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Accelerated Bridge Construction

Accelerated Bridge Construction

- Definition
- Benefits
- Concepts
- Applications

ABC is rapid construction of bridge elements using planning, design, materials and methods to reduce onsite construction time.

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Accelerated Bridge Construction

BENEFITS / IMPROVEMENTS

- Safety
- Quality
- Durability
- Social costs
- Environmental impacts

ABC IMPROVES:

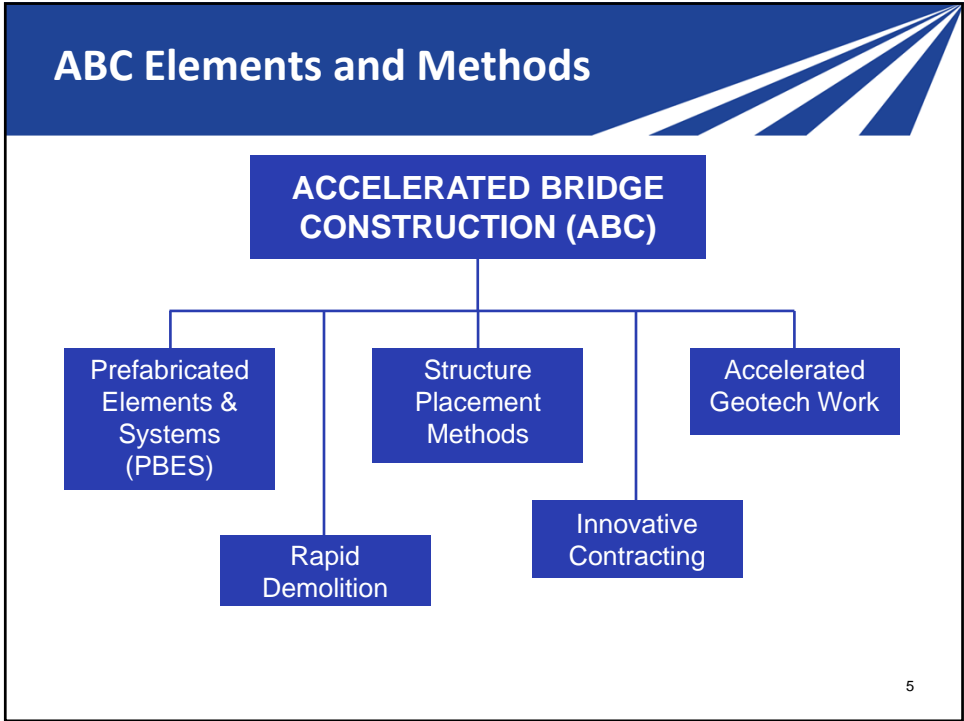
- Site constructability
- Project delivery time
- Workzone safety

ABC REDUCES:

- Traffic impacts
- Onsite construction time
- Weather-related time delays

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Prefabricated Decked Beam Elements



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Gantry Cranes / Above Deck Driven Carriers



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ABC in Indiana



Accelerated Bridge Construction

Indiana's Thoughts

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Obstacles to Implementing ABC

- Owners' Perspective
 - Recognize challenges in getting industry support
 - Seek to balance the increase in construction cost against user cost savings
 - Seek innovation, but with standardization
- Contractor's Perspective
 - Concerned about risk level and profitability
 - Outsourcing work to precasters or specialty subs
 - Will invest as number of projects grow

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Obstacles to Implementing ABC

- Engineer's Perspective
 - Lack of familiarity with ABC methods
 - Need design manuals, specifications and design aids
 - Understanding erection methods for large prefabricated elements
 - **ABC opportunities**

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Indiana's Thoughts

I interviewed Stephanie Wagner (INDOT Director of Bridge Design) about ABC:

- ABC is not just bridge slides, also about limiting interface of traffic and construction.
- Part of our process now, part of the discussion.
- Consider it a tool in your toolbox during SST analysis.
- Indiana's ABC history is suddenly here. Let's move forward.
- You have our support to propose ABC solutions.

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Indiana's Thoughts

- Goals for ABC in Indiana
 - Improve efficiency and safety during construction
 - Encourage implementation across INDOT program
 - Normalize techniques – design and construction
 - Normalize costs – design and construction
 - Balance INDOT's program
 - Less time on one project means more on the next!

