PRESENTATION HANDOUTS:

COURSE 1 SIBC OVERVIEW FOR DESIGNERS

Slide in Bridge Construction

Design Engineers

Name of Presenter
Title

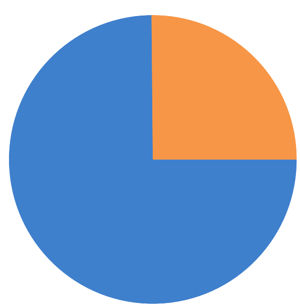
Meeting Name
Location Date

U.S. Department of Transportation
Federal Highway Administration

1

Introduction

U.S. bridges



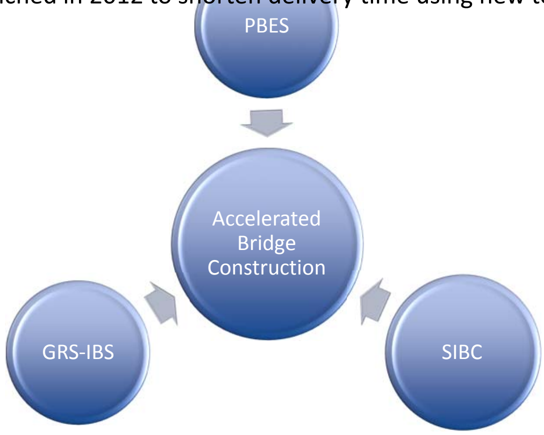
Background

Deploy underutilized innovations to

- Shorten delivery of highway projects
- Enhance roadway safety
- Reduce congestion
- Improve environmental sustainability

EDC-2 Initiative

EDC-2 launched in 2012 to shorten delivery time using new technologies



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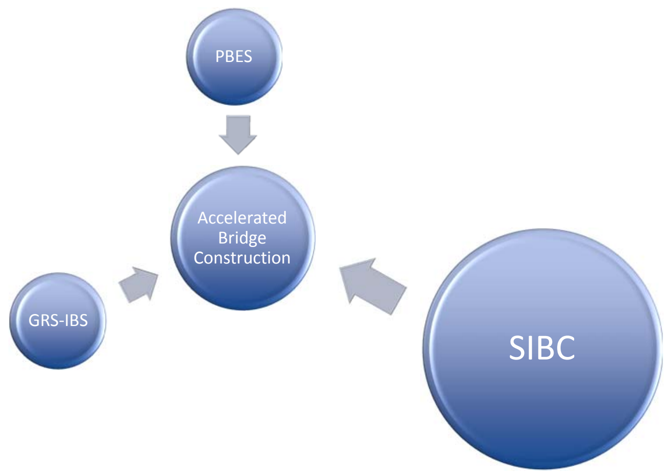


Agenda

Overview for designers

- Definition and benefits of SIBC
- Decision making and delivery methods
- Planning and designing for SIBC
- Typical details
- Case study

What is SIBC?

- ABC method also known as known as lateral sliding or skidding
- New bridge (normally) built parallel to existing bridge on temporary supports
- New bridge slid into place after
  - New substructure constructed
  - Old bridge demolished
  - Moved laterally using hydraulics or a winch. Some minor vertical jacking is typically needed.

What is SIBC?

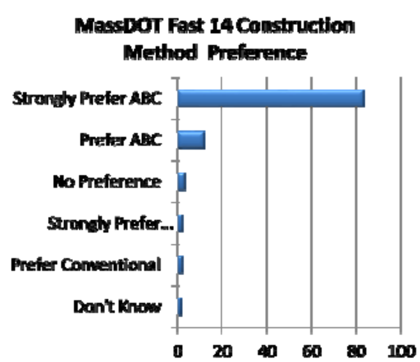
- Reduced disruption if substructure can be constructed below the existing bridge
- Minimal disruption likely requires innovative foundation systems
  - Drilled shafts outside footprint of existing bridge
  - Micro or mini piles
  - Integrating cap beams
  - Spread footings
- Prefabricated substructure units

What is SIBC?

- Can be used for temporary bypass bridges
  - Temporary substructure must be designed for live and other transient loads

Benefits

- What is driving the use of SIBC?
  - Increased traffic demands
  - Increasing congestion
  - Public demand for rapid delivery of projects
  - Safety
  - Societal costs
  - Mobility
  - Environmental impact
  - Lower cost and less risk when compared to other structure placement methods (e.g., SPMT)



Benefits

- Offers non-traditional site options
- Eliminates crossovers, shoo-flies, staged construction, and long term detours
  - Can result in lower construction costs/bid price
- Reduces mobility impacts

Benefits

- Promotes user and worker safety
- Better contractor "buy-in" when compared to other ABC methods
- Could reduce environmental impact

Benefits

- Removes bridge construction from critical path
  - May lead to better quality end product
- Involves public in reducing societal costs
  - Results in greater "buy-in" in the overall project
- Road closures better managed
  - Dates and duration are more predictable

Project Highlight

I-84 at Dingle Ridge Road – New York

- Cost savings
  - Over $1.2 M in user delay cost savings by using ABC (Source: NYSDOT)
  - $2 M cost savings from elimination of cross-overs, temporary bridge (Source: NYSDOT)
  - Savings in work-zone accidents costs

Potential Challenges

- Internal resistance in the DOT
- Finding experienced contractors or heavy lift engineer
  - Mitigated through education
  - Becoming less of a challenge as more projects are bid nationwide
- Public interest
  - Spectators on the job site

Potential Challenges

- Curved bridges; high skews
- Vertical profile changes
- Lack of space adjacent to bridge
- Traffic management plans
  - A need to be fluid and/or a have a contingency plan in place

Potential Challenges

- Possible contractor limitations
  - Forethought, significant temporary shoring, and unconventional schedules are required
- Time commitment
  - Requires 24 hour commitment of the contractor/design/owner team during slide operations
- Worker fatigue
  - Extended time for contractor, owner, and designer

Potential Challenges

- Difficult foundations/substructures
- Equipment breakdowns
- Speed of approach work completion
- Surveying mistakes
- Public spectators

Project Highlight

Elk Creek – Oregon

- Site concerns
  - Mountainous terrain surrounding bridge construction site
  - Slides can be effective even in very confined locations

Factors of Interest

- ADT/ADTT
- Facility crossed
  - Railroad/roadway
  - Navigable waterway
  - Evacuation route
- Detour length
  - Duration and viability
- Environmental
  - Limits on when
  - Limits on how

Factors of Interest

- On critical path of entire project
- Available right of way for bridge construction
- Traffic analysis
- Contractor's work area and ingress/egress ability

Knowledge Check

In SIBC, the new bridge is constructed parallel to the existing bridge on temporary **supports**.

Knowledge Check

What types of innovative foundations systems are commonly used to minimize disruption?

- Drilled shafts outside footprint of existing bridge
- Micro or mini piles
- Integrating cap beams
- Spread footings
- All of the above

Knowledge Check

True or false: SIBC can eliminate crossovers, shoo-flies, staged construction, and long term detours resulting in lower construction costs/bid price?

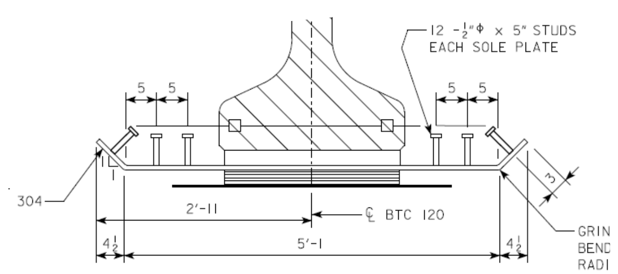
TRUE

Design and Detailing

- In general, loads from sliding operations are similar to normal service life loads though jacking force loads should be addressed in design
  - Special attention is required for the design and detailing of the push and jacking locations
  - The use of concrete integral diaphragms are useful in dealing with this issue
- Typically a bridge designer can relate slide operations to other maintenance operations
  - Lifting from slide bearings to final position is similar to replacing a bearing

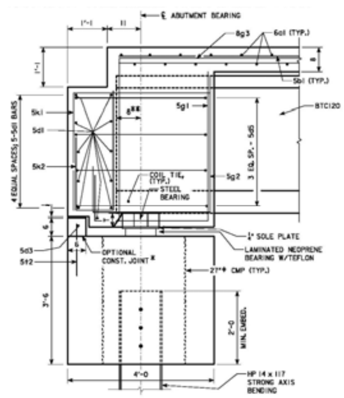
Design and Detailing

- Details are dependent on the slide system used
- Detailing of slide shoes and bearings required
- Jacking locations needed for bearing change-out



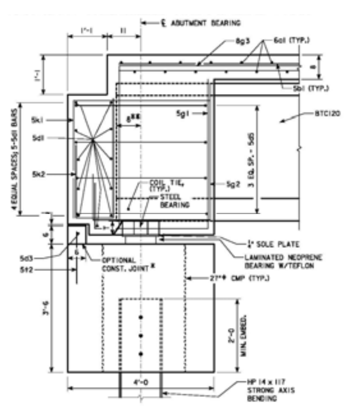
Design and Detailing

- Owner should be open to contractor suggestions for modifications of the design to accommodate specific construction processes
  - Include notes in contract to allow for contractor submitted alternate slide shoes and jacking locations
- Semi-integral abutments can be used to facilitate detail; substructure needs to be designed appropriately

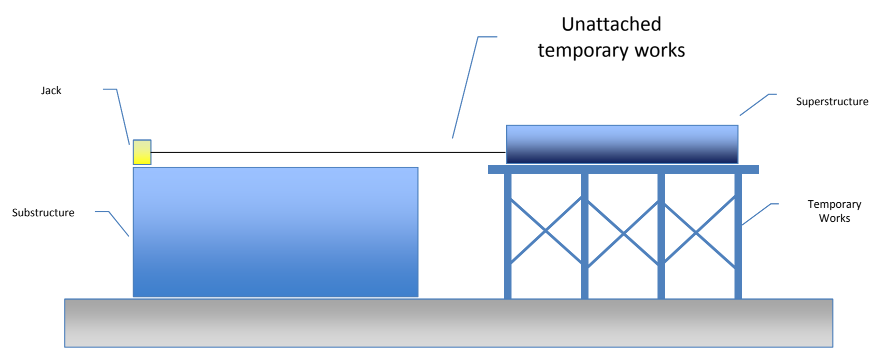


Design and Detailing

- Detail adjustability on the bearings to provide uniform loading on all bearings
- Need for slide displacement monitoring and controls
- Temporary works structure should be attached to substructure



Force Diagram



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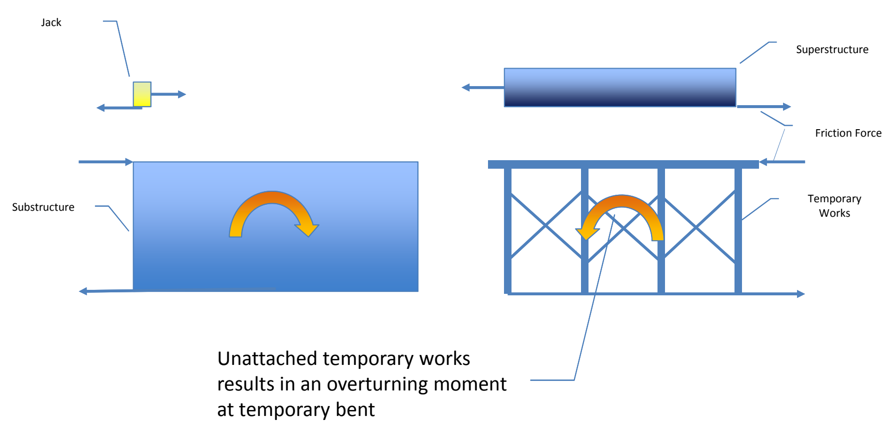

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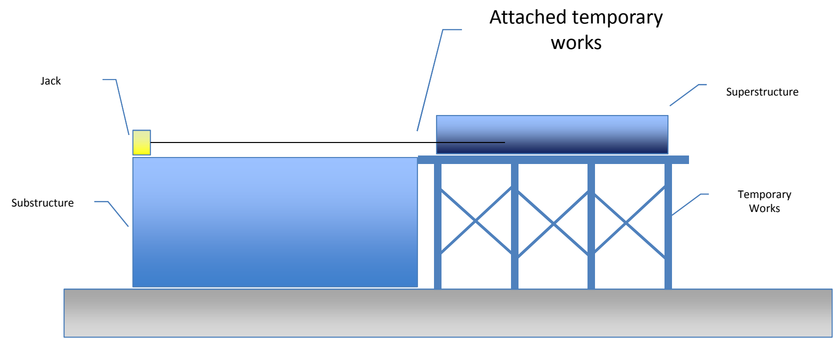

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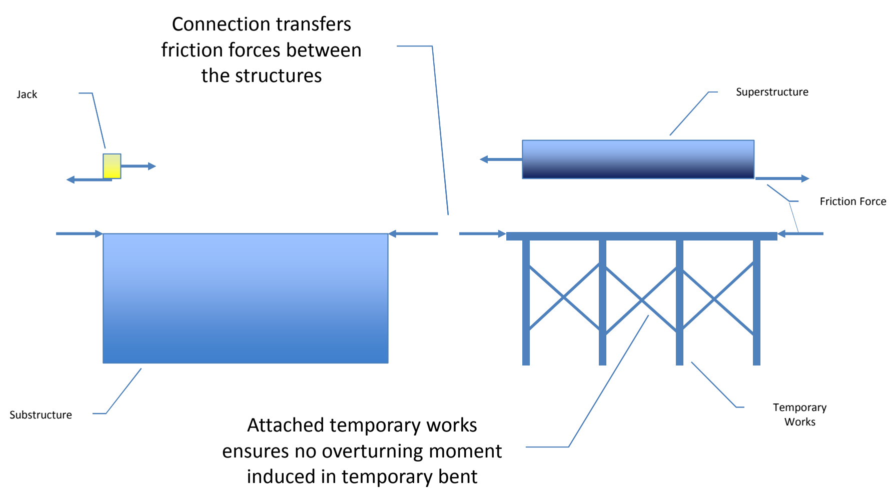
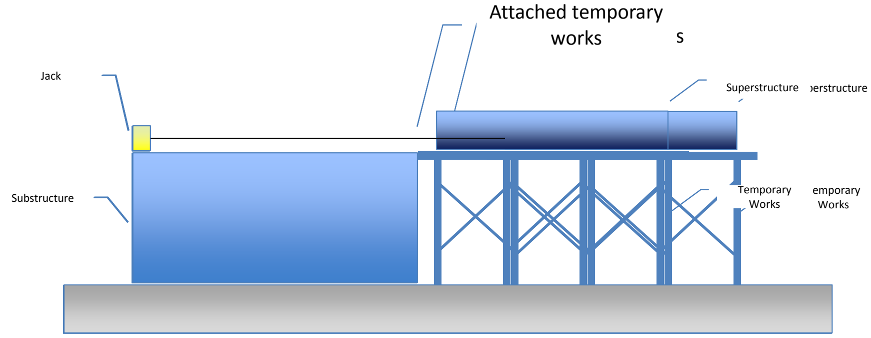


Knowledge Check

Which is a better method for constructing temporary works?



