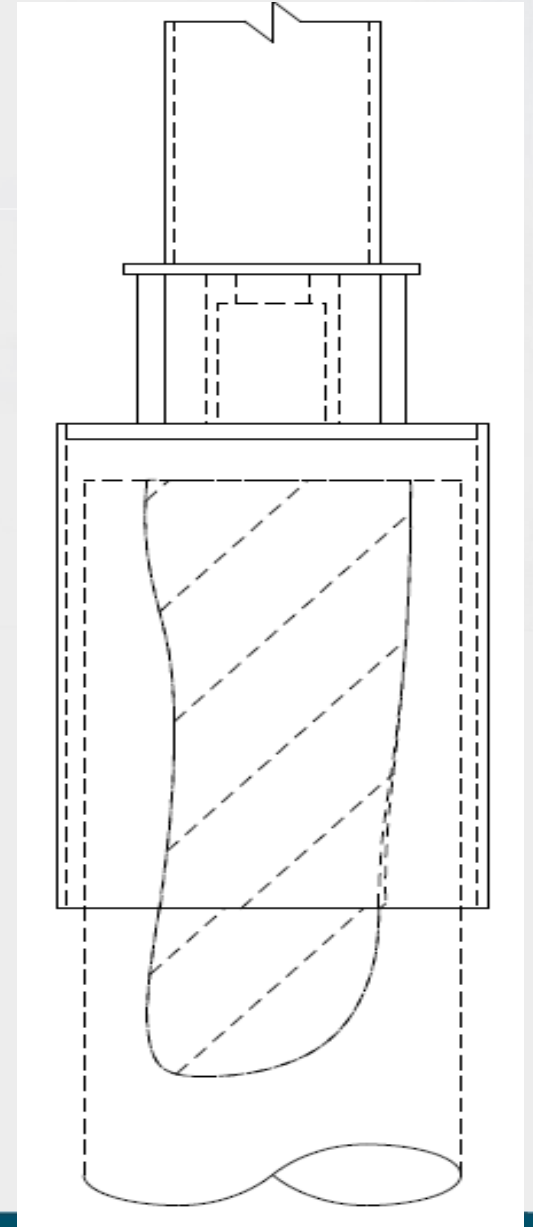
Drawbacks

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



New Pile Repair Method

- Limits excavation depths by reducing splice length and allowing splices at locations with 2" shells.
- Replaces reinforced concrete splice with steel casing.
- Preloading done by hydraulic jack for pile dead load control.
- Design was destructively tested by OSU.



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



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





Completed Splice



Step 12: Back fill
to existing ground
level



Modifications: “Dumbbell Repair”



Modifications: "Square post"



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



Compression Test Setup







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



Typical Lateral Test Failure



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

Pile Repair Cost Data

- Pile Repair completed in 1 day.
 - Project takes 2 days with shoring and excavation.
- Typical plan set requires 3 sheets.
- \$10,000 dollars for PE
- \$20,000 for construction
- Cost per pile ~ \$30,000.

Timber Cap Repairs:



Timber Cap Repair Options:

- Encapsulate with steel.



- Remove and Replace



- Epoxy Injection?





- Cutting Pile Off to install splice.





08/05/2015



- Installing channel shims to connect steel cap to pile splice.



