Lindberg Bridge Project

Presented at 99th Annual Purdue Road School | March 2013
LINDBERG BRIDGE DESIGN

PARTNERS

• Tippecanoe County
• City of West Lafayette
• American Structurepoint, Inc.
• Cardno ATC
• Jack Isom Construction Co., Inc.
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PRESENTATION SUMMARY

- Project Background
- The Problems
- Possible Solutions
- Final Bridge Design
- Bridge Construction
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PROJECT BACKGROUND

• Lindberg Road was constructed in 2001-2002 as a federal-aid project
• The owners received many complaints and public criticisms of the outcome
• The Celery Bog is a popular destination
• The City and County were collectively looking for a solution
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THE PROBLEMS
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THE PROBLEMS

- Roadway was constructed on poor soils
- Contractor proposed redesign
- Limits of poor soils not completely identified
- Geogrid was not used as the redesign proposed
- Roadbed settled around the auger-cast piles

ADD THE CAVIAT THAT WE DID NOT PERFORM A FORENSIC INVESTIGATION, CONCLUSIONS ARE BASED UPON OBSERVATIONS
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THE PROBLEMS
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THE PROBLEMS

• 18”-diameter auger-cast piles of various lengths
• Geogrid over the sub-base and pile tops
• Thick aggregate sub-grade
• HMA pavement
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POSSIBLE SOLUTIONS

- Resurface the existing facility with HMA, periodically
- Develop a structural roadbed using the existing auger-cast piles
- Construct a bridge to span the poor soils
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POSSIBLE SOLUTIONS

• Short term costs
  – Bridge option most expensive
  – Resurfacing option least expensive
  – Bridge option longest to construct
  – Resurfacing option shortest to construct
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POSSIBLE SOLUTIONS

• Risk and long-term costs
  – Resurfacing
    • Highest risk
    • Periodic road construction along Lindberg Road
    • Does not fix the problem
  – Structural roadbed on existing auger cast piles
    • Mid-level risk
  – New bridge construction
    • Lowest risk level
    • Lowest long-term costs
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FINAL BRIDGE DESIGN
## LINDBERG BRIDGE DESIGN

### FINAL BRIDGE DESIGN

- Structure size and type
- Thermal expansion
- Substructure design with existing piles
- Context-sensitive solution
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FINAL BRIDGE DESIGN

• Bridge length
  – Must span poor soils
  – Total length = 1450’

• Span lengths
  – Single row of piles
  – Pier locations must avoid existing piles
  – Equal span lengths
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- Bridge layout
  - Type II AASHTO girders
  - 30 spans
  - 48’ and 49’ spans
  - Open pile bent caps (interior piers)
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- Expansion joint
  - Joint type
  - Number of joints
  - Location of the joint
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• Single modular expansion joint near the center of the superstructure to facilitate 8” of thermal movement
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• Bearing design
  – Options investigated
    • Fixed piers
      – Expansion end bents
      – Allow piers to move in soft soils
      – Soils must be investigated to verify they can allow for large expansion
    • Expansion piers
      – Integral end bents with battered piles
      – Stainless steel sliding plate on elastomeric bearing pad
      – PTFE bearing assembly is more expensive (290 required)
  – Solution
    • Soils found to be too stiff for pier expansion
    • Expansion piers are the only viable option
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• Plan to avoid pile conflicts
  – As-built plans
  – Pile locations superimposed onto the topographic survey drawings
  – Surveyors stake the proposed pier locations
  – Two separate field investigations to verify existing piles locations
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• Pile conflicts unavoidable
  – Piles not constructed as planned
  – Design piers to avoid stopping operations and causing change orders
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• Pier design
  – Two designs
    • Piers within limits of existing piles
    • Piers outside limits of existing piles
  – Piers outside limits of existing piles
    • Length = 40'-9", Width = 3'-9", Thickness = 3'-0" minimum
    • Pile spacing = beam spacing = 8'-9"
    • Cap overhang = 2'-10½"
    • Minimum cap reinforcement
  – Piers within limits of existing piles
    • Dimensions same as piers outside limits of existing piles
    • Cap reinforcing designed to allow for:
      – 10' pile spacing
      – 3' distance from beam reaction on cap overhang to nearest pile
    • Maximum nominal soil resistance specified
    • Special provision created
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[Diagram of bridge design]
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• Special provision for piers within limits of existing piles
  – Remove soil and expose existing piles
  – Mark proposed pile locations
  – Engineer to measure and sketch the center of existing piles related to the proposed piles
  – Designer to revise pile layout

• All piers within limits of existing piles required pile layout revisions
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FINAL BRIDGE DESIGN

• Context-sensitive solutions
  – Trail system design
  – Wetland grasses used
  – Channel cut for wildlife passage
  – Low roadway vertical profile
  – Proximity of Birck Boilermaker Golf Complex
  – Time constraints
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BRIDGE CONSTRUCTION
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BRIDGE CONSTRUCTION

- Bid to Jack Isom Construction for $4,285,932
- $77 per sft including incidentals
- Design change to construct solid wall piers for speed of construction
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BRIDGE CONSTRUCTION