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ABC in Indiana

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graph TD; A[Accelerated Bridge Construction] --- B[Indiana's Thoughts]; B --- C[Indiana's Experience]; C --> D[CLASSIC vs. CURRENT];
```

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Indiana's Experience - Classics

- 1**

Sedley Road Bridge
- 2**

Milton Madison Bridge
- 3**

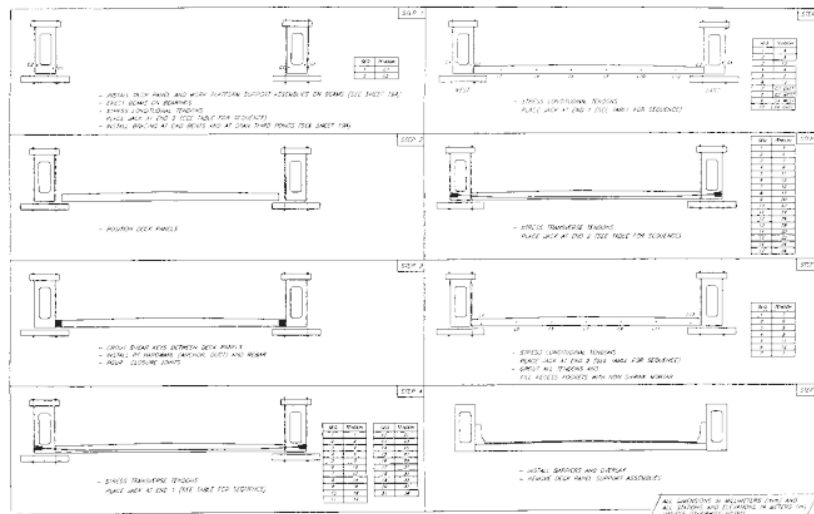
I-70 Bridge Slide
- 4**

Additional Experience

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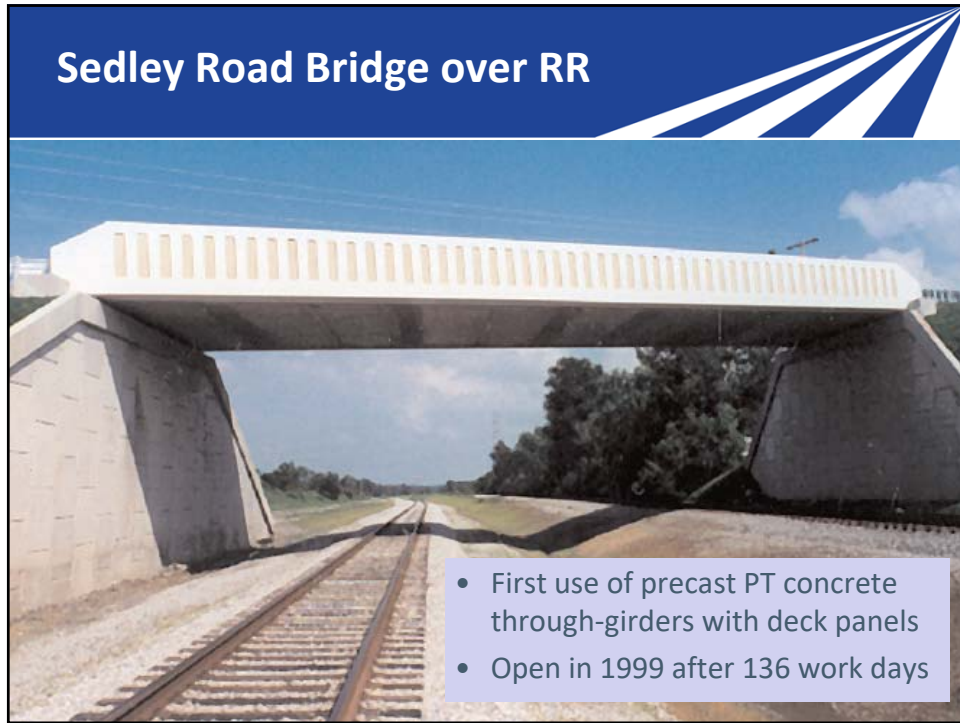
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Sedley Road Bridge over RR



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Sedley Road Bridge over RR

- First use of precast PT concrete through-girders with deck panels
- Open in 1999 after 136 work days

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Milton-Madison Bridge

- Contractor-driven ABC
- D-B project, limiting river crossing closure days
- INDOT's contract proposal
 - Ferry service during a bid amount of closure days
- ABC Solution
 - Construct new truss adjacent to existing (temp. location)
 - Transfer traffic to new and demolish old truss
 - Slide new truss to permanent location on strengthened existing piers

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Milton-Madison Bridge



- Truss lift to temporary piers
- Benefits
 - Closure reduced from 365 days to 10 days
 - 20% cost reduction

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I-70 Bridges over SR 121

- Agency-driven ABC
- ABC Method: Full bridge slide
- Goals:
 - Accelerate adoption of ABC on Indiana interstates
 - Develop experience (design and construction)
 - Minimize user and MOT cost



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I-70 Bridges over SR 121

- BLN designed slide-in and SPMT/offline options
- Alternate bidding allowed contractor to choose

A+B Bidding	A	Construction Cost
	B	User Cost of I-70/SR 121 Closures

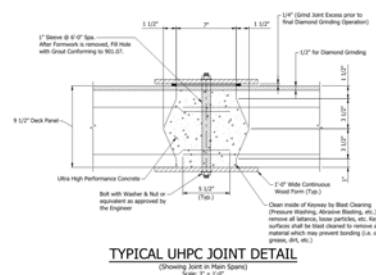
- Walsh/ASI built slide-in option

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Additional Experience

1. SR 163 over Wabash River
 - Full-depth, full-width deck panels
 - Proposed UHPC joints
 - 24 mi. detour / Proposed short closure for deck
2. Precast bridge elements (beams, railings, MSE)
3. “Old-school” partial-depth deck panels
4. Gantries on I-69 and I-65
5. Others (audience participation?)



TYPICAL UHPC JOINT DETAIL
(Showing Joint on High Spans)
Scale: 1" = 4'-0"

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ABC in Indiana

- Accelerated Bridge Construction
- Indiana's Thoughts
- Indiana's Experience
- Current Project Spotlights

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Indiana's Experience - Current

- 1
US 52 over Mud Creek
- 2
US 33 over Blue River
- 3
I-69 over Cedar Creek A+B
- 4
I-65 / I-70 North Split

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US 52 over Mud Creek

- Location: Greenfield District
