ABC: Accelerated Bridge Construction

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Final Design Unit Leader

Presentation Outline

- ABC – What it is/What it involves
- ABC – Reasons to consider ABC
- ABC – MN Applications
- ABC - Analysis
- ABC – MN Implementation
- ABC – MnDOT Contact Info

Definition of ABC

- Not just building bridges faster – **Building bridges while minimizing traffic disruption**
  - Contracting/Procurement Methods
  - Construction Means/Methods
- Affects Design, Cost, Risk, etc.
  (vs. Conventional Methods)

Contracting/Procurement Methods

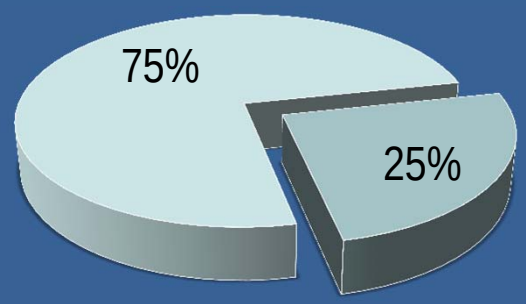
- **Design-Bid-Build**
  - **"A + B" Bidding**
  - **Incentives (& Disincentives)**
  - **Off-peak Scheduling**
  - **Lane Rental**
- **Design-Build**
- **CMGC (new MN option; 2012 Leg.)**

Construction Means/Methods

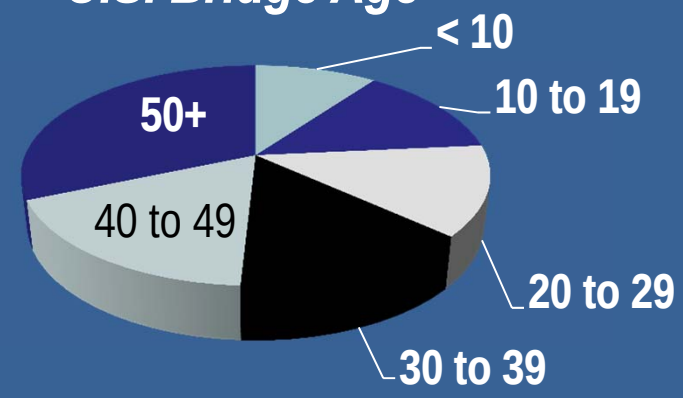
- **Materials**
  - Concrete & Steel Strengths
- **Equipment**
  - SPMT, Cranes
- **Procedures**
  - Post-tensioning, Precasting, Temp. Works
- **Maintenance of Traffic**

Why Consider ABC?

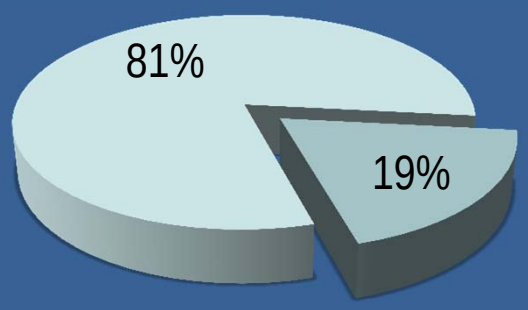
U.S. Bridge Deficiency



U.S. Bridge Age

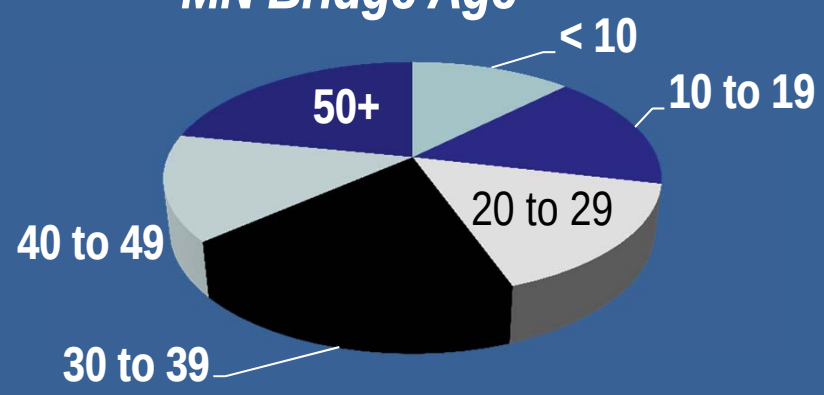


MN Bridge Deficiency



(non-culvert, all roadways)

MN Bridge Age



Why Consider ABC?