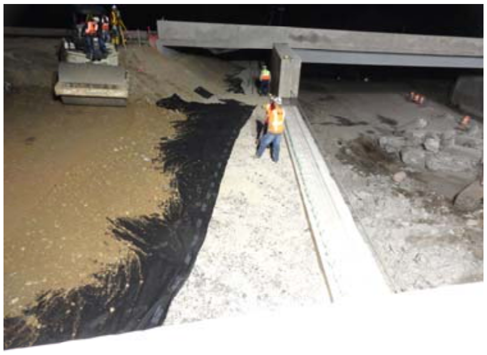
Project Highlight

Massena – Iowa

- Semi-integral abutment acts as jacking location
- Temporary works attached to permanent substructure

Approach Slab

Attention to approach slab design and construction should be a priority and not an afterthought

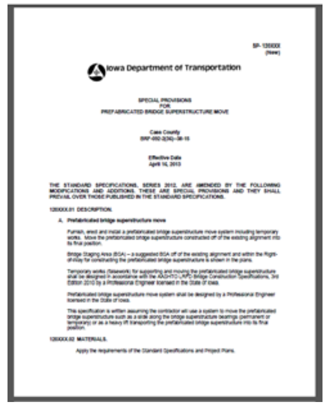


Approach Slab Options

- Approach slabs slid with bridge (Utah method)
  - Fast, but expensive
- Precast approach slabs placed after the slide
  - Some states have problems setting slabs
  - Consider the use of flowable fill under the ends of the slab
- CIP approach slabs
  - Can be built in 2 days
  - Need time to cure
- Buried approach slabs (European method)

Specifications

- Requirements for an assembly plan should be included
- Consider prequalification of high early strength grout
- Review field welding specifications
- Reasonable tolerances should included
  - Consider thermal expansion and contraction



Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
PREFABRICATED BRIDGE SUPERSTRUCTURE MOVE

Specifications

- Pay special attention to contractual specifications (incentives/disincentives, liquidated damages, etc.)
- Requirements for timing of plan submissions and reviews should be included
- Prequalify slide contractor and slide system

Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
PREFABRICATED BRIDGE SUPERSTRUCTURE MOVE

Specifications

- Need for rehearsal slide prior to final slide
- Contingency plan during slide-in
- Detailed CPM schedule for slide-in
- Submittal of slide system working drawings

	Day								
Activity	1	2	3	4	5	6	7	8	9
Start Critical Closure	9/27/2013								
Bridge Removal and Grading	■								
Pile Driving	■	■	■						
Revetment		■	■	■					
Abutment Footing			■						
Bridge slide				■	■				
Precast wings					■				
Granular Backfill						■			
Bridge Barrier Rail						■			
Approach paving							■		
Barrier End Sections							■		
Steel Guardrail								■	
Longitudinal Grooving									■
Pavement Marking									■
Finish Critical Closure									10/6/2013

Design of Temporary Works

- Temporary works usually lies within the contractor's responsibilities, including foundation design. Possibly different if live load on temporary works is intended
- Must be completed by a competent, registered professional engineer
- Geotechnical investigation should be the responsibility of the engineer of record
  - Reports should consider both deep and shallow foundations
  - Design parameters should be included in the contract documents

Design of Temporary Works

- Additional geotechnical borings at falsework locations may be required to ensure that the temporary foundation system operates as desired/needed
  - The contractor should be required to hire a geotechnical engineer if the proposed foundations are different than what is described in the geotechnical report
- Codified resources
  - Guide Design Specifications for Bridge Temporary Works
  - Temporary substructure according to AASHTO for temporary bridges
  - Design for full seismic, wind or other probability based design loads may not be needed
- Engineer of record for the temporary works will be responsible for the acceptance of that portion of the project

Design of Temporary Works

- Engineer of record should have ways of verifying certification of materials used for temporary works
- It is recommended to hold a pre-bid meeting
  - Sample temporary works drawings should be provided to contractors new to SIBC
- The construction of the superstructure on the falsework is nearly identical to that of conventional construction

Design of Temporary Works

- Accurate estimation of jacking forces is critical
- Where the jacking forces will be applied is equally critical. Design engineer must consider localized effects during design
- Engineer must recognized that lateral slides rarely go perfectly lateral. Racking or binding increases concentrated loads at the jacking points. Connections must be appropriately designed
- Temporary works frame needs to be attached to permanent substructure
- Provide jacking locations for vertical adjustment of superstructure

Design of Temporary Works

- Minimize differential settlements
- All loads are transient and changing. Therefore analysis must be completed at each state and stage
- Differential displacement must be minimized to the extent possible
- P-delta forces might need to be considered. When critical, additional bracing should be provided
- Some critical loading cases will be for horizontally and vertically applied jacking loads

Design of Temporary Works

The engineer must make a very good estimation of the coefficient of friction (static and kinetic) expected during the slide. Verify during rehearsal slide.

Slide Mechanism	Estimated Lateral Force Required*
PTFE coated neoprene bearing pads	10% of vertical load
Heavy duty rollers	5% of vertical load**

* Recommended 5% minimum design load in any case
** Possibility of roller binding occurring increasing lateral force required

Design of Temporary Works

Transition from temporary support to permanent structure must be designed to accommodate the transient load and possible differential deflection.

Knowledge Check

Who is typically responsible for the design of temporary works for slide in bridge construction?

Contractor

Knowledge Check

What percentage of vertical load can be considered a good estimate for the forces required to slide a bridge superstructure on PTFE coated neoprene bearing pads?

- 5%
- 10%
- 15%
- 20%
- 25%

SIBC Slide Methods

SIBC Hardware

- Rollers
- Skids
- PTFE pads
- Hydraulic rams
- Hydraulic threaded bars
- Vertical jacking hardware

Power Systems

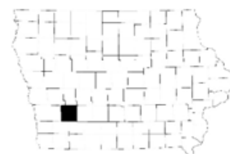
- Hydraulic jack
- Hydraulic push/pull jack
- Winches
- Cranes
- Other equipment

Case Study: Massena, IA

Iowa Department of Transportation

Location

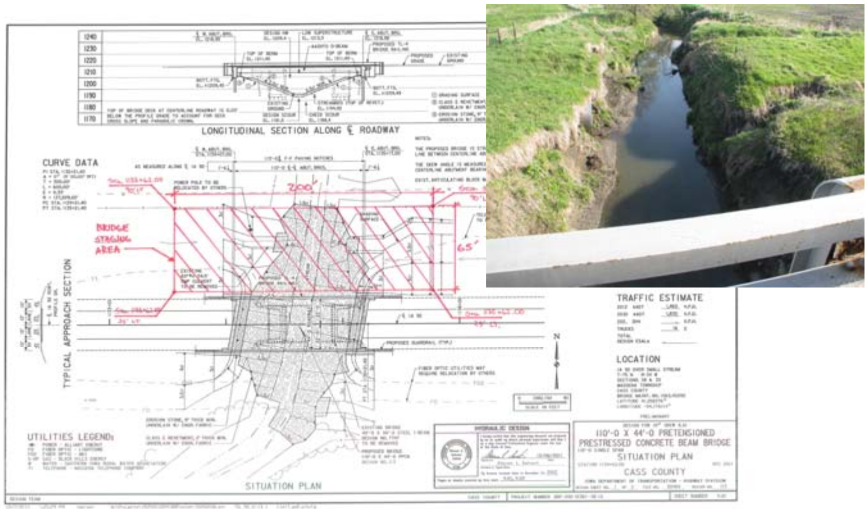
- IA 92 over small stream, 1.0 miles west of IA 148



Why ABC?

- 13 mile detour – 7 mile out-of-distance travel
- AADT (2012) – 1,460 with 16% trucks
- User costs for 180-day detour
  - Indirect = $437,000
  - Direct = $15,000
    - County road maintenance
    - Detour signage

Why SIBC?



Delivery Method and Cost

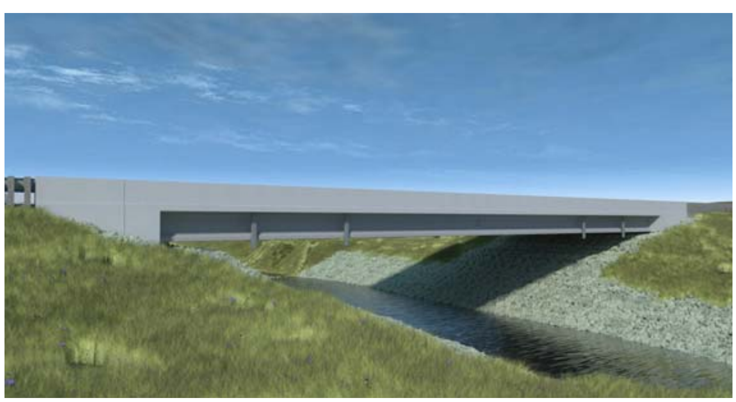
- Design-bid-build
  - Design completed by DOT with external peer review
  - Peer exchange of information from Utah DOT was critical
  - Let April 16, 2013
- Cost
  - Winning bid - $1,300,000
  - Unit cost - $112/SF
    Historic bridge unit cost - $85/SF

Existing Structure

- 40' x 30' steel I-beam
- Constructed – 1930
- Reconstructed – 1949
- Overlay – 1968
- Retrofit rail – 1992
- Overlay – 1998
- Structurally deficient – sufficiency rating=38.2

Proposed Replacement

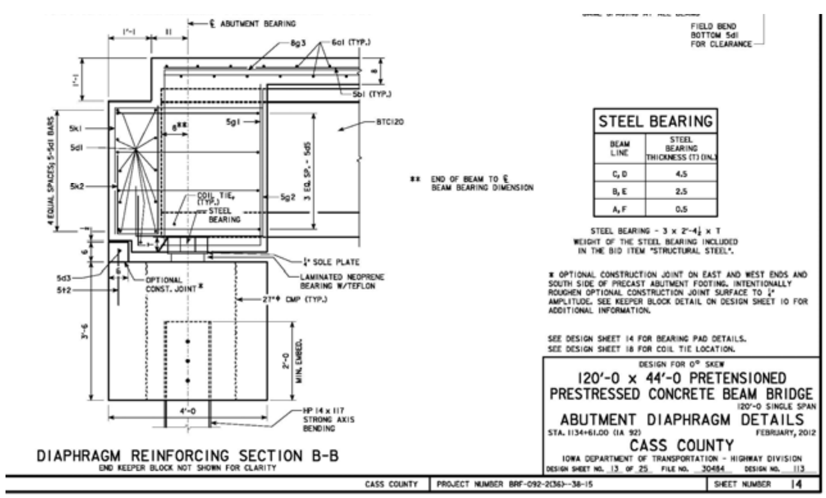
- Pretensioned, prestressed concrete beam bridge



Plan Design and Details

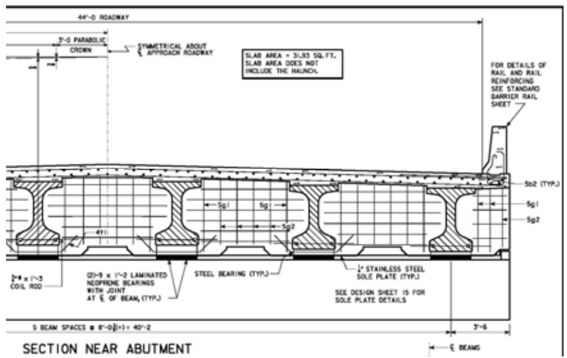
- Semi-integral abutment details
- Abutment diaphragm
  - Jacking pockets for lifting
  - Block for pushing/pulling the prefabricated superstructure
- Precast abutment footing
  - H-Pile connections
- Precast wingwalls
  - H-Pile connections

Semi-Integral Abutment

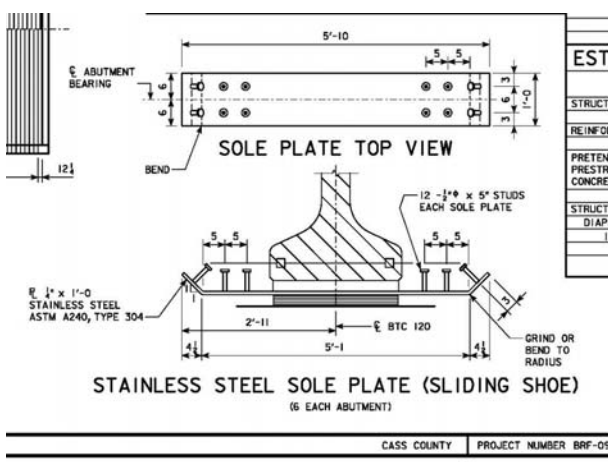


Sliding Pad

- Engineer's sliding concept
- Contractor elected to use commercially available rollers



Sliding Shoe



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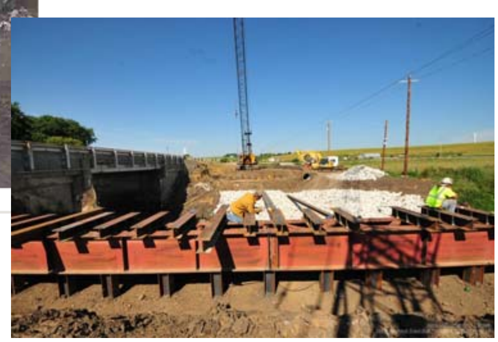
Lessons Learned

- Let ABC projects similar to steel bridges, in the fall with time for the contractor to gather resources
- Offer precast/CIP options for substructure
- Be prepared to fully evaluate impact of contractor method changes
- Do not allow reuse of laminated neoprene bearings
- Add a specification requiring falsework design engineer to inspect and accept falsework construction

Lessons Learned

- More design and review time required for first SIBC project than anticipated
- First time design team time
  - Design Engineer – 97 hours
  - Detailer – 338 hours
  - Check Engineer – 168 hours
  - Total – 603 hours
- First time submittal review engineer – 137 hours
  - Structural steel
  - Falsework
  - Precast wingwalls
  - Move plans and calculations
  - Move procedures
- It is anticipated the time required will be greatly reduced with subsequent projects



Time Lapse Video

"FHWA Slide"

www.fhwa.dot.gov/construction/sibc/

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Every Day Counts

U.S. Department of Transportation
Federal Highway Administration

Thank you!

