2015 T.H.E. Conference

Short Span Bridge Design Alternatives

By: Jack Elston, P.E.,
Steve Megginson, P.E., S.E.

Illinois Department of Transportation

HLR

AGENDA

- Introduction
- Bridge Planning Alternatives
- Design Comparisons
- Summary

Introduction

Pragmatic Comparison of Rural Bridges 40 – 120 ft

- Precast Prestressed Concrete Deck Beams
- Cast-in-Place Concrete Slabs
- Concrete Slab on Steel Beams
- Concrete Slab on Precast Prestressed Girders
- Culverts / 3 Sided Structures <40 ft

Precast Prestressed Concrete Deck Beams

- Span Lengths: 40 ft to 100 ft
- Predominant on County & Township Inventories
- Quick Fabrication and Erection
- Salt and heavy loads deteriorate shear keys
- Concrete and HMA & A-3 overlays improve ride quality

Bridge Planning Alternatives

Cast-in-Place Concrete Slabs

- Max Span length ~ 45 ft
- Requires Piers in channel
- Thin superstructure depth
- Long life span / Low maintenance
- High labor costs - Regional

Concrete Slab on Steel Beams

- Single Span Lengths: 60 ft to 120 ft
- Weathering Steel / Integral Abutments
- Long Life Span and Low Maintenance
- Suitable for Rehabilitation/ Deck Replacement

Structural Steel Prices have remained competitive

Concrete Slab on Precast Prestressed Concrete Beams (PPCI)

- Single Span Lengths: 60 ft to 135 ft
- Long Life and Low Maintenance
- Less Competitive Than Steel: Span to Beam Depth Ratio

New PPC-IL Shapes planned for release

Box Culverts

- Single and Double Boxes are most cost effective
- Long Life and Low Maintenance
- Labor Intensive Construction
- Intrusive Instream Work

  & Permitting / Debris

Bridge Planning Alternatives

3 Sided Structures

- Provide quick construction and natural bottom
- Applications can be limited by foundation material
- Evaluate Scour Potential

Design Comparisons

Span Length

Life Expectancy

Construction Costs

Instream Work

Maintenance Needs

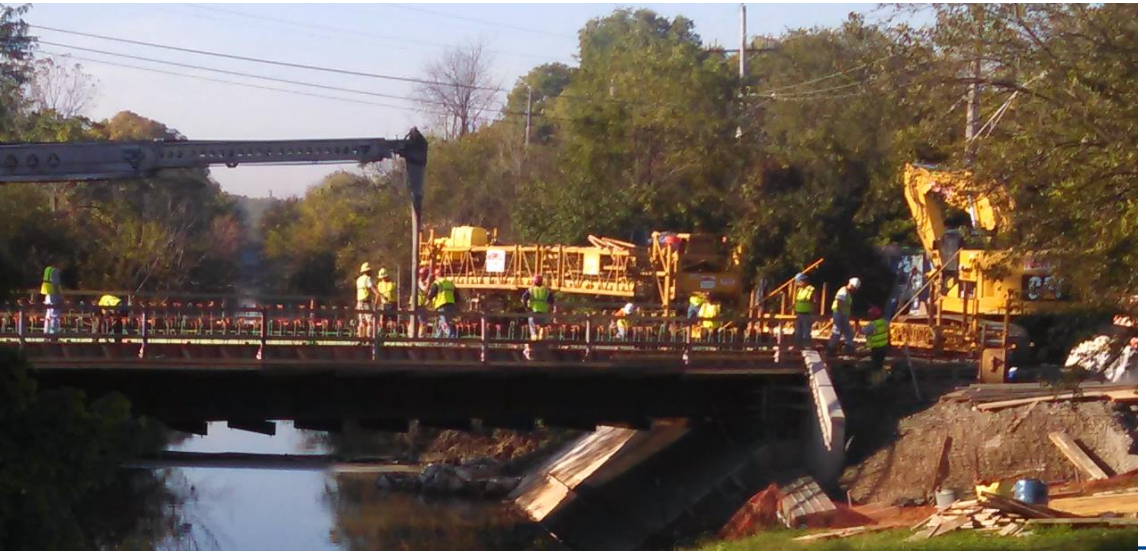
Determine Design Span Length

- Site Layout – Channel Width
- Highwater & Hydraulic Capacity
- Superstructure Construction Depth
- Set Approach Roadway Grade

Design Comparisons

Optimize Constructability

- Reduce Instream Work
- Allow Equipment Access to Superstructure
- Ensure Material Delivery & Logistics



- Reduce Closure Time
- Allow Future Rehabilitation
- Salt Usage?

Average Bridge Cost Comparisons

• CIP Concrete Slabs	3 span	154 $/sf
• PPC Deck Beams	3 span	165 $/sf
• PPC Deck Beams	Single span	149 $/sf
• Steel Beams	Single span	173 $/sf

2014 Lettings

Design Comparisons

Case Study: Long Span Structure options

Vermilion County, Township Bridge, 120 ft length

1)	Three Span PPC Deck Beam	$642,000
2)	Single Span PPC Deck Beam	$580,000
3)	Single Span Steel Beam	$653,000

Steel Beams provided longer expected life span

Low Maintenance, Clear of Debris

Design Comparisons

Case Study: Multiple Span Structure options

Fayette/ Shelby County, C.H. 14 Bridge, 225 ft Length

1) Three Span PPC Deck Beam $1,263,000
2) Three Span Steel Superstructure $1,306,000

Limited Detour Options for Traffic

PPC Beams allow quicker construction

Design Comparisons

Case Study: Medium Length Structure options

McLean County, C.H. 36, 84 ft length

1) Three Span CIP Concrete Slab $774,000
2) Single Plate Steel Superstructure $800,000

Piers Eliminated in Channel

Adequate Freeboard for

Deeper Steel beams

Design Comparisons

Case Study: Short Span Structure options

Ford/ Iroquois County, Township Bridge, 68 ft length

1)	Three Span PPC Deck Beam	$193,000
2)	Three Span CIP Concrete Slab	$232,000

Concrete Slab provides longer structure life

SUMMARY

In Conclusion:

- ***Initial Cost*** and ***Life Expectancy*** most often affect structure choice.

- ***Communication and Planning*** of design factors are critical to find the best solutions.

2015 T.H.E. Conference

Questions?

By: Jack Elston, P.E.,
Steve Megginson, P.E., S.E.

Illinois Department of Transportation

HLR