Timber Piling Repair and Rehabilitation Techniques

International Conference on Timber Bridges

October 2, 2013

Motivation

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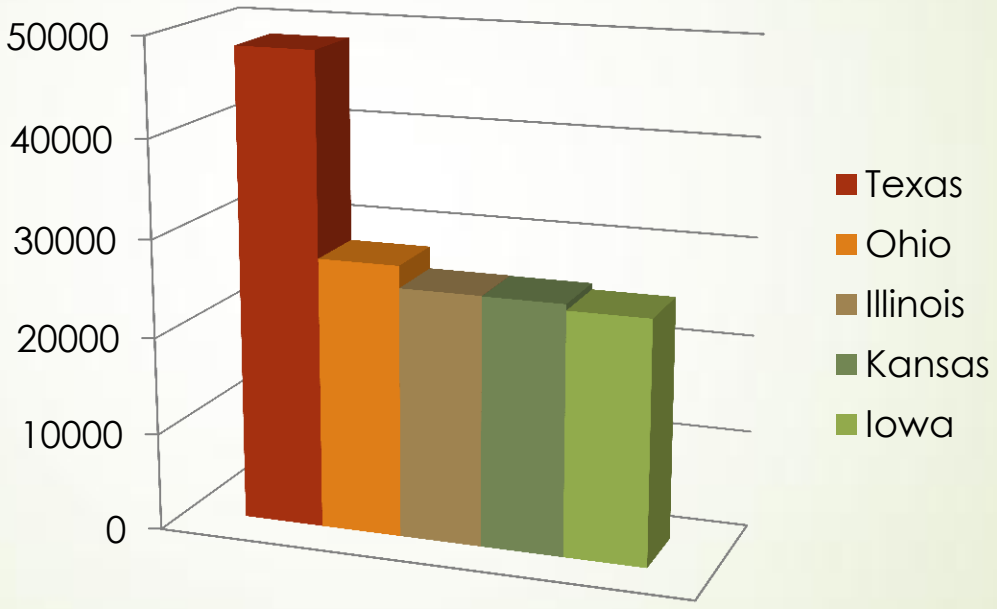

Iowa ranks number 5 in total number of bridges

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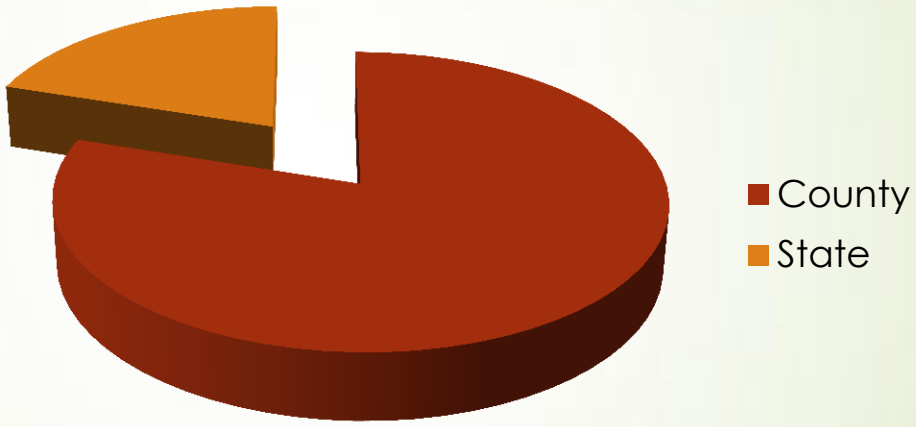

80% of Iowa's nearly 25,000 bridges are on low volume roads and, thus, the responsibility of county engineers