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COURSE 2 SIBC OVERVIEW FOR CONTRACTORS

Photo courtesy of Horrocks Engineers

Slide in Bridge Construction

Construction Contractors

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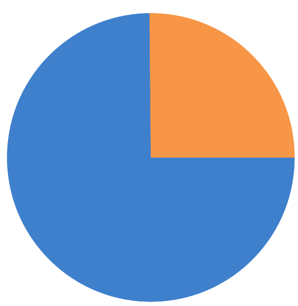

In need of rehabilitation, repair, or replacement

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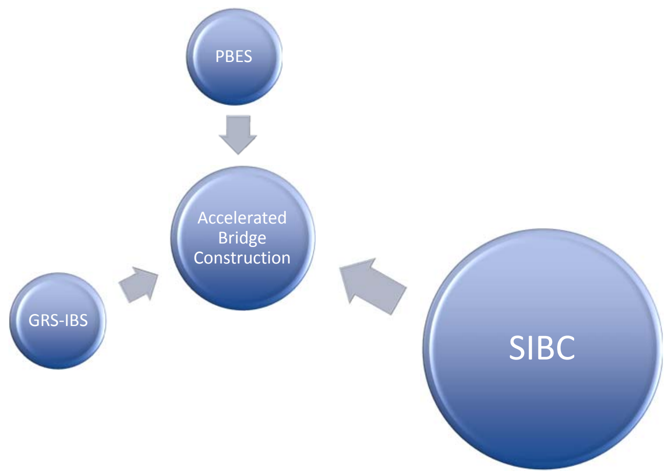

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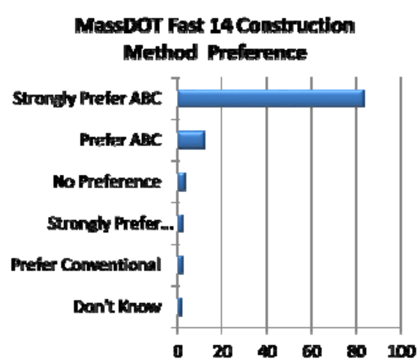

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Costs

- Direct vs. indirect
  - Account for agency and other indirect cost savings during decision making (CEI labor, flagging, field office, etc.)
- Avoided costs (detours)
- Reduced inflation costs (i.e., decreased construction time)

Project Highlight

Mesquite Interchange - Nevada

- Project costs
  - Total interchange reconstruction = $15 million
  - Original estimate without ABC = $25 million

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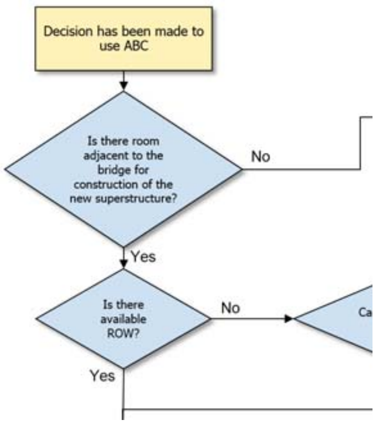
TRUE

When to Use SIBC

- Ideal conditions for SIBC
  - Wide, flat area(s) adjacent to original structure
- Factors to be considered
  - Limited ROW
  - Terrain around existing bridge is rugged
  - Geotechnical conditions cannot adequately support temporary works
  - Alignment restrictions
  - Utilities

SIBC Flowchart Method

Sites Suitable for SIBC



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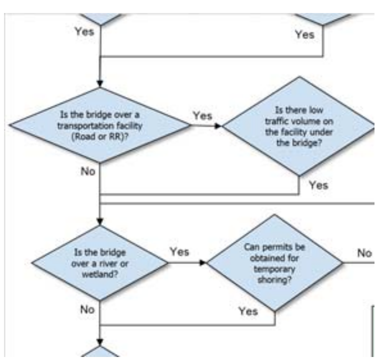
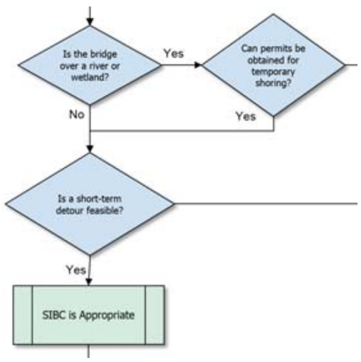


Sites Suitable for SIBC



Delivery Methods/Contracting

- Not all options are available in all locations – some governments prohibit certain contracting methods
- Design-bid-build
- Design-build
- Construction manager/general contractor (CM/GC)
- A+B contracting
- And value engineering should always be an option

Design-Bid-Build

- Separate contracts for design and build
- Selection based on lowest total construction cost
- A complete design must be developed prior to bid
  - Temporary shoring design is still undertaken by the contractor

Design-Bid-Build

- Advantages
  - Widely applicable and well understood
  - Clearly defined roles for parties involved
  - Competitive bidding process
- Disadvantages
  - Lack of input from contractor
  - Delay claims and disputes are common
  - Change orders are common
  - SIBC is new to most designers

Design-Build

- Brings the design and construction under one contract for one team
- Owner gives up much of the control over the design and construction processes. Owner must communicate expectations very clearly
- Owner typically does some up-front design work prior to bidding
- Owner must then define fundamentals of what is expected in terms of performance, etc.

Design-Build

- Advantages
  - Faster project delivery in many cases
  - Design can be tailored to contractors experience
  - May promote innovative design thinking
  - Can benefit from contractor SIBC experience
  - Change orders are minimized
- Disadvantages
  - Outcomes must be clearly communicated
  - Owner relinquishes control; designer is working for the contractor and not the owner. DB team takes on more risk
  - Team must complete some design “at their expense” in order to bid
  - Cost savings, if any, can vary

CM/GC

- Similar to design-build in that the contractor and designer work together
- However, each has their own contract with owner; and, the owner is an integral part of the team
- Both designer and contractor are independently selected by the owner
- Risks are identified and managed

CM/GC

- Advantages
  - Fast project delivery
  - No significant up-front design needed
  - Design can be tailored to contractor capabilities
  - Lower construction costs possible
  - Change orders are minimized
- Disadvantages
  - Question as to how to select contractor without a design
  - Must be a checks-and-balances system to verify bid costs
  - Cost negotiations

A+B

- Combines base bid price and a value to a time component.
- Winning bid is the combination considered to be of best overall value
  - A = dollar bid for the contract work items
  - B = usually road user costs associated with user delays
- Contractor is only paid the A component

A+B

- Advantages
  - Contractor’s schedule must minimize construction time and delays
- Disadvantages
  - Contract changes are magnified
  - More resources may be required for contract administration

Project Highlight

Design-Build

- Mesquite Interchange
  - Team proposed slide
  - Saved 6 mo. and $10 M
- Elk Creek
  - Team proposed slide
  - Saved 22 mo. and $3M

Knowledge Check

Can any delivery method option be used in all locations?

No

Some governments prohibit certain contracting methods.

Planning for SIBC

- The owner must ensure that there is sufficient right-of-way at the site for likely SIBC equipment
- Great care must be given to determining acceptable length of closures
  - Incentives and disincentives must be appropriately defined. Too high or too low can have undesired consequences
- Expectations with respect to "traffic impact" must be defined
  - On bridge
  - Below bridge
- The owner and contractor should involve the public from very early on
- Naming or branding the project or program (i.e., "Accelerated Bridge Program") early on should be considered because it is likely to be named by the media or public regardless

Planning for SIBC

- The programming of costs should recognize that higher costs may be realized
- Owner must define needed submittals and provide project specifications that define the desired design criteria
- It is likely that a great level of attention to creating and reviewing specifications will be required of the owner especially on the first project. The same is also true for contractor submittals
- The owner needs to devise a reasonable project timeline where the SIBC period is conducive to submission, review, weather, and closure timing

Planning for SIBC

- Once construction begins the owner must be willing to dedicate additional resources to construction inspection
  - Inspectors must have a clear understanding of what is desired, what is acceptable and what isn't
  - Must be prepared for inspectors to work long hours
- The contractor must be willing and able to commit more resources than normal during the slide or other critical operations
- The contractor should be required to effectively communicate means and methods with an assembly plan so that the owner, designer, and others understand and can verify
- The contractor must have a fluid and efficient communication plan both before and during construction

Planning for SIBC

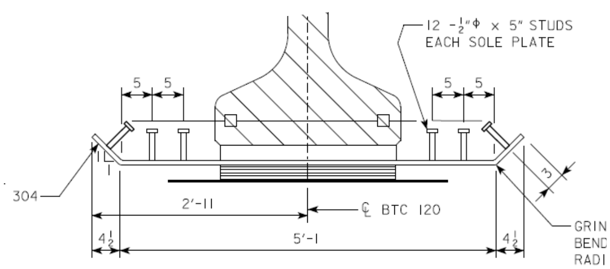
- The contractor must have a contingency plan
  - Emergency response
  - Equipment failure
  - Extended detour time
  - Accident on detour
  - Severe weather

Design and Detailing

- In general, loads from sliding operations are similar to normal service life loads though jacking force loads should be addressed in design
  - Special attention is required for the design and detailing of the push and jacking locations
  - The use of concrete integral diaphragms are useful in dealing with this issue
- Typically a bridge designer can relate slide operations to other maintenance operations
  - Lifting from slide bearings to final position is similar to replacing a bearing

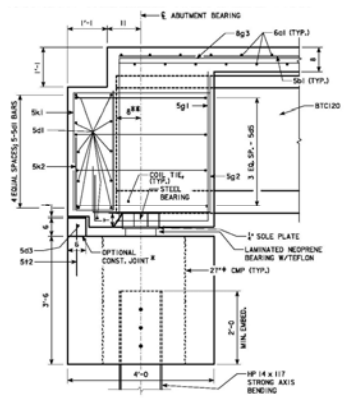
Design and Detailing

- Details are dependent on the slide system used
- Detailing of slide shoes and bearings required
- Jacking locations needed for bearing change-out



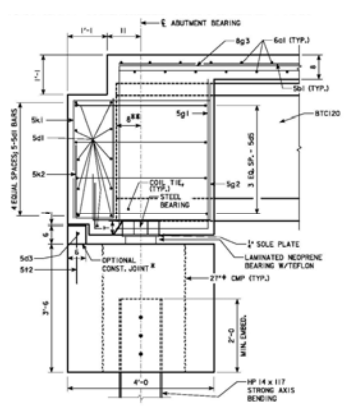
Design and Detailing

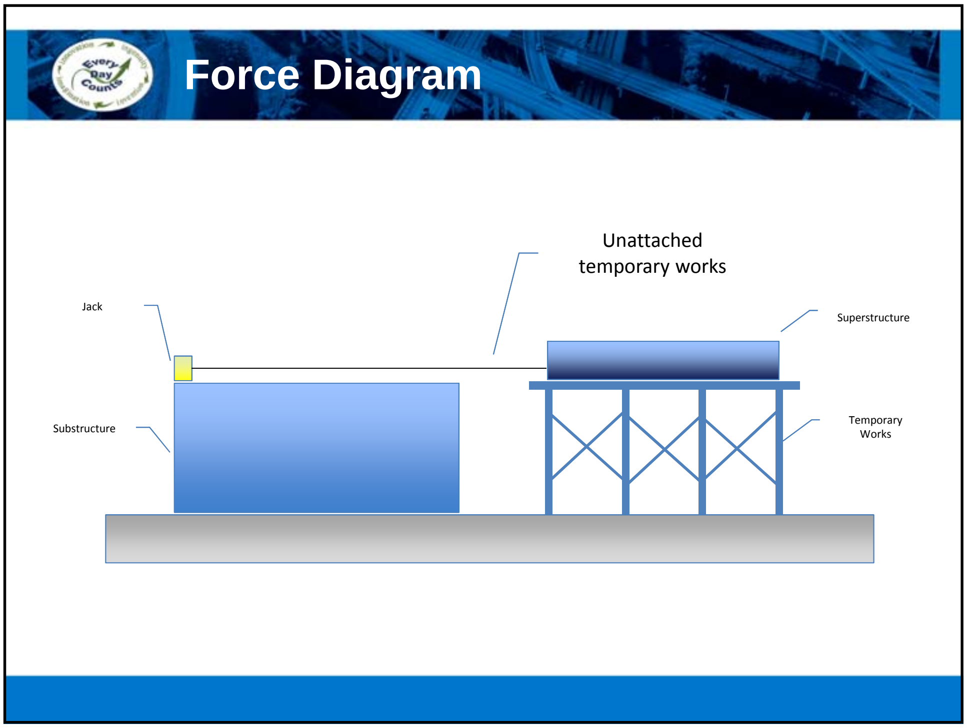
- Owner should be open to contractor suggestions for modifications of the design to accommodate specific construction processes
  - Include notes in contract to allow for contractor submitted alternate slide shoes and jacking locations
- Semi-integral abutments can be used to facilitate detail; substructure needs to be designed appropriately

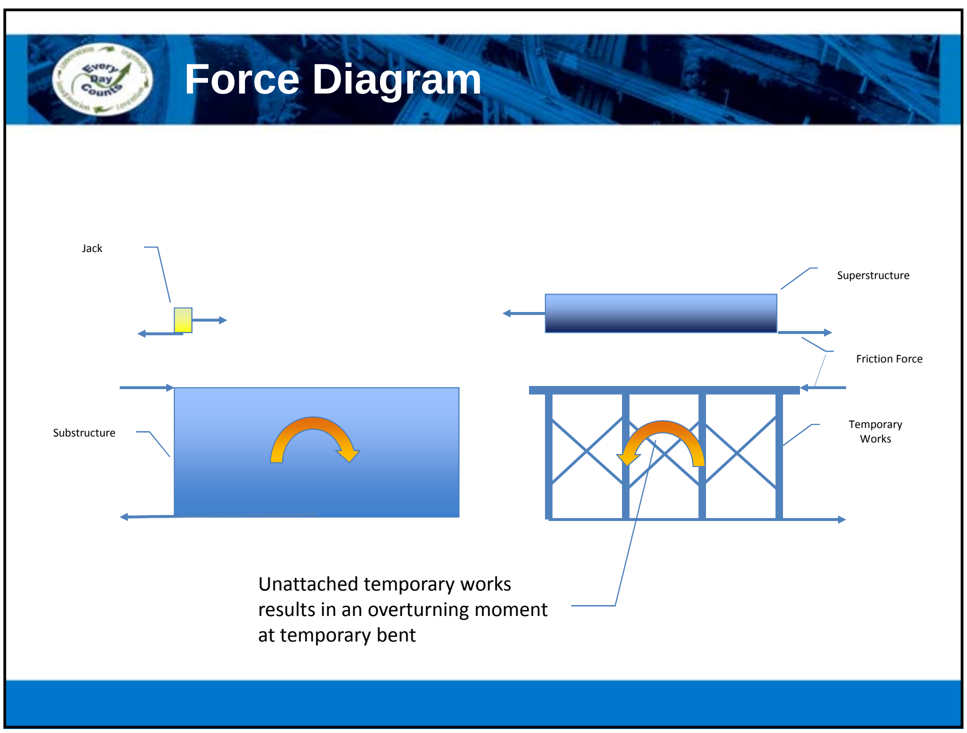


Design and Detailing

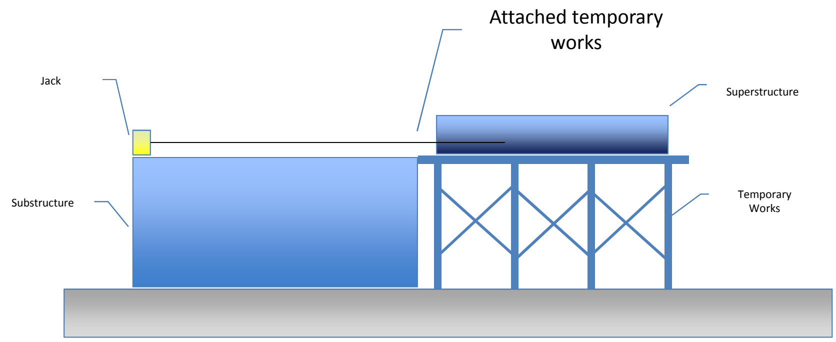
- Detail adjustability on the bearings to provide uniform loading on all bearings
- Need for slide displacement monitoring and controls
- Temporary works structure should be attached to substructure