- Status: Design by HNTB / Letting Sept 2020
- ABC Method: PBES + rapid bridge replacement
- Driver: District-driven
- Goals: Reduce construction duration and traffic/mobility impacts

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US 52 ABC Process

- ABC Screening and Feasibility Report
 - Screen to determine ABC viability
 - Score per standard industry processes
 - THEN...evaluate ABC techniques for technical feasibility and economic justification

**ACCELERATED BRIDGE CONSTRUCTION
SCREENING AND FEASIBILITY REPORT**

US 52 over Mud Creek

DES 1004264
Contract No. B-35480
Str. No. 082-70-10277
RIS No. 192

January 11, 2008

Prepared For
INDOT Government District
Kokomo Region

Prepared By
HNTB
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US 52 ABC Process

FIRST-LEVEL SCREENING - ABC RATING (Custom Level)
US 52 over Mud Creek

1. Average Daily Traffic	<input type="checkbox"/>	0 No Traffic Impacts 1 Less than 5,000 2 5,000 to 10,000 3 More than 10,000
2. Truck Traffic %	<input type="checkbox"/>	0 Less than 5% or unknown 3 5% to 10% 5 > 10%
3. Detour/Bypass Length	<input type="checkbox"/>	0 Less than 0.5 Miles 1 Between 0.5 Miles and 1 Mile 2 Between 1 Mile and 5 Miles 3 Greater than 5 Miles
4. Daily Operating Vehicle Costs	<input type="checkbox"/>	0 No User Costs 1 Less than \$4,250 2 \$4,250 to \$9,250 3 \$9,250 to \$18,100 4 \$18,100 to \$44,000 5 More than \$44,000
5. Impact to local economy	<input type="checkbox"/>	0 Normal Bridge - minimal access impacts 5 Essential Bridge - impacts to locals and to
6. Project Type	<input type="checkbox"/>	0 Unknown 1 Full Bridge Replacement, Continuous ICS 2 Full Bridge Replacement, Simple Span 3 Superstructure Replacement, Continuous 5 Superstructure Replacement, Simple Span
7. Repetitive Spans	<input type="checkbox"/>	0 Single Span or Unknown 3 Multiple Spans
8. Road User and Worker Safety	<input type="checkbox"/>	0 Average Safety 5 Improved Safety
9. Bridge Geometry	<input type="checkbox"/>	0 Curved Alignment 2 Tangent Alignment with skew > 15 deg 5 Tangent Alignment with skew < 15 deg
10. ROW Impacts / Site Selection	<input type="checkbox"/>	0 Restrictive ROW and Site Conditions 3 Limited ROW and Site Conditions
11. Underpassing Feature	<input type="checkbox"/>	0 River or Stream 1 Local Road 3 State Road 5 Interstate or Railroad

US 52 over Mud Creek ABC Screening Score Summary

Category	Score	Weight Factor	Adjusted Score	Maximum Score	Adjusted Max. Score
1) Average Daily Traffic	1	10	10	3	30
2) Truck Traffic %	5	5	25	5	25
3) Detour/ Bypass Length	3	5	15	3	15
4) Daily Operating Vehicle Costs	3	10	30	5	50
5) Impact to local economy	0	10	0	5	50
6) Project Type	1	5	5	5	25
7) Repetitive Spans	3	3	9	3	9
8) Road User and Worker Safety	5	10	50	5	50
9) Bridge Geometry	5	3	15	5	15
10) ROW Impacts/ Site Condition	3	5	15	3	15
11) Underpassing Feature	0	10	0	5	50
Total:			174	Max:	334
			Normalized Score		52

- Results of screening support ABC evaluation

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US 52 ABC Process