Deficiencies → Construction

Construction → Traffic Disruption

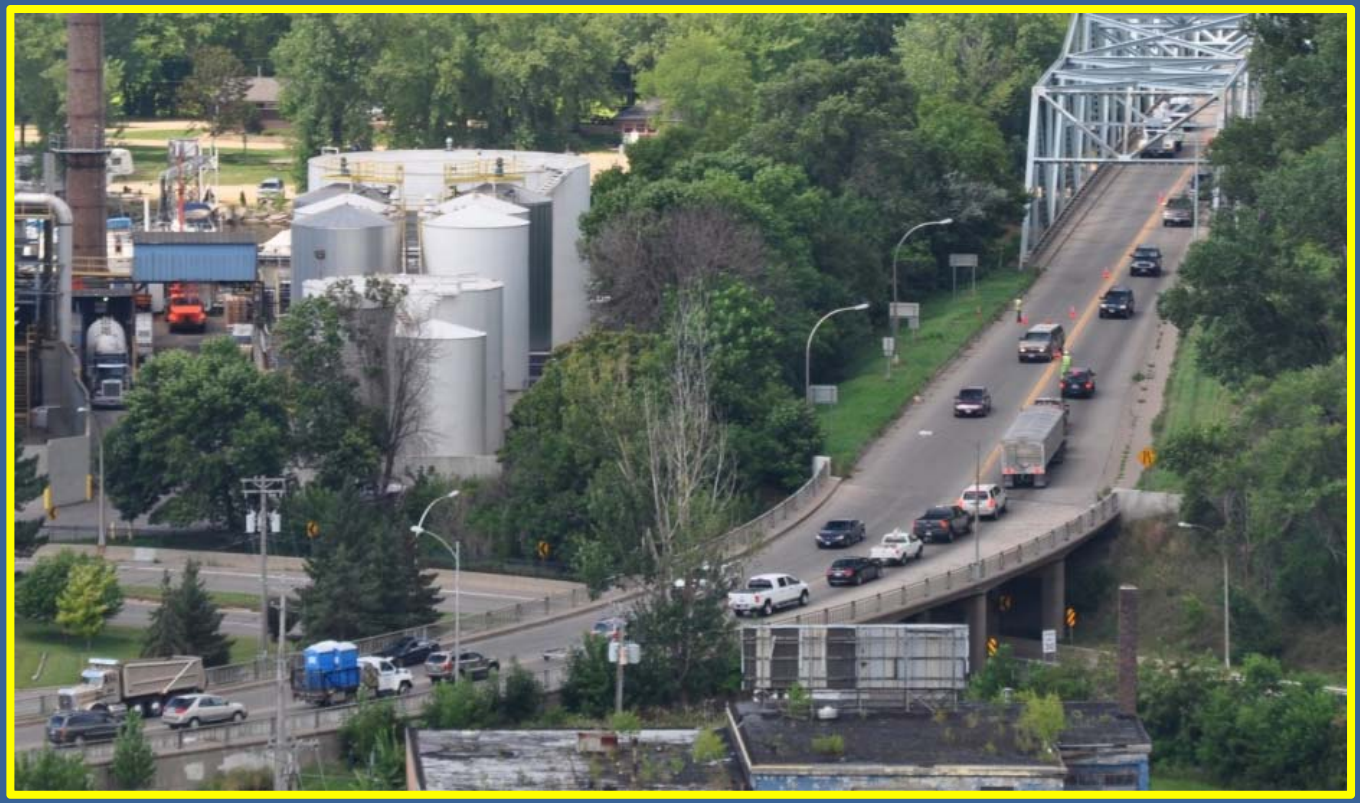


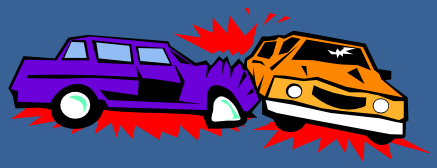
Photo courtesy of Atkins

Why Consider ABC?

- **Societal Expectations**
  - **Context: NOW!**

- **Roadway User Costs (RUCs)**
  - **Time is Money**

- **Safety**
  - **Motorists & Workers**



Why Consider ABC?