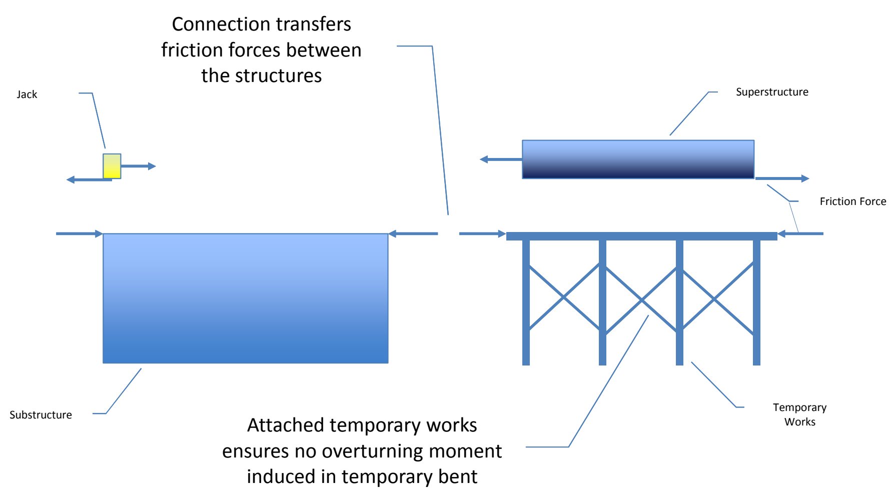

Force Diagram
Unattached
temporary works
Jack
Superstructure
Substructure
Temporary
Works


Force Diagram
Jack
Superstructure
Friction Force
Substructure
Temporary
Works
Unattached temporary works
results in an overturning moment
at temporary bent

Force Diagram

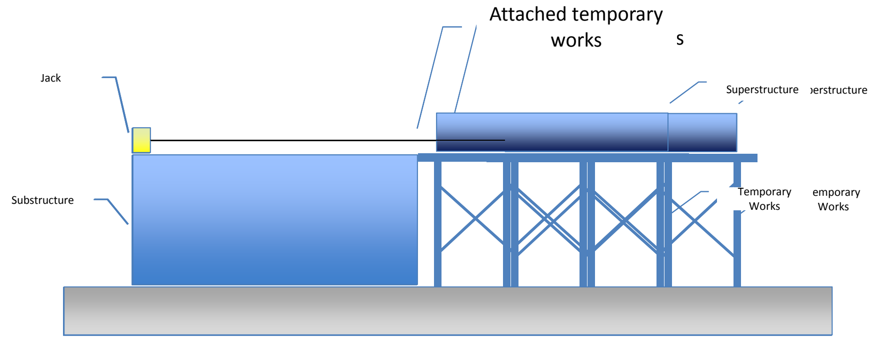


Force Diagram



Knowledge Check

Which is a better method for constructing temporary works?



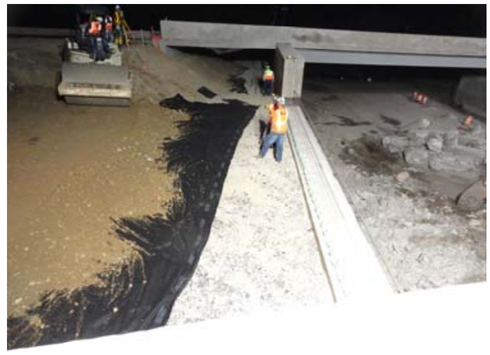
Project Highlight

Massena – Iowa

- Semi-integral abutment acts as jacking location
- Temporary works attached to permanent substructure

Approach Slab

Attention to approach slab design and construction should be a priority and not an afterthought



Design of Temporary Works

- Temporary works usually lies within the contractor's responsibilities, including foundation design. Possibly different if live load on temporary works is intended
- Must be completed by a competent, registered professional engineer
- Geotechnical investigation should be the responsibility of the engineer of record
  - Reports should consider both deep and shallow foundations
  - Design parameters should be included in the contract documents

Design of Temporary Works

- Additional geotechnical borings at falsework locations may be required to ensure that the temporary foundation system operates as desired/needed
  - The contractor should be required to hire a geotechnical engineer if the proposed foundations are different than what is described in the geotechnical report
- Codified resources
  - Guide Design Specifications for Bridge Temporary Works
  - Temporary substructure according to AASHTO for temporary bridges
  - Design for full seismic, wind or other probability based design loads may not be needed
- Engineer of record for the temporary works will be responsible for the acceptance of that portion of the project

Design of Temporary Works

- Engineer of record should have ways of verifying certification of materials used for temporary works
- It is recommended to hold a pre-bid meeting
  - Sample temporary works drawings should be provided to contractors new to SIBC
- The construction of the superstructure on the falsework is nearly identical to that of conventional construction

Design of Temporary Works

- Accurate estimation of jacking forces is critical.
- Where the jacking forces will be applied is equally critical. Design engineer must consider localized effects during design.
- Engineer must recognized that lateral slides rarely go perfectly lateral Racking or binding increases concentrated loads at the jacking points. Connections must be appropriately designed
- Temporary works frame needs to be attached to permanent substructure
- Provide jacking locations for vertical adjustment of superstructure

Design of Temporary Works

- Minimize differential settlements
- All loads are transient and changing. Therefore analysis must be completed at each state and stage
- Differential displacement must be minimized to the extent possible
- P-delta forces might need to be considered. When critical, additional bracing should be provided
- Some critical loading cases will be for horizontally and vertically applied jacking loads

Design of Temporary Works

The engineer must make a very good estimation of the coefficient of friction (static and kinetic) expected during the slide. Verify during rehearsal slide

Slide Mechanism	Estimated Lateral Force Required*
PTFE coated neoprene bearing pads	10% of vertical load
Heavy duty rollers	5% of vertical load**

* Recommended 5% minimum design load in any case
** Possibility of roller binding occurring increasing lateral force required

Design of Temporary Works

Transition from temporary support to permanent structure must be designed to accommodate the transient load and possible differential deflection

Knowledge Check

Who is typically responsible for the design of temporary works for slide in bridge construction?

Contractor

Knowledge Check

What percentage of vertical load can be considered a good estimate for the forces required to slide a bridge superstructure on PTFE coated neoprene bearing pads?

- 5%
- 10%
- 15%
- 20%
- 25%

SIBC Slide Methods

SIBC Hardware

- Rollers
- Skids
- PTFE pads
- Hydraulic rams
- Hydraulic threaded bars
- Vertical jacking hardware

Power Systems

- Hydraulic jack
- Hydraulic push/pull jack
- Winches
- Cranes
- Other Equipment

Submittals

- Slide system
- Slide plan
  - Hour by hour schedule
  - Communication plan
  - Contingency plan
- Contractor’s ingress/egress plan
- Temporary works
  - Separate temporary supports and actual slide

Case Study: Elk Creek

Oregon Department of Transportation

Location

Project Overview

- Design Build, Best Value Selection
- Winning team proposed 2 slide-ins to eliminate expensive detours and flagging
- Winning bid: approximately $50,000,000
- Engineers estimate: approximately $53,000,000
- Actual project duration: 32 months
- Estimated project duration: 54 months

Why SIBC?

Crossing No. 3

- 2-lane detour very expensive and high risk
  - Long detour bridge with high bents or shorter detour with potentially unstable rock cut presenting high risk of unknown resultant solution
  - High risk due to temporary bents within narrow stream channel
  - Very little working room left on East end
- Rapid replacement would score higher and guaranteed full incentive

- Reduced risk of unknowns by avoiding cut slopes and potential geologic instabilities

Why SIBC?

Crossing No. 4

- Single-lane detour problematic
  - A two-lane detour was impossible
  - Staging at tunnel portal would have required temporary signal or constant flagging
  - Analysis demonstrated temporary traffic signal would back traffic up across Crossing No. 3 – negative in proposal
  - 180 calendar days to complete new bridge

- Rapid replacement, which was not envisioned in the procurement documents for these sites, would score higher and guaranteed full incentive

Crossing 3

- Three-span continuous steel plate girder
- Translation accomplished by support at two interior points with end spans cantilevered

Crossing 4

- Two-span prestressed concrete deck girder bridge
- Translation supported at four points

Crossing 4

Keys to success

- Reduction in construction time offsetting additional SIBC costs
- Reduction In MOT time resulting in schedule savings and good public relations
- Elimination of flagging, 180 days one way traffic and traffic shifts – cost savings
- Elimination of a significant temporary bridge carrying public traffic – risk reduction
- Coordination and cooperation with the owner and local communities

Keys to success

- Performance based procurement specifications allowing for innovation and an engineered solution
- Maintained traffic on alignment throughout, greatly enhancing traveler safety and reducing risk

Community Outreach

- Instrumental in providing information to traveling public
- Initiative with local schools
- Student pylon designs
  - $500 scholarship
- Time capsule

Picture Courtesy of Structural Engineer Magazine

Contractor Obstacles on DBB

- Contract issues
  - Design modifications to complete the slide (Will the owner accept the changes?)
  - Contract documents may preclude a complete closure. Will an owner accept a complete overnight closure in place of months of lane restrictions?
  - Are additional environmental clearances or permits required?
- ATC process provides a viable method to bid
- Site concerns
- Reduction in quality
- Design concerns
- Cost concerns
- Increase in risk
- Contract issues

Time Lapse Video

“FHWA Slide”

www.fhwa.dot.gov/construction/sibc/

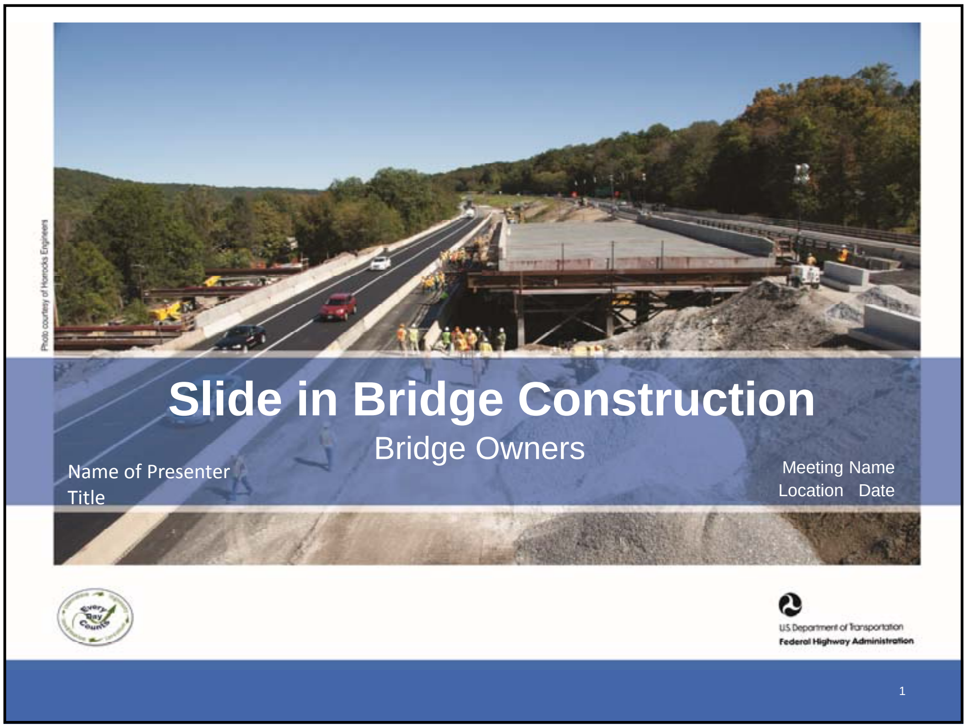
U.S. Department of Transportation
Federal Highway Administration

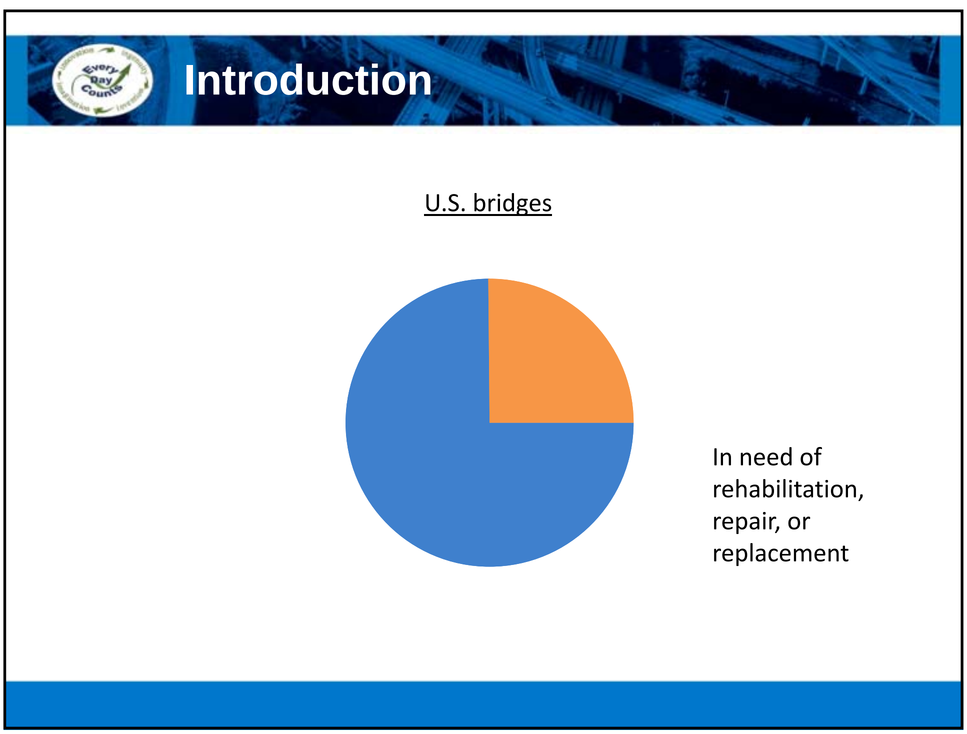
Thank you!

U.S. Department of Transportation
Federal Highway Administration

PRESENTATION HANDOUTS:

COURSE 3 SIBC OVERVIEW FOR OWNERS


Slide in Bridge Construction
Bridge Owners
Name of Presenter
Title
Meeting Name
Location Date
U.S. Department of Transportation
Federal Highway Administration
1


Introduction
U.S. bridges
In need of rehabilitation, repair, or replacement

Background

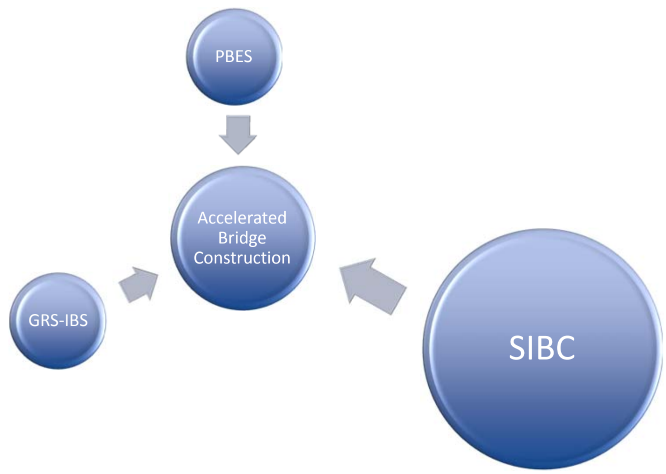
Deploy underutilized innovations to:

- Shorten delivery of highway projects
- Enhance roadway safety
- Reduce congestion
- Improve environmental sustainability

EDC-2 Initiative

EDC-2 launched in 2012 to shorten delivery time using new technologies

EDC-2 Initiative



Agenda

Overview for owners

- Definition and benefits of SIBC
- Decision making and delivery methods
- Planning and designing for SIBC
- Relations with media and public
- Case study

What is SIBC?