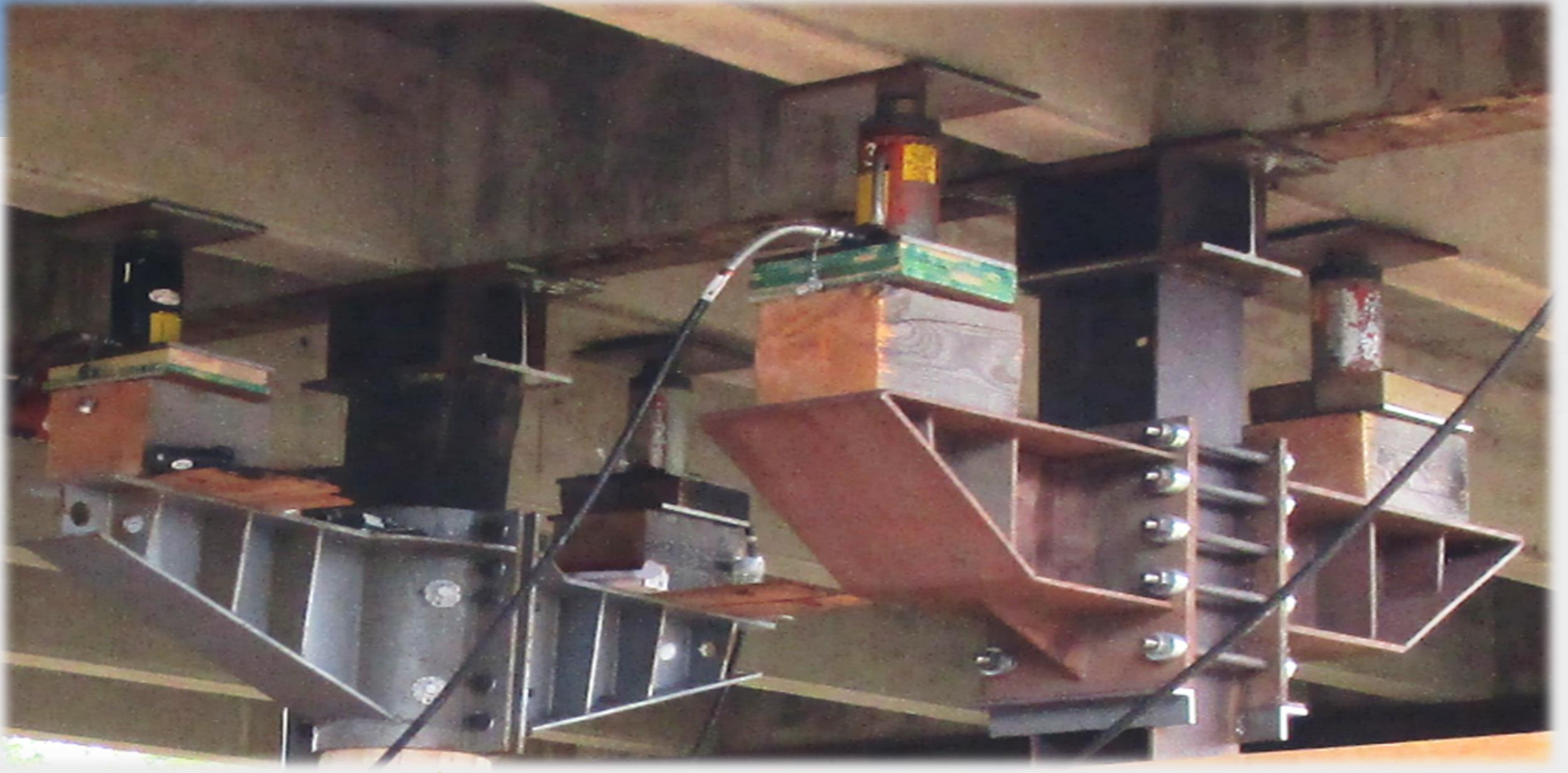
Timber Cap Replacements

- Timber member usually replaced with Steel H Beam of similar size.
- Requires shoring the structure while old cap is removed and new cap is installed.



Pile Clamps

- Use to jack and shore the superstructure during pile cap repairs.
- They have been in heavy use by ODOT bridge crews and Local Agency bridge crews.
- Crews had clamps fabricated to fit on square piles also.
- Bridge is typically left open to all traffic throughout the project.
- First used in 1980's?
- Video of replacement available on YouTube.



Replacing cap with pile clamps



Replacing cap with pile clamps



Jacking from the Ground



Epoxy Injection?

- Repair in place.
- Some caps don't function like beams but instead were used for construction and now act as a spacer between pile and girder.



Lets try it...