- **Environment**
  - Smaller/Cleaner Constr. Sites

- **Minnesota Weather**
  - Short Constr. Season/Cold Weather

- **Higher Quality**
  - Precast vs. C.I.P.

- **Because We Can!**
  - Equipment, Materials

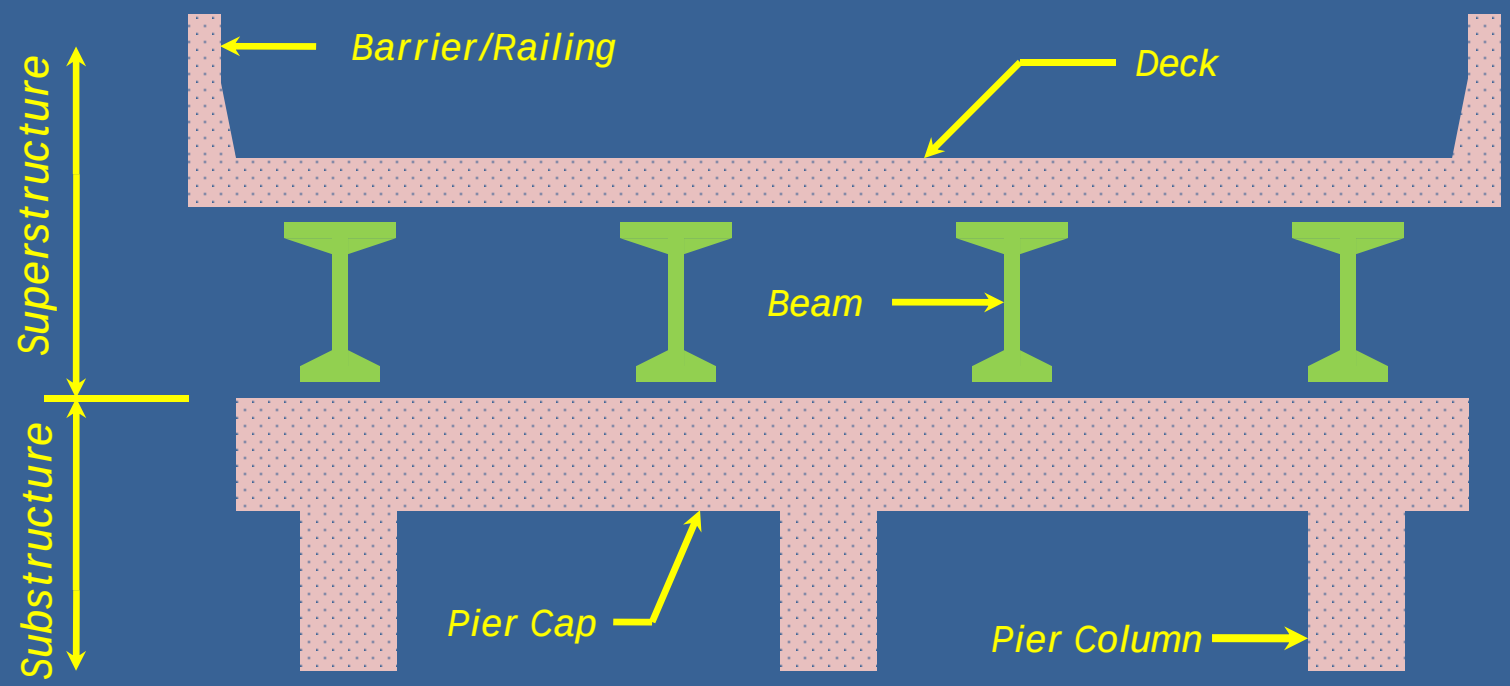
Why Consider ABC?

- Many Beneficiaries
  - Travelling Public (time, $$, safety)
  - MnDOT (public perception)
  - Business & Industry (access, delivery)
  - Contractors (safety, more tools in toolbox)
  - Environment

How to Achieve ABC?