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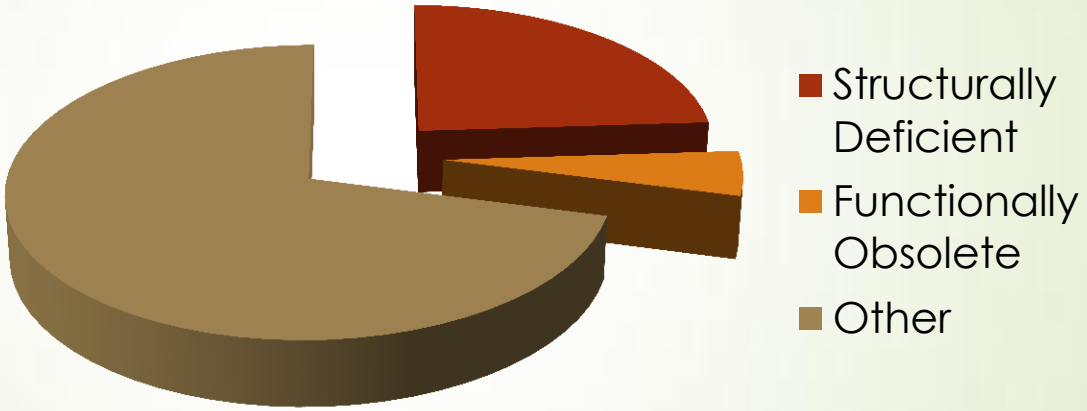

Nearly 1/3 are considered structurally deficient or functionally obsolete

Motivation

- Large number built on timber piling
- Significant number structurally deficient because of substructure condition

Proposed Solution

Repair and rehabilitate timber substructure elements of those bridges with sound superstructures

- Several counties have implemented various techniques
- Minimal data documenting the effectiveness of these techniques

Research Objectives

- Review existing products for timber preservation and repair
- Review methods used by engineers to repair and restore load carrying capacity of piling
- Determine/develop effective methods for transferring bridge loads through the failed portions piles
- Determine that safe load capacity is restored by the repair methods (existing or new) determined to be structurally efficient

Timber Preservation

Iowa Field Observation

- A large percentage of timber bridge components in Iowa are preserved with creosote
  - Abutment piles located away from stream channel found to last 60 to 70 years
  - Piles located in stream channel or moist areas generally expected to last 40 to 50 years
  - Elements not in contact with the ground were found to last 50 years or more
- Only a few constructed with non-creosote preserved timber
  - Pentachlorophenol and copper naphthenate treated bridges were too few and too new to determine longevity trends

Iowa Field Observation

- Member protection contributed to the longevity of bridge components regardless of the preservative treatment
  - Treated elements previously field-cut generally had less decay than untreated cut members
  - Numerous older bridges used bituminous coatings on cut or damaged areas
  - Interior girders typically in better condition than exterior girders
  - Piles and cap beams with metal or felt covers typically found to be in better condition than those without

Pile Maintenance and Rehabilitation

Pile Maintenance

- Preventative maintenance
  - Deterioration has not started, but the conditions or potential are present
- Remedial maintenance
  - Deterioration is present but the capacity or performance of the structure is not affected
- Major maintenance
  - Significant deterioration is present and immediate corrective measures to restore the structure to original condition are required

State of Practice

- When asked to describe remedial and/or strengthening measures to repair or restore the load carrying capacity of a pile, the following answers were provided:
  - Driving new piles adjacent to or near rotten piles
  - Posting
  - Concrete encasement
  - Performing remedial preservative treatment

Rehabilitation Methods

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Rehabilitation Methods

Field Testing

Field Testing

- Corrugated metal pipe used as concrete form to encapsulate deteriorated timber pile

Field Testing

- New piles placed adjacent to existing
- All piles cast in concrete at pile/ground interface

Field Testing

- Abutment piles and backwall encapsulated by additional planking and concrete infill

Field Testing

- Steel H-pile section posted on remaining original pile

New Strengthening Systems

New Strengthening Systems

- Control specimens were loaded in axial compression
- All reached a maximum stress of at least 3100 psi

New Strengthening Systems

- Steel H-pile section and base plate
- Steel angles lagged to existing timber pile
- Threaded rod with leveling nuts attached to angles and base plate

New Strengthening Systems

- Steel "sisters" attached to timber pile above and below the simulated decay with threaded thru-rods

Conclusions

- Thousands of structurally deficient county-level timber bridges in the state of Iowa could potentially be upgraded if only substructure elements are rehabilitated
- Constructible and cost effective methods exist for restoring the strength to decayed and damaged piles and back walls
- New technologies and improvements to existing strengthening methods are being identified through field and lab testing

Thank You