- ABC method also known as known as lateral sliding or skidding
- New bridge (normally) built parallel to existing bridge on temporary supports
- New bridge slid into place after
  - New substructure constructed
  - Old bridge demolished
  - Moved laterally using hydraulics or a winch. Some minor vertical jacking is typically needed.

What is SIBC?

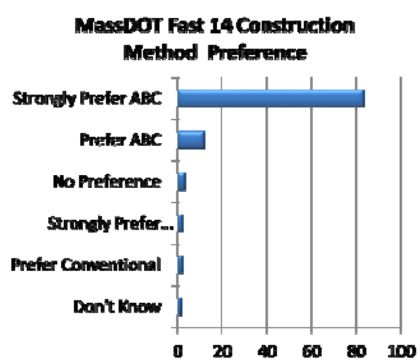
- Reduced disruption if substructure can be constructed below the existing bridge
- Minimal disruption likely requires innovative foundation systems
  - Drilled shafts outside footprint of existing bridge
  - Micro or mini piles
  - Integrating cap beams
  - Spread footings
- Prefabricated substructure units

What is SIBC?

- Can be used for temporary bypass bridges
  - Temporary substructure must be designed for live and other transient loads

Benefits

- What is driving the use of SIBC?
  - Increased traffic demands
  - Increasing congestion
  - Public demand for rapid delivery of projects
  - Safety
  - Societal costs
  - Mobility
  - Environmental impact
  - Lower cost and less risk when compared to other structure placement methods (e.g., SPMT)



Benefits

- Offers non-traditional site options
- Eliminates crossovers, shoo-flies, staged construction, and long term detours
  - Can result in lower construction costs/bid price
- Reduces mobility impacts

Benefits

- Promotes user and worker safety
- Better contractor “buy-in” when compared to other ABC methods
- Could reduce environmental impact

Benefits

- Removes bridge construction from critical path
  - May lead to better quality end product
- Involves public in reducing societal costs
  - Results in greater "buy-in" in the overall project
- Road closures better managed
  - Dates and duration are more predictable

Project Highlight

I-84 at Dingle Ridge Road – New York

- Cost savings
  - Over $1.2 M in user delay cost savings by using ABC (Source: NYSDOT)
  - $2 M cost savings from elimination of cross-overs, temporary bridge (Source: NYSDOT)
  - Savings in work-zone accidents costs

Potential Challenges

- Internal resistance in the DOT
- Finding experienced contractors or heavy lift engineer
  - Mitigated through education
  - Becoming less of a challenge as more projects are bid nationwide
- Public interest
  - Spectators on the job site

Potential Challenges

- Curved bridges; high skews
- Vertical profile changes
- Lack of space adjacent to bridge
- Traffic management plans
  - A need to be fluid and/or a have a contingency plan in place

Potential Challenges

- Possible contractor limitations
  - Forethought, significant temporary shoring, and unconventional schedules are required
- Time commitment
  - Requires 24 hour commitment of the contractor/design/owner team during slide operations
- Worker fatigue
  - Extended time for contractor, owner, and designer

Potential Challenges

- Difficult foundations/substructures
- Equipment breakdowns
- Speed of approach work completion
- Surveying mistakes
- Public spectators

Project Highlight

Elk Creek – Oregon

- Site concerns
  - Mountainous terrain surrounding bridge construction site
  - Slides can be effective even in very confined locations

Factors of Interest

- ADT/ADTT
- Facility crossed
  - Railroad/roadway
  - Navigable waterway
  - Evacuation route
- Detour length
  - Duration and viability
- Environmental
  - Limits on when
  - Limits on how

Factors of Interest

- On critical path of entire project
- Available right of way for bridge construction
- Traffic analysis
- Contractor’s work area and ingress/egress ability

Costs

- Direct vs. indirect
  - Account for agency and other indirect cost savings during decision making (CEI labor, flagging, field office, etc.)
- Avoided costs (detours)
- Reduced inflation costs (i.e., decreased construction time)

Project Highlight

Mesquite Interchange - Nevada

- Project costs
  - Total interchange reconstruction = $15 million
  - Original estimate without ABC = $25 million

Knowledge Check

In SIBC, the new bridge is constructed parallel to the existing bridge on temporary **supports.**

Knowledge Check

What types of innovative foundations systems are commonly used to minimize disruption?

- Drilled shafts outside footprint of existing bridge
- Micro or mini piles
- Integrating cap beams
- Spread footings
- All of the above

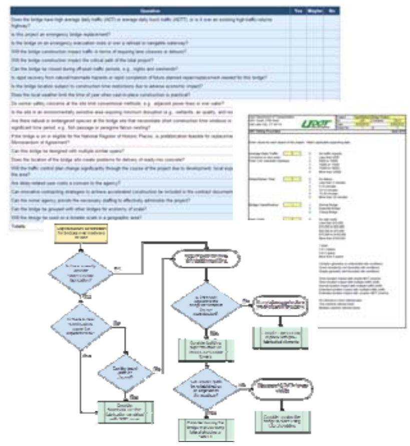
Knowledge Check

True or false: SIBC can eliminate crossovers, shoo-flies, staged construction, and long term detours resulting in lower construction costs/bid price?

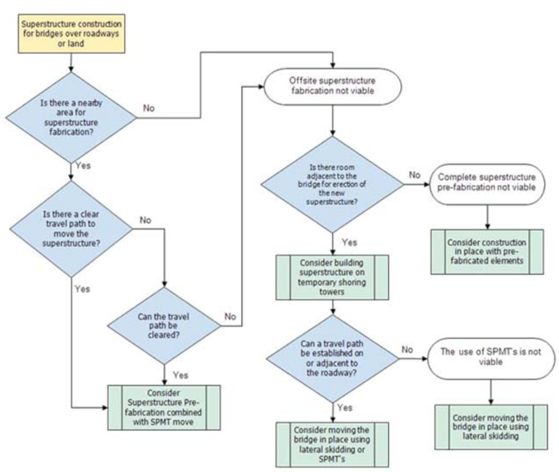
TRUE

Decision Making

- Tools exist to help owners decide when and where to use ABC and what type of ABC to use
- Tools come in five primary forms
  - Flowcharts
  - Weighted Scoring Method
  - Matrix
  - Narratives to describe the situation
  - Analytical Hierarchy Process (AHP)



Flowchart Method



Weighted Scoring Method

Utah Department of Transportation
4501 South 2700 West
Salt Lake City, UT 84114

Project:	Hypothetical Bridge Project
By:	JJS
Checked:	CELS
Date:	8/30/2010
Date:	8/30/2010
Sheet No.	1 of 3

ABC Rating Procedure — June 2010

Enter values for each aspect of the project. Attach applicable supporting data.

Aspect	Value	Score	Description
Average Daily Traffic Combined on and under Enter 5 for Interstate Highways	5	0	No traffic impacts
		1	Less than 5000
		2	5000 to 10000
		3	10000 to 15000
		4	15000 to 20000
		5	More than 20000
Delay/Detour Time	2	0	No delays
		1	Less than 5 minutes
		2	5-10 minutes
		3	10-15 minutes
		4	15-20 minutes
		5	More than 20 minutes
Bridge Classification	1	1	Normal Bridge
		3	Essential Bridge
		5	Critical Bridge
User Costs	4	0	No user costs
		1	Less than $10,000
		2	$10,000 to $50,000
		3	$50,000 to $75,000
		4	$75,000 to $100,000
		5	More than $100,000
Economy of Scale (total number of spans)	2	0	1 span
		1	2 to 3 spans
		2	4 to 5 spans
		3	More than 5 spans
Use of Typical Details	1	1	Complex geometry or unfavorable site conditions
		3	Some complexity, but favorable site conditions
		5	Simple geometry and favorable site conditions
Safety	5	1	Short duration impact with simple MOT scheme
		2	Short duration impact with multiple traffic shifts
		3	Normal duration impact with multiple traffic shifts
		4	Extended duration impact with multiple traffic shifts
		5	Extended duration impact with complex MOT scheme
Railroad Impacts	0	0	No railroad or minor railroad spur
		3	One mainline railroad track
		5	Multiple mainline railroad tracks

Utah Department of Transportation
4501 South 2700 West
Salt Lake City, UT 84114

Project:	Hypothetical Bridge Project
By:	JJS
Checked:	CELS
Date:	8/30/2010
Date:	8/30/2010
Sheet No.	2 of 3

ABC Rating Procedure — June 2010

Note: Do not adjust weight factors without prior consultation with UDOT Structures Division Project Manager

ABC RATING SCORE FACTORS AND WEIGHTS

	Score	Weight Factor	Adjusted Score	Maximum Score	Adjusted Score
Average Daily Traffic	5	10	50	5	50
Delay/Detour Time	2	10	20	5	50
Bridge Classification	1	5	5	5	25
User Costs	4	10	40	5	50
Economy of Scale	2	3	6	3	9
Use of Typical Details	1	3	3	5	15
Safety	5	10	50	5	50
Railroad Impacts	0	5	0	5	25
		Total Score	174	Max. Score	274

ABC Rating Score: 64

The ABC Rating Score is driven by the four most heavily weighted factors: Average Daily Traffic, Delay/Detour Time, User Costs and Safety. For a detailed explanation, review the narrative on page 4 of the ABC Decision Making Process.

Cost Considerations:
Calculate the following costs for use in determining the lowest total project cost

TOTAL PROJECT COST EVALUATION

	Alternative #1	Alternative #2
Construction Costs	$2,500,000	$3,000,000
User Costs	$1,000,000	$250,000
Total Project Cost	$3,500,000	$3,250,000

Matrix Method

Question	Yes	Maybe	No
Does the bridge have high average daily traffic (ADT) or average daily truck traffic (ADTT), or is it over an existing high-traffic-volume highway?			
Is this project an emergency bridge replacement?			
Is the bridge on an emergency evacuation route or over a railroad or navigable waterway?			
Will the bridge construction impact traffic in terms of requiring lane closures or detours?			
Will the bridge construction impact the critical path of the total project?			
Can the bridge be closed during off-peak traffic periods, e.g., nights and weekends?			
Is rapid recovery from natural/manmade hazards or rapid completion of future planned repair/replacement needed for this bridge?			
Is the bridge location subject to construction time restrictions due to adverse economic impact?			
Does the local weather limit the time of year when cast-in-place construction is practical?			
Do worker safety concerns at the site limit conventional methods, e.g., adjacent power lines or over water?			
Is the site in an environmentally sensitive area requiring minimum disruption (e.g., wetlands, air quality, and noise)?			
Are there natural or endangered species at the bridge site that necessitate short construction time windows or suspension of work for a significant time period, e.g., fish passage or peregrine falcon nesting?			
If the bridge is on or eligible for the National Register of Historic Places, is prefabrication feasible for replacement/rehabilitation per the Memorandum of Agreement?			
Can this bridge be designed with multiple similar spans?			
Does the location of the bridge site create problems for delivery of ready-mix concrete?			
Will the traffic control plan change significantly through the course of the project due to development, local expansion, or other projects in the area?			
Are delay-related user costs a concern to the agency?			
Can innovative contracting strategies to achieve accelerated construction be included in the contract documents?			
Can the owner agency provide the necessary staffing to effectively administer the project?			
Can the bridge be grouped with other bridges for economy of scale?			
Will the design be used on a broader scale in a geographic area?			
Totals:			

* Example taken from PBES Framework for Decision Making. Intended for illustrative purposes only.

Narrative Method

- Through a series of short descriptive narratives, an owner can be guided to a more plausible method of construction.
- The method is composed of five unique components:
  - The problem
  - Defining the solutions
  - Deciding the solution
  - Product realization
  - Final product

AHP Decision Making Tool

- Designed to select the best option from a set of alternatives
  - Compares ABC vs. conventional
  - Compares ABC alternatives
- Performs pairwise comparisons to rank alternatives
- Inputs and outputs are both qualitative and quantitative
- The tool is best used when completed independently by several people then combined for final collaboration
  - Creates excellent dialog
  - Qualitative input by different staff can lead to varied results. A consistent approach and same staff for each decision process is suggested

Knowledge Check

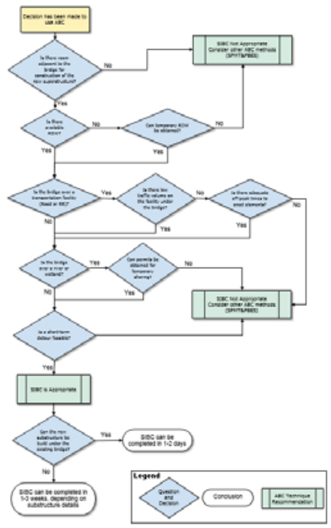
Which decision making tool assigns a value or score to what would otherwise only be a subjective decision?

Weighted Scoring Method

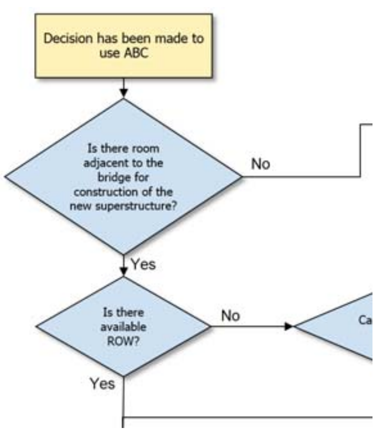
When to Use SIBC

- Ideal conditions for SIBC
  - Wide, flat area(s) adjacent to original structure
- Factors to be considered
  - Limited ROW
  - Terrain around existing bridge is rugged
  - Geotechnical conditions cannot adequately support temporary works
  - Alignment restrictions
  - Utilities

SIBC Flowchart Method



Sites Suitable for SIBC



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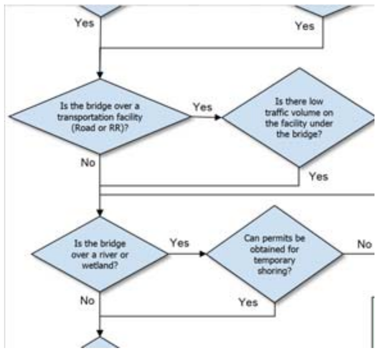

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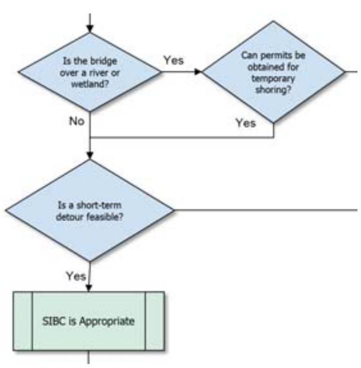

Delivery Methods/Contracting

- Not all options are available in all locations – some governments prohibit certain contracting methods
- Design-bid-build
- Design-build
- Construction manager/general contractor (CM/GC)
- A+B contracting
- And value engineering should always be an option

Design-Bid-Build

- Separate contracts for design and build
- Selection based on lowest total construction cost
- A complete design must be developed prior to bid
  - Temporary shoring design is still undertaken by the contractor

Design-Bid-Build

- Advantages
  - Widely applicable and well understood
  - Clearly defined roles for parties involved
  - Competitive bidding process
- Disadvantages
  - Lack of input from contractor
  - Delay claims and disputes are common
  - Change orders are common
  - SIBC is new to most designers

Design-Build

- Brings the design and construction under one contract for one team
- Owner gives up much of the control over the design and construction processes. Owner must communicate expectations very clearly
- Owner typically does some up-front design work prior to bidding
- Owner must then define fundamentals of what is expected in terms of performance, etc.