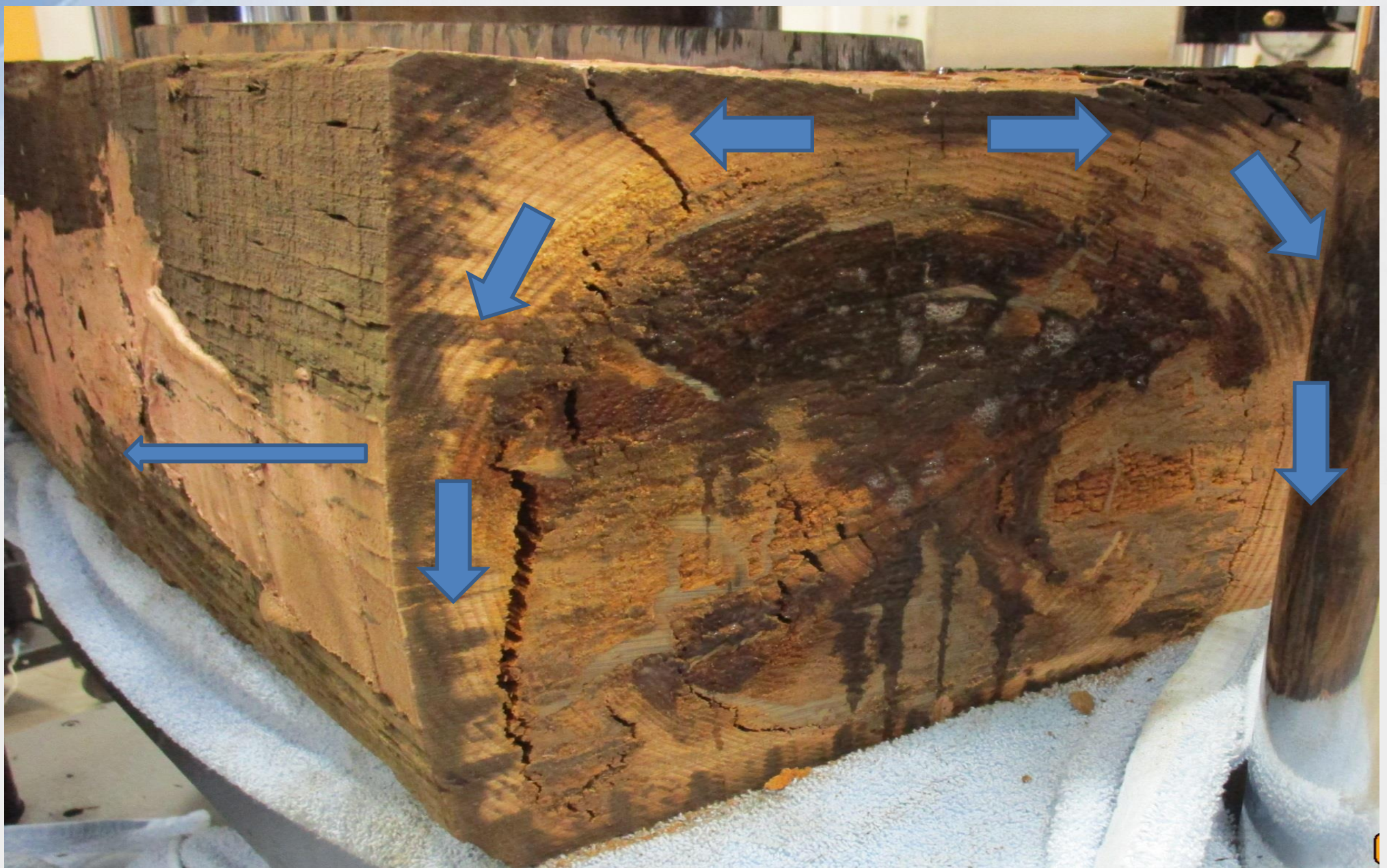




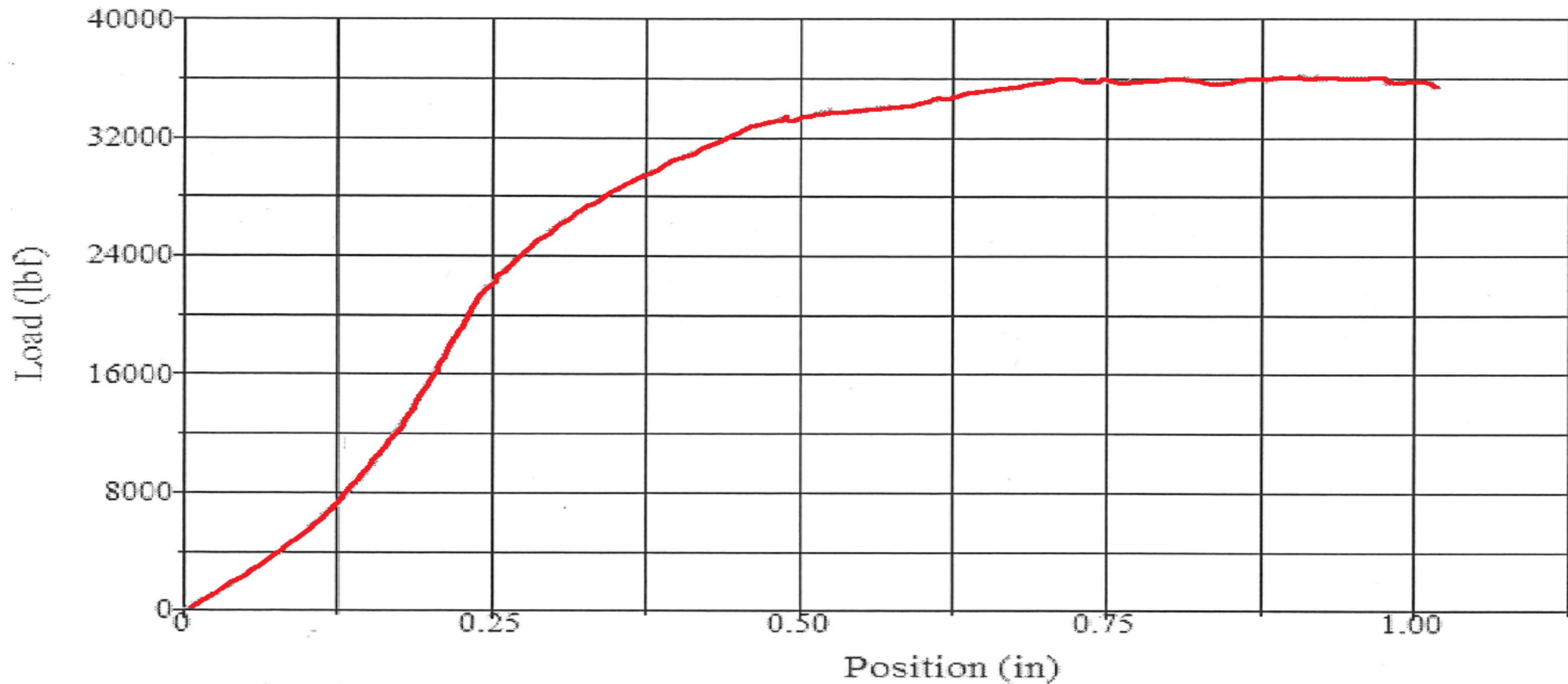




09/25/2017



Destructive Testing Results



Cap Repair Summary:

- Encapsulation:
 - Useful when utilities or shoring constraints make full removal problematic.
 - \$50,000 - \$80,000.
 - Connection to piles can be difficult.
 - Not feasible on abutments.
- Cap Replacement:
 - \$25,000 - \$65,000
 - Shoring dominates design constraints and overall cost.
- Epoxy Injection:
 - Not recommended at this time as a viable cap repair.

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Questions