- **Main Theme: Prefabrication**
  - **Precast Superstructure Elements**
  - **Precast Substructure Elements**
  - **Bridge Moves (Precast Entire Structure)**

Conventional Bridge Construction



Prefabricated Elements

Typ. Cast-in-Place (CIP) Concrete Elements

Accelerated Bridge Construction

Components that Can Be Prefabricated

ABC – MN Applications

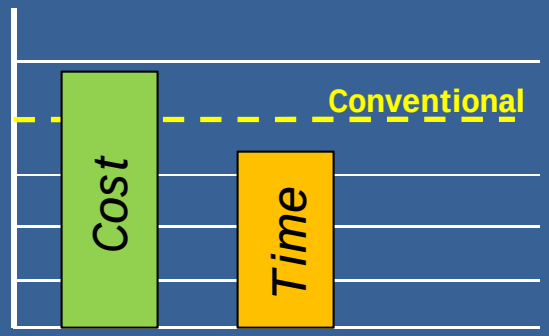
- ABC Techniques for Minnesota
  - Contracting/Procurement Methods
  - Full-depth Precast Conc. Deck Panels
  - Inverted-tee Beams
  - Precast Conc. Segmental Box Girders
  - Precast Substructures
  - Slide-in Construction
  - Self-Propelled Modular Transporters (SPMT)

Full-Depth Precast Conc. Deck Panels

Photo courtesy of CME Associates

Full-Depth Precast Conc. Deck Panels

- **Pros:**
  - Any Size Bridge (New or Rehab)
  - Quality/Durability
  - Faster Construction
- **Cons:**
  - Requires Post-tensioning
  - Roadway Crown Logistics
  - Grouting (Shear Pockets, Haunches)
  - Skewed Supports
  - Existing Shear Connectors On Rehabs



Full-Depth Precast Conc. Deck Panels

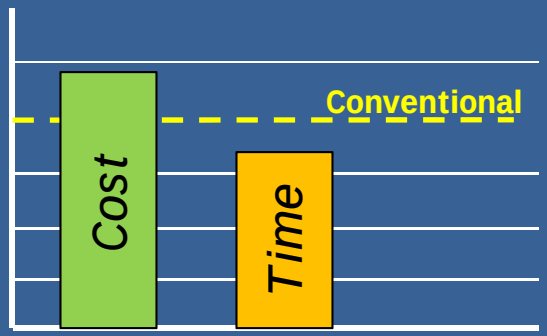
- **Nationwide Implementation:**
  - Tried by About Half the States
  - Use Dates Back to 1970's
  - Detail & Spec Resources Available
- **MnDOT Implementation:**
  - Br. 69071, SB T.H. 53 over Paleface River
  - Let Jan. 2011
  - Panel Fabrication in Progress
  - Delayed by Bidding Issues

Inverted-Tee Beams

Photo courtesy of MnDOT

Inverted-Tee Beams

- **Pros:**
  - Slab Span Alternative
  - Higher Quality Precast Elements
  - Faster Construction
  - No Falsework, Improved Safety
- **Cons:**
  - Still Requires Some CIP Conc.
  - Cracking Issues in Topping



Inverted-Tee Beams

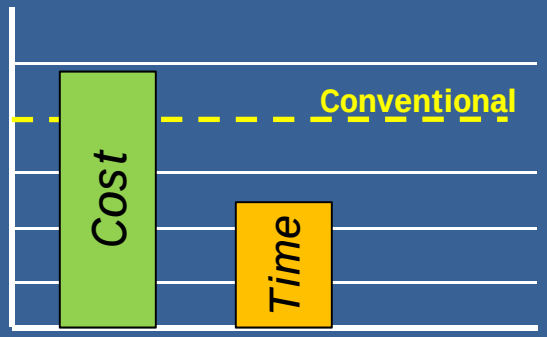
- **History/Development:**
  - Based on French System
  - Developed in U.S. by MnDOT
  - Design Still Evolving (Stds. being developed)
- **MnDOT Implementation:**
  - First Bridges Let in 2005
  - 11 Bridges Let to Date
  - Research at Univ. of Minnesota
  - Price Has Come Down

Precast Conc. Segmental Box Girder

Photo courtesy of MnDOT

Precast Conc. Segmental Box Girder

- **Pros:**
  - Long Spans/Geometric Constraints
  - Higher Quality Precast Elements
  - Speed of Construction
- **Cons:**
  - Requires PT and Grouting
  - Deck Replacement Not Feasible
  - Specialized Equipment/Skills



Precast Conc. Segmental Box Girder

- **Nationwide Implementation:**
  - First Used in U.S. in early 1970's
  - Hundreds of Bridges Nationwide
  - Used In All Regions
- **MnDOT Implementation:**
  - 35W/62 Crosstown (4 Bridges)
  - Center Span of New 35W Bridge
  - Potential Use on St. Croix