Design-Build

- Advantages
  - Faster project delivery in many cases
  - Design can be tailored to contractors experience
  - May promote innovative design thinking
  - Can benefit from contractor SIBC experience
  - Change orders are minimized
- Disadvantages
  - Outcomes must be clearly communicated
  - Owner relinquishes control; designer is working for the contractor and not the owner. DB team takes on more risk
  - Team must complete some design “at their expense” in order to bid
  - Cost savings, if any, can vary

CM/GC

- Similar to design-build in that the contractor and designer work together
- However, each has their own contract with owner, and the owner is an integral part of the team
- Both designer and contractor are independently selected by the owner
- Risks are identified and managed

CM/GC

- Advantages
  - Fast project delivery
  - No significant up-front design needed
  - Design can be tailored to contractor capabilities
  - Lower construction costs possible
  - Change orders are minimized
- Disadvantages
  - Question as to how to select contractor without a design
  - Must be a checks-and-balances system to verify bid costs
  - Cost negotiations

A+B

- Combines base bid price and a value to a time component
- Winning bid is the combination considered to be of best overall value
  - A = dollar bid for the contract work items
  - B = usually road user costs associated with user delays
- Contractor is only paid the A component

A+B

- Advantages
  - Contractor's schedule must minimize construction time and delays
- Disadvantages
  - Contract changes are magnified
  - More resources may be required for contract administration

Project Highlight

Design-Build

- Mesquite Interchange
  - Team proposed slide
  - Saved 6 mo. and $10 M
- Elk Creek
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Can any delivery method option be used in all locations?

No

Some governments prohibit
certain contracting methods.

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- The contractor must have a fluid and efficient communication plan both before and during construction

Planning for SIBC

- The contractor must have a contingency plan
  - Emergency response
  - Equipment failure
  - Extended detour time
  - Accident on detour
  - Severe weather

Media/Public Relations

- Develop a media plan
- Communicate that additional costs will replace months of inconvenience
- Allow adequate time for the public to make alternative plans during the most inconvenient times
- Communicate with the community prior to setting the schedule
- If traffic is variable, do extensive traffic counts to find the least amount of traffic, then select closure period appropriately
- Reach out through local news, websites, mailings, PR, meetings, Twitter, Facebook, etc.

Media/Public Relations

- Pay special attention to businesses and others directly adjacent to the site
- Use VMS in advance of the project to convey the plans
- If safely accomplished, invite and encourage the public to attend the slide
- Provide engineers and communications specialists to answer questions during construction
- Conduct feedback surveys from users after the slide-in

Project Highlight

Jamaica Ave – New York

- Substantial public outreach campaign began 3-4 weeks in advance of construction
- Communicated project details via letters, meetings, radio
- Posted construction details on State and City websites
- Broadcast of press release/travel advisory to media outlets and coordination of area-wide VMS signs

Knowledge Check

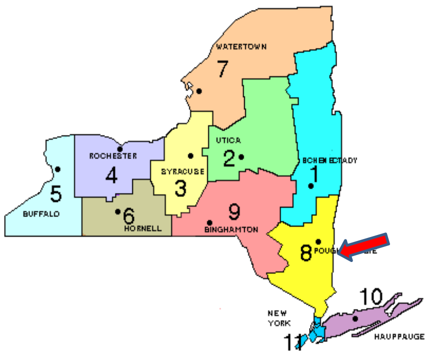
What methods of communication effectively convey the message to the general public regarding road closure times and durations for a slide in bridge project?

- Local news
- Websites
- Mailings
- Meetings
- Social media
- VMS
- All of the above

Case Study: Dingle Ridge Road

New York Department of Transportation

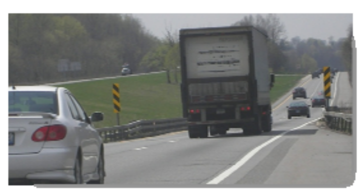
Project Location



- I-84 about 50 miles north of New York City
- 1 mile from CT border

Why ABC?

- Over 75,000 ADT
- One construction season for each bridge
- Traffic impact up to 2 years
- Seven acres of temporary impact
- Dozens of other bridges on NY I-84 corridor could benefit from ABC/slide-in construction



Why SIBC?

- Traditional methods would have required
  - Temporary bridge in the median
  - Substantial cross-over roadways
- Existing bridges are too narrow for cross-overs with two-way traffic
- Elevation differences between EB & WB roadways makes cross-overs more difficult
- Additional cost of approximately $2.0 M

Delivery Method

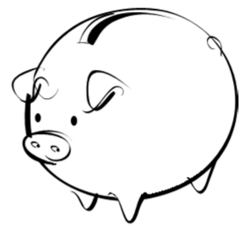
- Design-Bid-Build
  - Bridge design: HNTB
  - Highway design: NYSDOT Region8
  - Contractor: Yonkers Contracting, NY
  - Precaster: Dailey Precast, Vermont
  - Slide Contractor: Barnhart / Marino
  - Temp Structures: Siefert Associates, NY
  - Design funding: SHRP 2
  - Construction funding: NYSDOT and Highways for Life

SHRP2 STRATEGIC HIGHWAY RESEARCH PROGRAM

HIGHWAYS FOR LIFE Accelerating Innovation for the American Driving Experience.

Cost Savings with ABC

- Over $1.2 M in user delay cost savings by using ABC (Source: NYSDOT)
- $2 m cost savings from elimination of cross-overs, temporary bridge (Source: NYSDOT)
- Savings in work-zone accidents costs
- Cost for temporary supports and lateral slide: $1.06 M for both bridges



BID / ABC Schedule

- Low bid: Yonkers Contracting, New York
- Contract award January 2013
- $10.2 M (total cost); (bridge cost $6.1 M)
- Bid for temp. supports & lateral slide: $1.06 M
- Replaced westbound bridge: 9/21/13
- Replaced eastbound bridge: 10/19/13
- ABC window: 5 PM Saturday to 1 PM Sunday (20 hours)

Bridge Slide

Slide-In Construction

- Traffic disruption on I-84 reduced from two years to two weekend nights
- Dingle Ridge Road (low volume local road) was closed for 5 days

Pre Slide

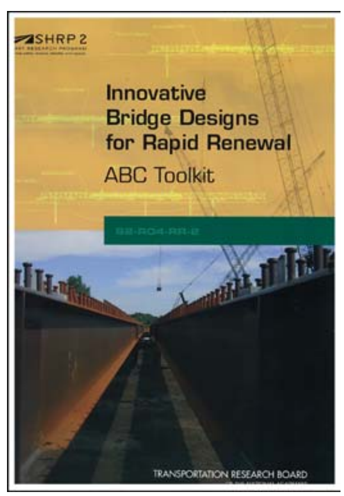
Slide Operation

Traffic Control

- Not an interchange – ramp detours not available
- Route 6/202, parallel to I-84, used as the detour (3 miles)

Bridge Design

- Structure design guided by Innovative Bridge Designs for Rapid Renewal
- SHRP2 ABC Toolkit concepts used for:
  - Concrete NEXT beams (Double Tee)
  - Precast approach slabs
  - UHPC connections
- Toolkit is being extended to cover slide-in bridge construction concepts



Design - New Bridges

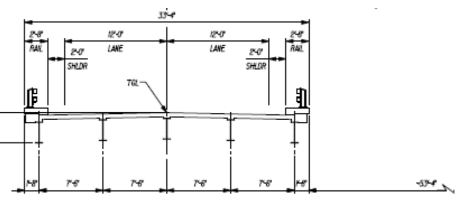
- Single span 80'; three lanes at 12' with shoulders
  - Original bridge was 3 spans
- Bridge width increased from 33'-4" to 57'-0"
- Use 3" asphalt wearing surface eliminates grinding
- Dingle Ridge Road passing beneath new bridges on 15.7% grade
- New bridges will be about two feet higher to maintain under-clearance
- Need to minimize new structure depth

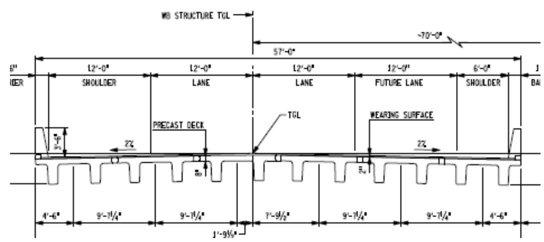
Design Challenges

- Complete slide in one weekend night
- Need to raise I-84 approaches as much as 2 feet during ABC window to satisfy under-bridge-clearance

Superstructure Sections

- 80 ft span
- Wider new bridge
- NEXT beam (double T beam) superstructure
- UHPC closure pours
- Precast approach slabs





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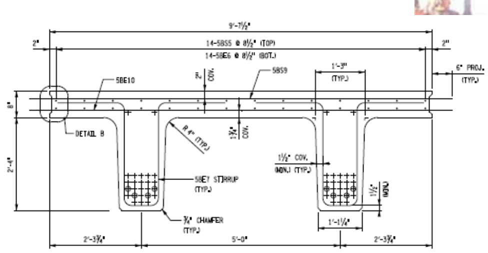
Superstructure Sections

- NEXT deck beams
- 36 inch deep sections
- 9'-8" flange; 8" thick
- f'c = 10 ksi
- 1.8 klf



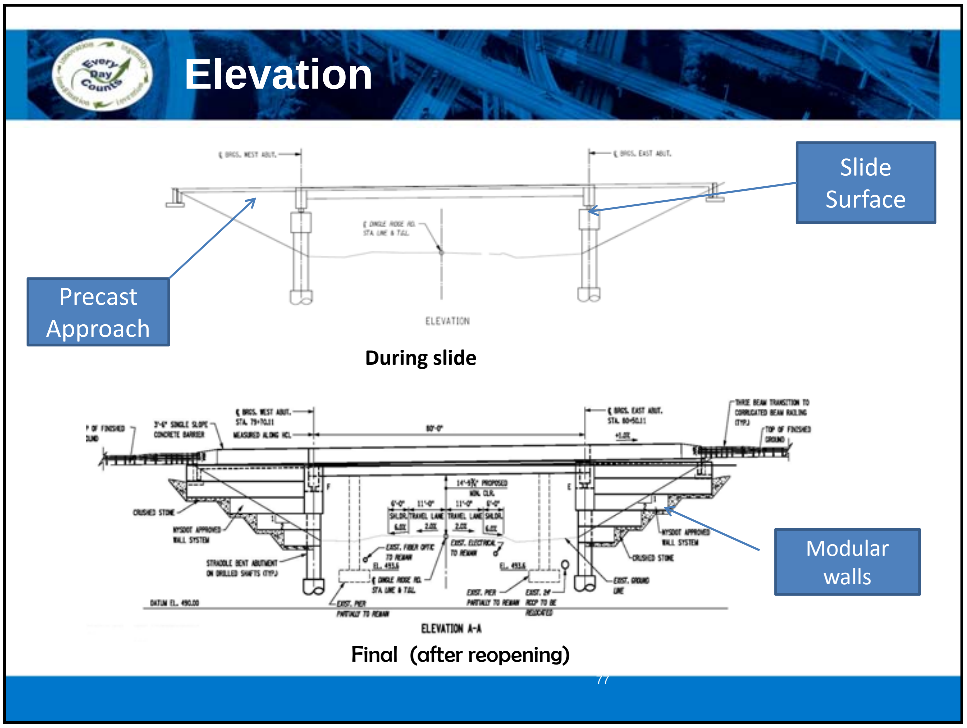
UHPC Connections

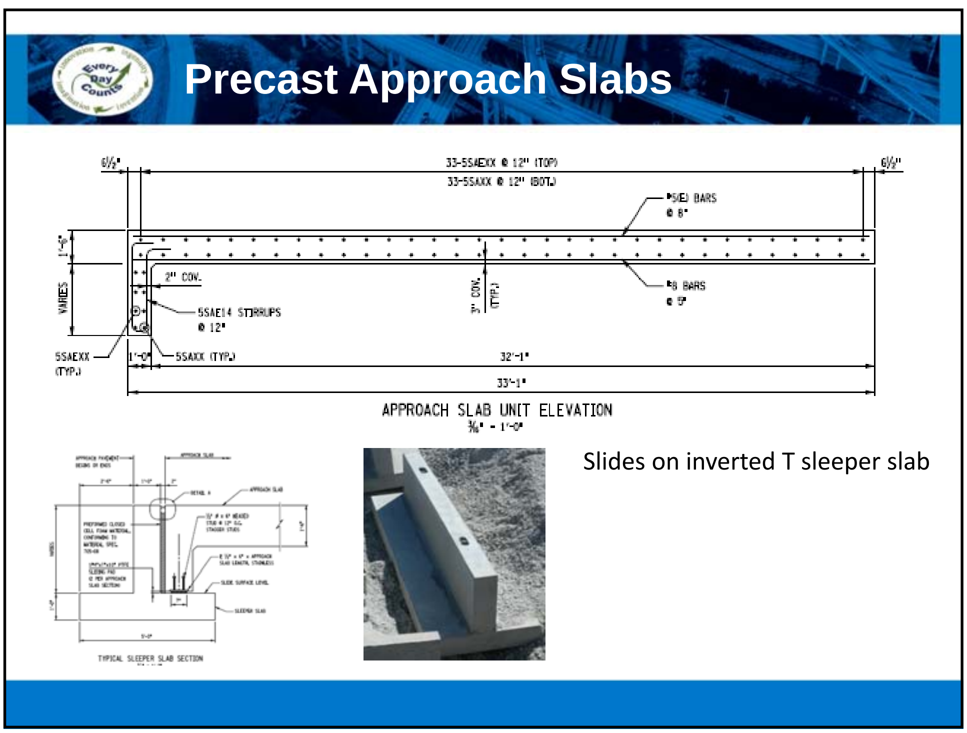
6” width

Compressive strength:
20,000 to 30,000 psi

Deck Waterproofing

- Spray-applied waterproofing membrane placed before the slide
- 3” asphalt overlay


Elevation
Slide Surface
Precast Approach
ELEVATION
During slide
Modular walls
ELEVATION A-A
Final (after reopening)