- Find feasible ABC methods
 - Precast concrete slab spans
 - FSBeam / MnDOT precast slab beams
 - Decked Bulb Tee (one-span)
 - NEXT Beams (one-span)

- **Precast concrete slab spans selected**
 - Simplest construction
 - Avoids PCI-certified off-site precasting and out-of-state systems
 - Can be field-cast in a staging area

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US 52 ABC Process

ABC	CONVENTIONAL
30 days	120 days
Higher Constr. \$\$\$	Lower Constr. \$\$\$
Lower User \$\$\$	Higher User \$\$\$
Lower Lifecycle \$\$\$	Higher Lifecycle \$\$

- Compared ABC to Conventional

Table 5-2: Summary of Comparative Costs

Alternate and Description	Comparative Construction Cost	User Cost	Lifecycle Cost	Total Comparative Cost
Alternate 1a - Three-span Continuous Reinforced Concrete Slab Bridge with Conventional Construction Techniques	\$658,000	\$1,359,000	\$66,000	\$2,083,000
Alternate 1b - Three-span Continuous Reinforced Concrete Slab Bridge with ABC Techniques	\$964,000	\$340,000	\$50,000	\$1,354,000
Alternate 2 - Single-span Precast Prestressed Concrete Bulb-tee Beam Bridge with Conventional Construction Techniques	\$698,000	\$1,359,000	\$72,000	\$2,129,000

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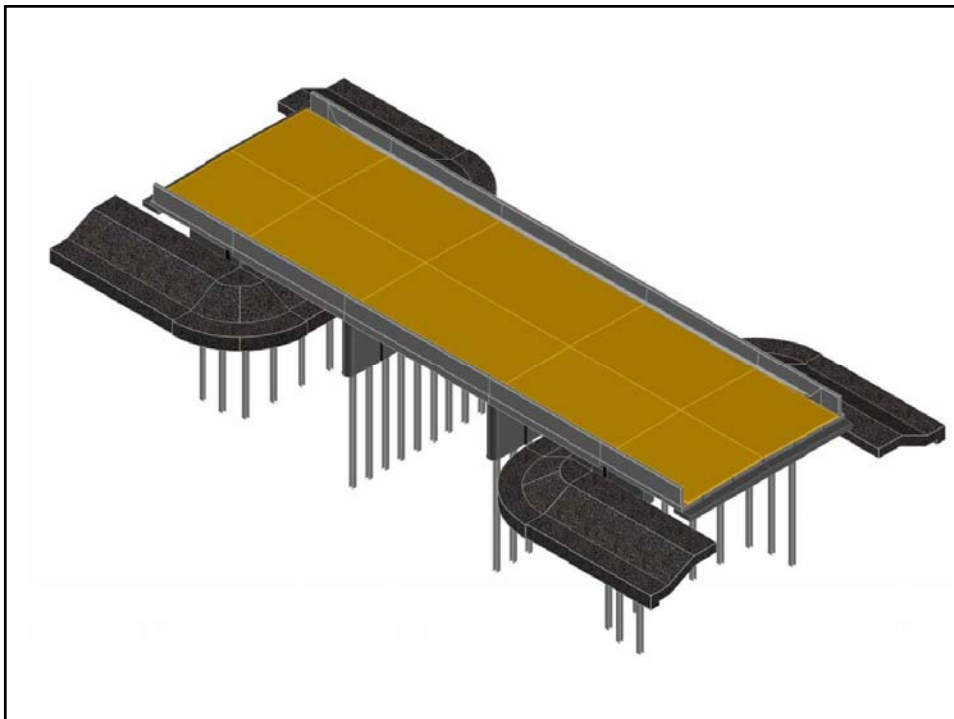
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Design / Detail Highlights

- Bridge Piles
 - Driven with 3" tolerance, requiring a template
 - Design same/similar pile pattern for piers and end bents (reuse template)
- Precast Concrete
 - Everything! Substructure, superstructure, railing, approach slabs....even sleeper slabs
 - Sized to accommodate typical crane lifting (not a monster)
 - UHPC closures
 - VES LMC overlay after closures

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US 33 over Blue River

- Location: Fort Wayne District
- Status: Design by USI / Letting Nov 2020
- ABC Method: PBES superstructure replacement
- Driver: Design-driven
- Goals: Reduce construction duration and traffic/mobility impacts (27 mile detour)

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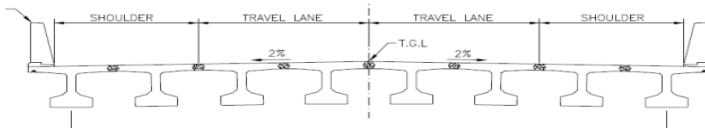
Design / Detail Highlights



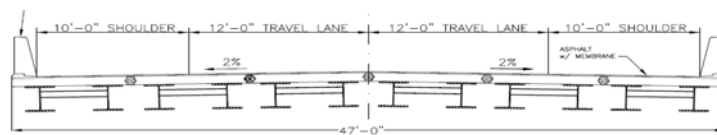
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Design / Detail Highlights

Decked Bulb Tees [eliminated]



Composite Steel System [selected]



- UHPC closures, grind and groove deck after

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I-69 over Cedar Creek

- **Location:** Fort Wayne District
- **Status:** Design by INDOT / Letting this month
» Cheryl Folz and St. Wagner
- **ABC Method:** Contractor's choice
» A+B bidding, temporary bridge @ median
- **Driver:** Contractor-driven
- **Goals:** Provide opportunity for contractor innovation for B (time) component
Reward not just low cost, but ability to construct rapidly (final bridge with PBES, or temporary bridge)

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I-69 over Cedar

NOTES