Precast Substructures

Abutments

Photo courtesy of MnDOT

Piers

Photo courtesy of Texas DOT

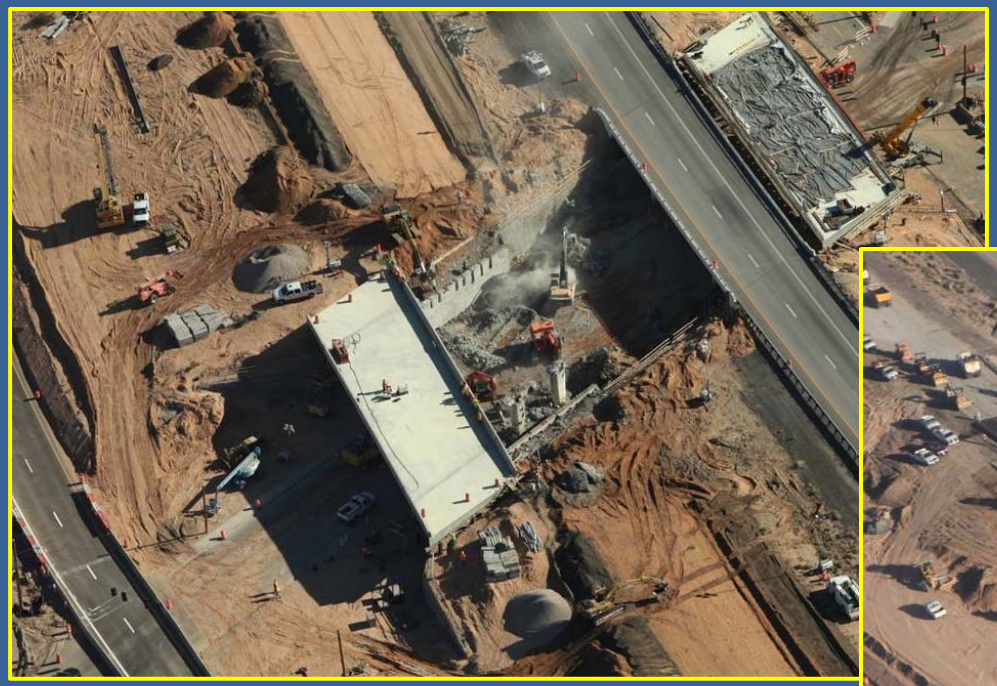
Precast Substructures

- **Pros:**
  - Higher Quality Precast Elements
  - Potential for Faster Construction
  - Advantage With Repeatable Elements
- **Cons:**
  - Connection Issues
  - Contractor Enthusiasm (tend to like C.I.P)
  - Early Strength Not Req'd (Exc. Pier Caps)

Precast Substructures

- **Nationwide Implementation:**
  - Tried By Many States
  - Texas Leader (research, implementation)
  - Attempts to Standardize
- **MnDOT Implementation:**
  - Br. No. 13004, T.H. 8, Chisago Co., 2005
  - Br. No. 25024, T.H. 61, Goodhue Co., 2011
  - Unweave the Weave (PT Column Alt.)

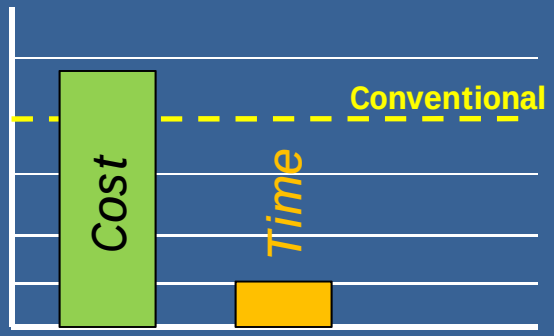
Slide-In Construction



Photos courtesy of Nevada DOT

Slide-In Construction

- **Pros:**
  - Very Minimal Traffic Disruption
  - Work Separated From Traffic
  - Higher Quality (not on Critical Path)
- **Cons:**
  - Need Right Site Conditions
  - New Foundations Under Inplace Bridge
  - Non-standard/Dynamic Loads