Precast Approach Slabs
33-5SAEXX @ 12" (TOP)
33-5SAXX @ 12" (BOT.)
#5(E) BARS @ 8"
#8 BARS @ 5"
2" COV.
5SAE14 STIRRUPS @ 12"
5SAEXX (TYP.)
5SAXX (TYP.)
32'-1"
33'-1"
APPROACH SLAB UNIT ELEVATION
Slides on inverted T sleeper slab
TYPICAL SLEEPER SLAB SECTION

Three Construction Stages

Stage 1: Pre slide period

- Complete substructures to slide elevation
- Construct new superstructure and approach slabs on temporary supports adjacent to existing bridge

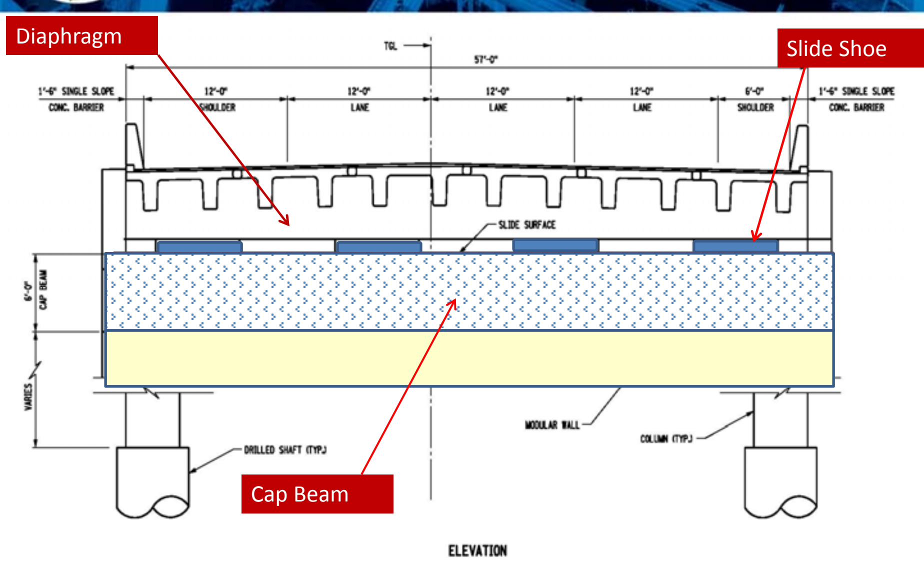
Stage 2: Slide period (20 hrs)

- Two weekends – Sept & Oct 2013
- Demolish bridge
- Slide in new bridge & approach slabs
- Raise approach roadways by over 2 ft

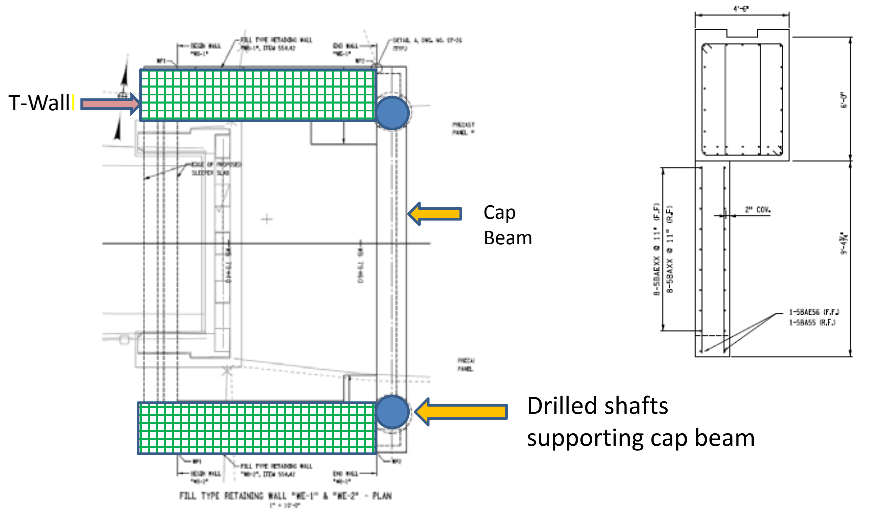
Stage 3: Post slide period

- Place flowable fill under approach slabs
- Remove temporary supports
- Complete approach roadway work

Straddle Bent Abutment



Abutment & Wingwalls



New Foundation

Foundation Construction

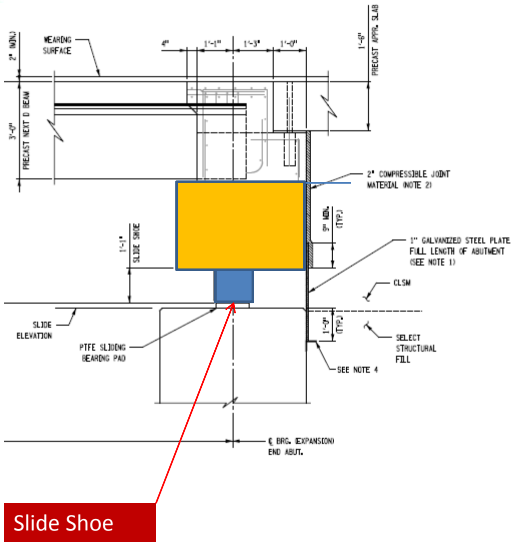
Drilled shafts outside existing footprint

Temporary Support

- Temporary bents on H piles
- Slide system

- Contractor designed
- Always connect temporary bents to the abutment

End Diaphragms & Slide Shoes



Slide Shoe

New Bridges

Abutment Slide Surface

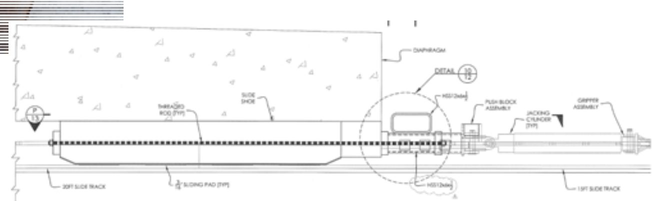
Stainless steel on 16 gage PTFE bonded to elastomeric bearing pad

Approach Slab Slide Surface

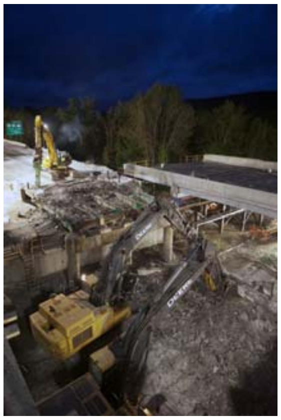
Stainless steel on PTFE pads

Inverted T Sleeper Slabs

Push/Pull Jacks at Abutments



Rapid Demolition – 4 Hours



- Chop and drop
- Local road below closed

Lateral Slide – Oct 21, 2013

Raising of Approach Roadways

- Done within slide period
- Slow compared to demo and slide

Both bridge slides completed 10 months after NTP!

View from Dingle Ridge Road

Lessons Learned

- Focus on roadway approaches as much as structure slide-in
- Need for displacement control during slide
- Importance of camber control in P/S beams
- With full depth precast P/S sections its recommended to use asphalt overlay

ABC Benefits

- Cost savings
- Minimizes road closure (2 weekend nights)
- Improved work zone safety
- Reduced impact to NYC watershed

Time Lapse Video

"FHWA Slide"

www.fhwa.dot.gov/construction/sibc/

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U.S. Department of Transportation
Federal Highway Administration

Thank you!

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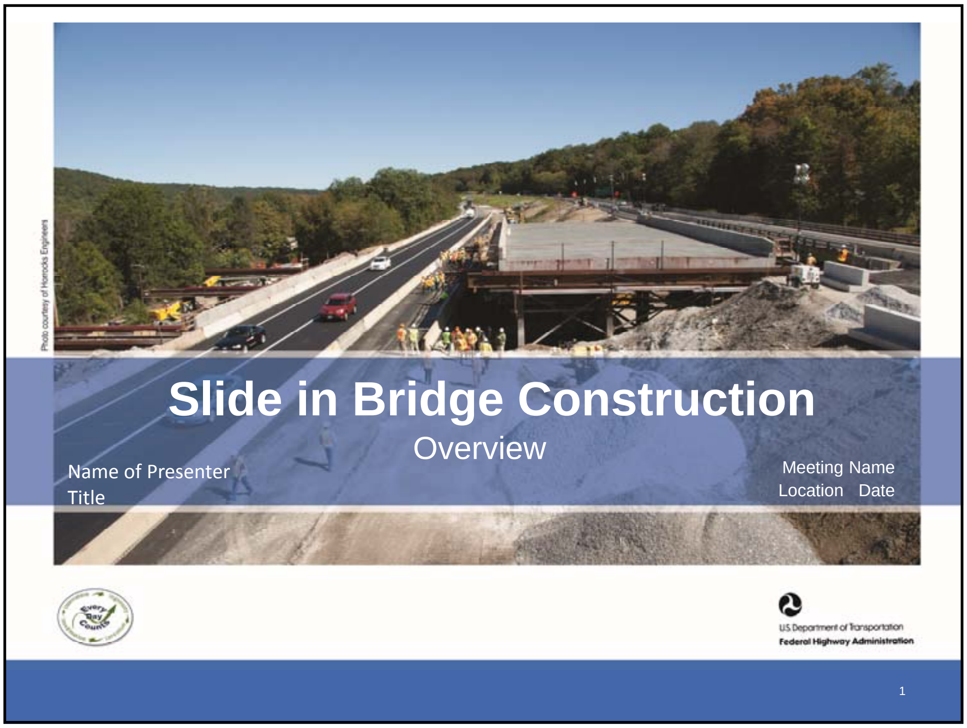
U.S. Department of Transportation
Federal Highway Administration

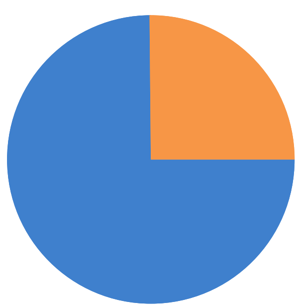
PRESENTATION HANDOUTS:

COURSE 4 SIBC OVERVIEW FOR ALL AUDIENCES



Introduction

U.S. bridges



In need of rehabilitation, repair, or replacement

Background

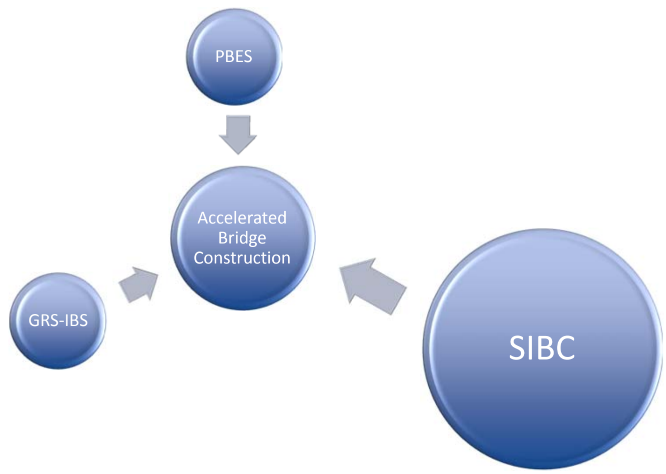
Deploy underutilized innovations to

- Shorten delivery of highway projects
- Enhance roadway safety
- Reduce congestion
- Improve environmental sustainability

EDC-2 Initiative

EDC-2 launched in 2012 to shorten delivery time using new technologies

EDC-2 Initiative



Agenda

Overview for owners, designers, and contractors

- Definition and benefits of SIBC
- Decision making and delivery methods
- Planning and designing for SIBC
- Submittals and temporary works
- Relations with media and public
- Case studies

What is SIBC?

- ABC method also known as known as lateral sliding or skidding
- New bridge (normally) built parallel to existing bridge on temporary supports
- New bridge slid into place after
  - New substructure constructed
  - Old bridge demolished
  - Moved laterally using hydraulics or a winch. Some minor vertical jacking is typically needed

What is SIBC?

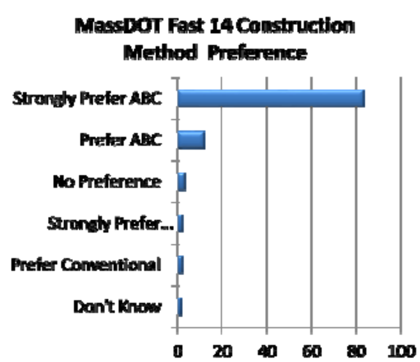
- Reduced disruption if substructure can be constructed below the existing bridge
- Minimal disruption likely requires innovative foundation systems
  - Drilled shafts outside footprint of existing bridge
  - Micro or mini piles
  - Integrating cap beams
  - Spread footings
- Prefabricated substructure units

What is SIBC?

- Can be used for temporary bypass bridges
  - Temporary substructure must be designed for live and other transient loads

Benefits

- What is driving the use of SIBC?
  - Increased traffic demands
  - Increasing congestion
  - Public demand for rapid delivery of projects
  - Safety
  - Societal costs
  - Mobility
  - Environmental impact
  - Lower cost and less risk when compared to other structure placement methods (e.g., SPMT)



Benefits

- Offers non-traditional site options
- Eliminates crossovers, shoo-flies, staged construction, and long term detours
  - Can result in lower construction costs/bid price
- Reduces mobility impacts

Benefits

- Promotes user and worker safety
- Better contractor “buy-in” when compared to other ABC methods
- Could reduce environmental impact

Benefits

- Removes bridge construction from critical path
  - May lead to better quality end product
- Involves public in reducing societal costs
  - Results in greater “buy-in” in the overall project
- Road closures better managed
  - Dates and duration are more predictable

Project Highlight

I-84 at Dingle Ridge Road – New York

- Cost savings
  - Over $1.2 M in user delay cost savings by using ABC (Source: NYSDOT)
  - $2 M cost savings from elimination of cross-overs, temporary bridge (Source: NYSDOT)
  - Savings in work-zone accidents costs

Potential Challenges

- Internal resistance in the DOT
- Finding experienced contractors or heavy lift engineer
  - Mitigated through education
  - Becoming less of a challenge as more projects are bid nationwide
- Public interest
  - Spectators on the job site

Potential Challenges

- Curved bridges; high skews
- Vertical profile changes
- Lack of space adjacent to bridge
- Traffic management plans
  - A need to be fluid and/or a have a contingency plan in place

Potential Challenges

- Possible contractor limitations
  - Forethought, significant temporary shoring, and unconventional schedules are required
- Time commitment
  - Requires 24 hour commitment of the contractor/design/owner team during slide operations
- Worker fatigue
  - Extended time for contractor, owner, and designer

Potential Challenges

- Difficult foundations/substructures
- Equipment breakdowns
- Speed of approach work completion
- Surveying mistakes
- Public spectators

Project Highlight

Elk Creek – Oregon

- Site concerns
  - Mountainous terrain surrounding bridge construction site
  - Slides can be effective even in very confined locations

Factors of Interest

- ADT/ADTT
- Facility crossed
  - Railroad/roadway
  - Navigable waterway
  - Evacuation route
- Detour length
  - Duration and viability
- Environmental
  - Limits on when
  - Limits on how

Factors of Interest

- On critical path of entire project
- Available right of way for bridge construction
- Traffic analysis
- Contractor's work area and ingress/egress ability

Costs

- Direct vs. indirect
  - Account for agency and other indirect cost savings during decision making (CEI labor, flagging, field office, etc.)
- Avoided costs (detours)
- Reduced inflation costs (i.e., decreased construction time)

Project Highlight

Mesquite Interchange - Nevada

- Project costs
  - Total interchange reconstruction = $15 million
  - Original estimate without ABC = $25 million

Knowledge Check

In SIBC, the new bridge is constructed parallel to the existing bridge on temporary **supports.**

Knowledge Check

What types of innovative foundations systems are commonly used to minimize disruption?