1. The bridge shall be constructed in accordance with the provisions of the Standard Specifications for Highway Bridges, 10th Edition, Section 205.01.
2. The bridge shall be constructed in accordance with the provisions of the Standard Specifications for Highway Bridges, 10th Edition, Section 205.02.
3. The bridge shall be constructed in accordance with the provisions of the Standard Specifications for Highway Bridges, 10th Edition, Section 205.03.
4. The bridge shall be constructed in accordance with the provisions of the Standard Specifications for Highway Bridges, 10th Edition, Section 205.04.
5. The bridge shall be constructed in accordance with the provisions of the Standard Specifications for Highway Bridges, 10th Edition, Section 205.05.
6. The bridge shall be constructed in accordance with the provisions of the Standard Specifications for Highway Bridges, 10th Edition, Section 205.06.
7. The bridge shall be constructed in accordance with the provisions of the Standard Specifications for Highway Bridges, 10th Edition, Section 205.07.
8. The bridge shall be constructed in accordance with the provisions of the Standard Specifications for Highway Bridges, 10th Edition, Section 205.08.
9. The bridge shall be constructed in accordance with the provisions of the Standard Specifications for Highway Bridges, 10th Edition, Section 205.09.
10. The bridge shall be constructed in accordance with the provisions of the Standard Specifications for Highway Bridges, 10th Edition, Section 205.10.

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I-65/I-70 North Split

- Location: Greenfield District
- DBBV Status: Active Procurement / 2020-2022
- ABC Method: Contractor's choice
 - » Encouraged by 40+ bridges, traffic volume
- Driver: Value-driven
- Goals: Value and closure reduction
 - » Selection places value on closure durations, interstate/local
 - » Contractor bids # days of closure for specific movements
- USP included in technical provisions for guidance

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ABC in Indiana

- Accelerated Bridge Construction
- Indiana's Thoughts
- Indiana's Experience
- Current Project Spotlights
- Challenge Moving Forward

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Moving Forward

- Classic and current examples show drivers
 - Agency, designer, contractor, value
- ABC adopted across US and abroad
- Tools available
 - SHRP2: guidance, equations, details
 - NCHRP 12-98: PBES tolerances and dynamic effects
 - AASHTO Guide Specification
- “Precast is easy” – Stephanie Wagner



**You have INDOT's support.
What are your ABC ideas?**

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Acknowledgements

Brandon Arnold, PE
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INDOT Bridge Design



Tyler Wolf, PE
Beam, Longest and Neff



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State of ABC in State of Indiana

Seth Schickel, HNTB 01/21/2020

Indiana Bridge Design Conference **HNTB**

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