Slide-In Construction

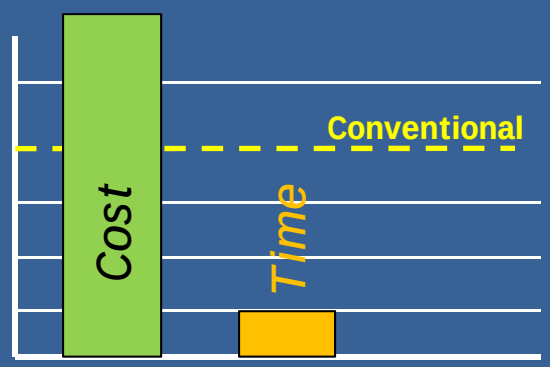
- **National Implementation:**
  - Not As Common as SPMT
  - Showcase/Demonstration Projects
  - More Variability (Contractor Methods)
- **MnDOT Implementation:**
  - 3 Staged Removals/Temp. Crossings
  - Br. 25028, T.H. 61 Red Wing, Jan. '13 Let
  - Potential Site in District 3
  - Other Potential Sites Being Considered

Self-Propelled Modular Transporter

Photo courtesy of Utah DOT

Self-Propelled Modular Transporter

- **Pros:**
  - Very Minimal Traffic Disruption
  - No Work Over Traffic
  - Higher Quality (not on Critical Path)
- **Cons:**
  - Need Right Site Conditions
  - New Foundations Under Inplace Bridge
  - High Mobilization Costs
  - Non-standard/Dynamic Loads



Self-Propelled Modular Transporter

- **National Implementation:**
  - Tried by at Least Dozen States (25+ in Utah)
  - Detail and Spec Resources Available
  - More Options for Heavy Lifter
- **MnDOT Implementation:**
  - Br. No. 62626 (Maryland over 35E)
  - Design-Build, Move Scheduled Summer '12
  - Hastings Design-Build (Arch Installation)

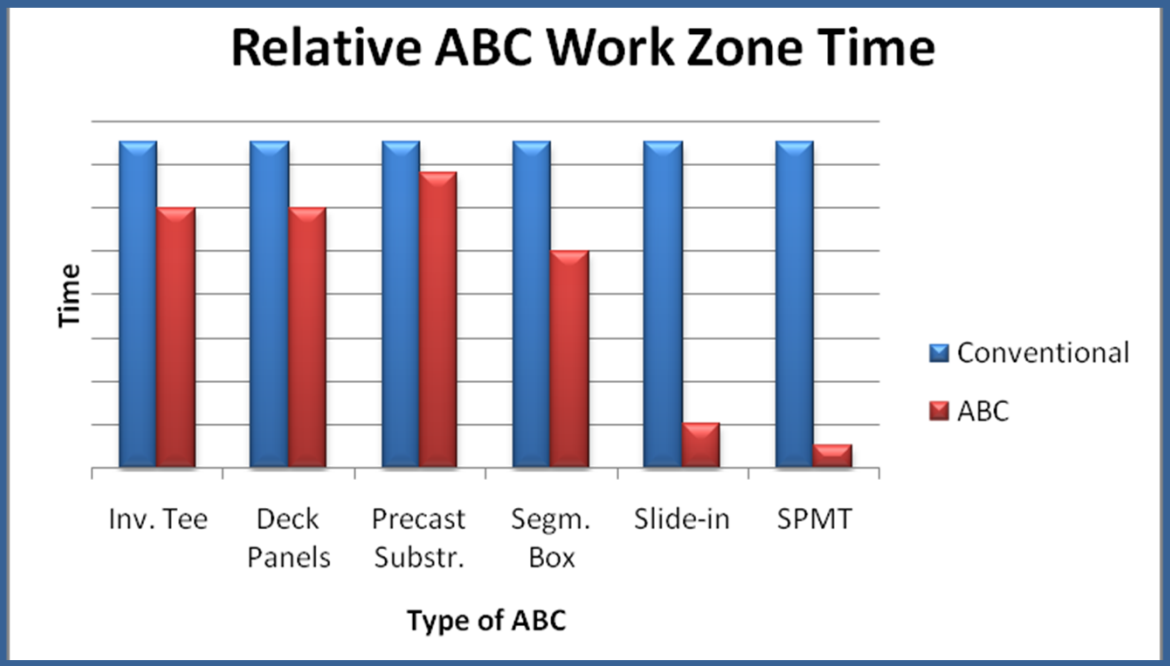
ABC: SPMT

Time-Lapse SPMT Move

Video courtesy of Utah DOT

ABC Analysis – The Good News

- **Reduction in Work Zone Time**



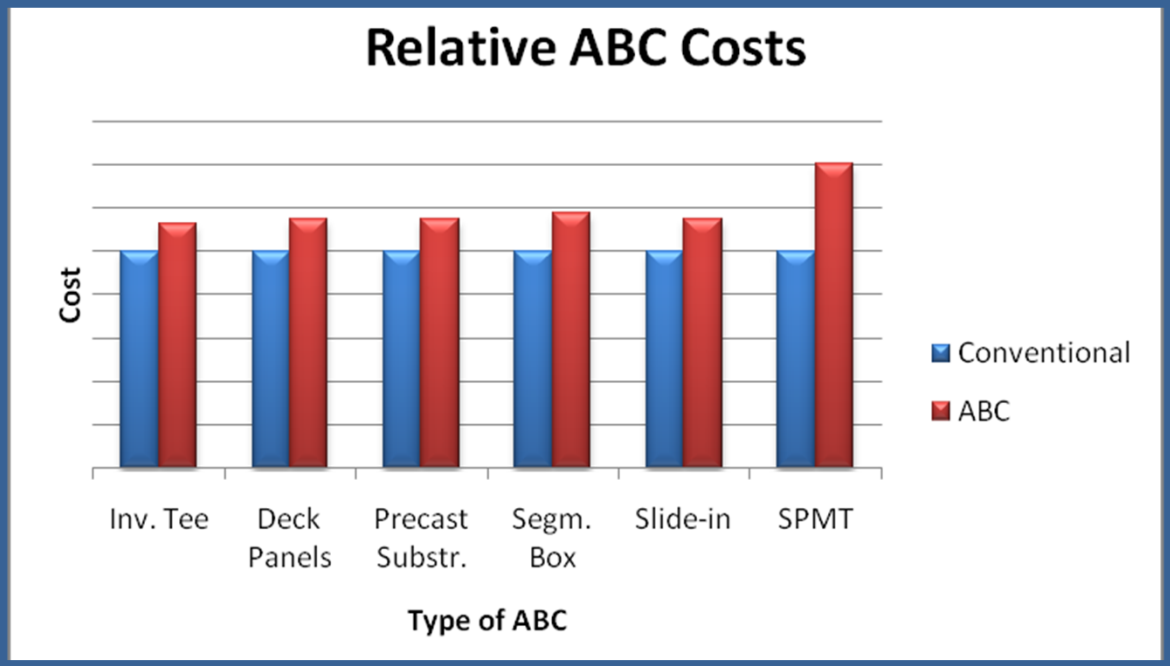
- **Real Savings for Roadway Users (RUCs)**

ABC Analysis – The Good News

- **Perfect Match for MnDOT Strategic Vision**
  - *Safety*: **reduce workzone accidents**
  - *Mobility*: **reduce congestion; improve flow**
  - *Innovation*: **new equipment & procedures**
  - *Leadership*: **new standards, use by local agencies**
  - *Transparency*: **public discussion of cost/benefit**

ABC Analysis – The Bad News

- **Increased Construction Costs**



- **RUCs Don't Come Back to MnDOT**

MnDOT Implementation of ABC

- ABC When Appropriate
  - Trial Projects, Shorten Durations in Future
- Internal ABC Committee
  - Constr., Prelim & Final Design, C.O. (STIP)
- Implementation on Selected Projects
  - Precast Substr., Inv Tee, Deck Panels, SPMT
- Actively Seeking Supplemental Funding
  - Highways for LIFE, Destination Innovation
- Develop Decision Criteria/Standards/Policy
  - Decision Criteria: Spreadsheets, Specialty Software
  - Standards/Policy: Based on Successful Projects

MN ABC – Consultant Involvement

- **Design-Build**
  - **Designer for Contractor**
  - **Design Oversight**
- **Design-Bid-Build**
  - **Consultant Contracts with MnDOT**
  - **Designs for Local Agencies**

MN ABC – Contact Info

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- Keith Molnau (Preliminary Design)
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- Todd Stevens (Final Design)
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Accelerated Bridge Construction

Thank You

Questions?