- Drilled shafts outside footprint of existing bridge
- Micro or mini piles
- Integrating cap beams
- Spread footings
- All of the above

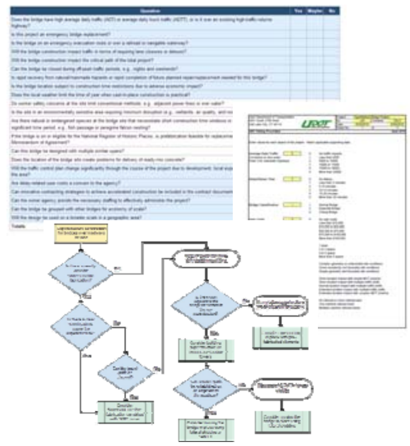
Knowledge Check

True or false: SIBC can eliminate crossovers, shoo-flies, staged construction, and long term detours resulting in lower construction costs/bid price?

TRUE

Decision Making

- Tools exist to help owners decide when and where to use ABC and what type of ABC to use
- Tools come in five primary forms
  - Flowcharts
  - Weighted Scoring Method
  - Matrix
  - Narratives to describe the situation
  - Analytical Hierarchy Process (AHP)



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Planning for SIBC

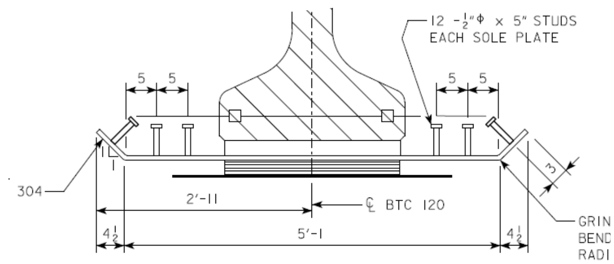
- The contractor must have a contingency plan
  - Emergency response
  - Equipment failure
  - Extended detour time
  - Accident on detour
  - Severe weather

Design and Detailing

- In general, loads from sliding operations are similar to normal service life loads though jacking force loads should be addressed in design
  - Special attention is required for the design and detailing of the push and jacking locations
  - The use of concrete integral diaphragms are useful in dealing with this issue
- Typically a bridge designer can relate slide operations to other maintenance operations
  - Lifting from slide bearings to final position is similar to replacing a bearing

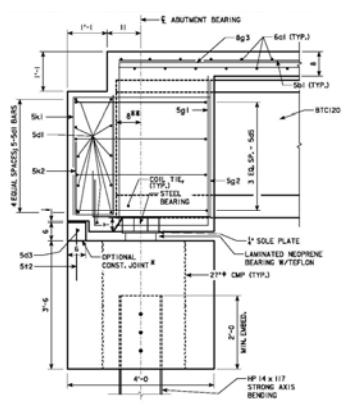
Design and Detailing

- Details are dependent on the slide system used
- Detailing of slide shoes and bearings required
- Jacking locations needed for bearing change-out.



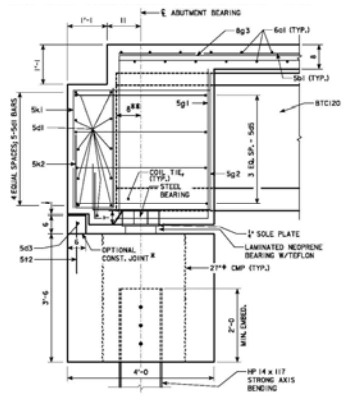
Design and Detailing

- Owner should be open to contractor suggestions for modifications of the design to accommodate specific construction processes
  - Include notes in contract to allow for contractor submitted alternate slide shoes and jacking locations
- Semi-integral abutments can be used to facilitate detail; substructure needs to be designed appropriately



Design and Detailing

- Detail adjustability on the bearings to provide uniform loading on all bearings
- Need for slide displacement monitoring and controls
- Temporary works structure should be attached to substructure



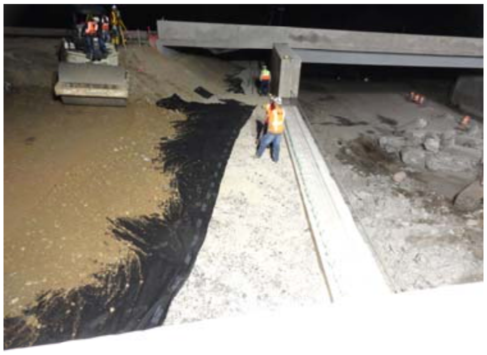
Project Highlight

Massena – Iowa

- Semi-integral abutment acts as jacking location
- Temporary works attached to permanent substructure

Approach Slab

Attention to approach slab design and construction should be a priority and not an afterthought

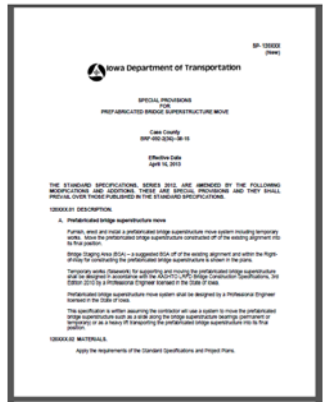


Approach Slab Options

- Approach slabs slid with bridge (Utah method)
  - Fast, but expensive
- Precast approach slabs placed after the slide
  - Some states have problems setting slabs
  - Consider the use of flowable fill under the ends of the slab
- CIP approach slabs
  - Can be built in 2 days
  - Need time to cure
- Buried approach slabs (European method)

Specifications

- Requirements for an assembly plan should be included
- Consider prequalification of high early strength grout
- Review field welding specifications
- Reasonable tolerances should be included
  - Consider thermal expansion and contraction



Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
PREFABRICATED BRIDGE SUPERSTRUCTURE MOVE

Cass County

Effective Date

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

DESCRIPTION.

A. Prefabricated bridge superstructure move

MATERIALS.

Apply the requirements of the Standard Specifications and Project Plans.

Specifications

- Pay special attention to contractual specifications (incentives/disincentives, liquidated damages, etc.)
- Requirements for timing of plan submissions and reviews should be included
- Prequalify slide contractor and slide system

Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
PREFABRICATED BRIDGE SUPERSTRUCTURE MOVE

Cass County

Effective Date

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DESCRIPTION.

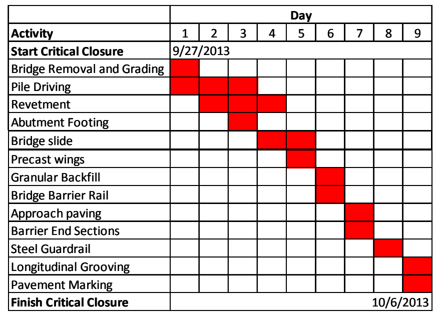
A. Prefabricated bridge superstructure move

MATERIALS.

Apply the requirements of the Standard Specifications and Project Plans.

Specifications

- Need for rehearsal slide prior to final slide
- Contingency plan during slide-in
- Detailed CPM schedule for slide-in
- Submittal of slide system working drawings



Design of Temporary Works

- Temporary works usually lies within the contractor's responsibilities, including foundation design. Possibly different if live load on temporary works is intended
- Must be completed by a competent, registered professional engineer
- Geotechnical investigation should be the responsibility of the engineer of record.
  - Reports should consider both deep and shallow foundations.
  - Design parameters should be included in the contract documents

Design of Temporary Works

- Additional geotechnical borings at falsework locations may be required to ensure that the temporary foundation system operates as desired/needed
  - The contractor should be required to hire a geotechnical engineer if the proposed foundations are different than what is described in the geotechnical report
- Codified resources
  - Guide Design Specifications for Bridge Temporary Works
  - Temporary substructure according to AASHTO for temporary bridges
  - Design for full seismic, wind or other probability based design loads may not be needed
- Engineer of record for the temporary works will be responsible for the acceptance of that portion of the project

Design of Temporary Works

- Engineer of record should have ways of verifying certification of materials used for temporary works
- It is recommended to hold a pre-bid meeting
  - Sample temporary works drawings should be provided to contractors new to SIBC
- The construction of the superstructure on the falsework is nearly identical to that of conventional construction

Design of Temporary Works

- Accurate estimation of jacking forces is critical
- Where the jacking forces will be applied is equally critical. Design engineer must consider localized effects during design
- Engineer must recognized that lateral slides rarely go perfectly lateral Racking or binding increases concentrated loads at the jacking points. Connections must be appropriately designed
- Temporary works frame needs to be attached to permanent substructure
- Provide jacking locations for vertical adjustment of superstructure

Design of Temporary Works

- Minimize differential settlements
- All loads are transient and changing. Therefore analysis must be completed at each state and stage
- Differential displacement must be minimized to the extent possible
- P-delta forces might need to be considered. When critical, additional bracing should be provided
- Some critical loading cases will be for horizontally and vertically applied jacking loads

Design of Temporary Works

The engineer must make a very good estimation of the coefficient of friction (static and kinetic) expected during the slide. Verify during rehearsal slide.

Slide Mechanism	Estimated Lateral Force Required*
PTFE coated neoprene bearing pads	10% of vertical load
Heavy duty rollers	5% of vertical load**

* Recommended 5% minimum design load in any case
** Possibility of roller binding occurring increasing lateral force required

Design of Temporary Works

Transition from temporary support to permanent structure must be designed to accommodate the transient load and possible differential deflection

Knowledge Check

Who is typically responsible for the design of temporary works for slide in bridge construction?

Contractor

Knowledge Check

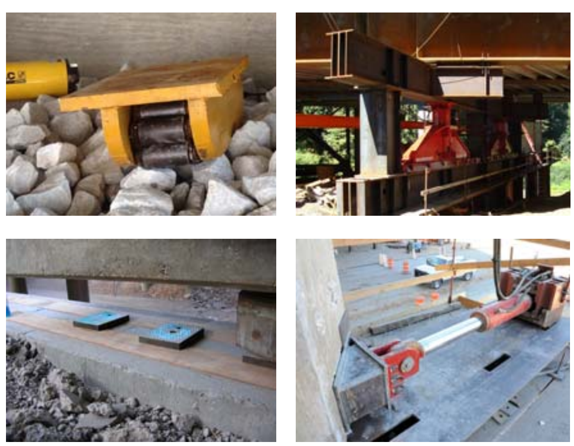
What percentage of vertical load can be considered a good estimate for the forces required to slide a bridge superstructure on PTFE coated neoprene bearing pads?

- 5%
- 10%
- 15%
- 20%
- 25%

SIBC Slide Methods

SIBC Hardware

- Rollers
- Skids
- PTFE pads
- Hydraulic rams
- Hydraulic threaded bars
- Vertical jacking hardware



Power Systems

- Hydraulic jack
- Hydraulic push/pull jack
- Winches
- Cranes
- Other equipment

Submittals

- Slide system
- Slide plan
  - Hour by hour schedule
  - Communication plan
  - Contingency plan
- Contractor's ingress/egress plan
- Temporary works
  - Separate temporary supports and actual slide

Media/Public Relations

- Develop a media plan
- Communicate that additional costs will replace months of inconvenience
- Allow adequate time for the public to make alternative plans during the most inconvenient times
- Communicate with the community prior to setting the schedule
- If traffic is variable, do extensive traffic counts to find the least amount of traffic, then select closure period appropriately
- Reach out through local news, websites, mailings, PR, meetings, Twitter, Facebook, etc.

Media/Public Relations

- Pay special attention to businesses and others directly adjacent to the site
- Use VMS in advance of the project to convey the plans.
- If safely accomplished, invite and encourage the public to attend the slide
- Provide engineers and communications specialists to answer questions during construction
- Conduct feedback surveys from users after the slide-in

Project Highlight

Jamaica Ave – New York

- Substantial public outreach campaign began 3-4 weeks in advance of construction
- Communicated project details via letters, meetings, radio
- Posted construction details on State and City websites
- Broadcast of press release/travel advisory to media outlets and coordination of area-wide VMS signs

Knowledge Check

What methods of communication effectively convey the message to the general public regarding road closure times and durations for a slide in bridge project?

- Local news
- Websites
- Mailings
- Meetings
- Social Media
- VMS
- All of the above

Case Study: Massena, IA

Iowa Department of Transportation

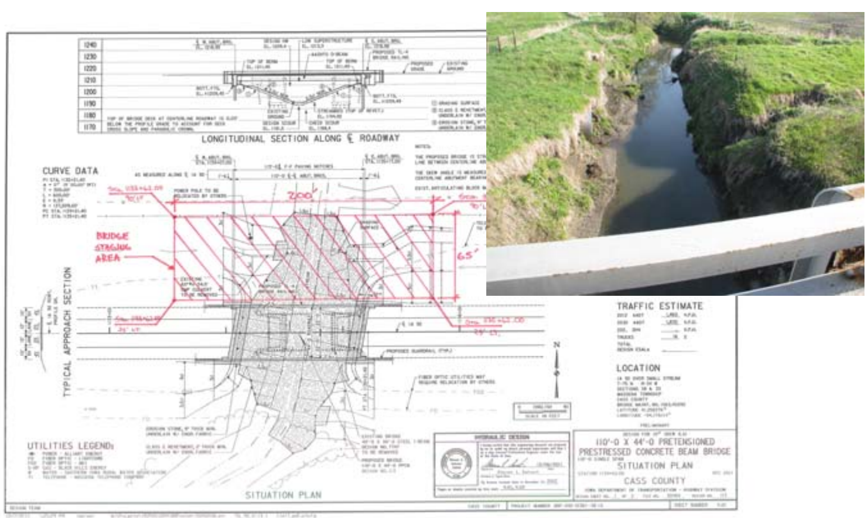
Location

- IA 92 over small stream, 1.0 miles west of IA 148

Why ABC?

- 13 mile detour – 7 mile out-of-distance travel
- AADT (2012) – 1,460 with 16% trucks
- User costs for 180-day detour
  - Indirect = $437,000
  - Direct = $15,000
    - County road maintenance
    - Detour signage

Why SIBC?



Delivery Method and Cost

- Design-bid-build
  - Design completed by DOT with external peer review
  - Peer exchange of information from Utah DOT was critical
  - Let April 16, 2013
- Cost
  - Winning bid - $1,300,000
  - Unit cost - $112/SF
    Historic bridge unit cost - $85/SF

Existing Structure

- 40’ x 30’ steel I-beam
- Constructed – 1930
- Reconstructed – 1949
- Overlay – 1968
- Retrofit rail – 1992
- Overlay – 1998
- Structurally deficient – sufficiency rating=38.2

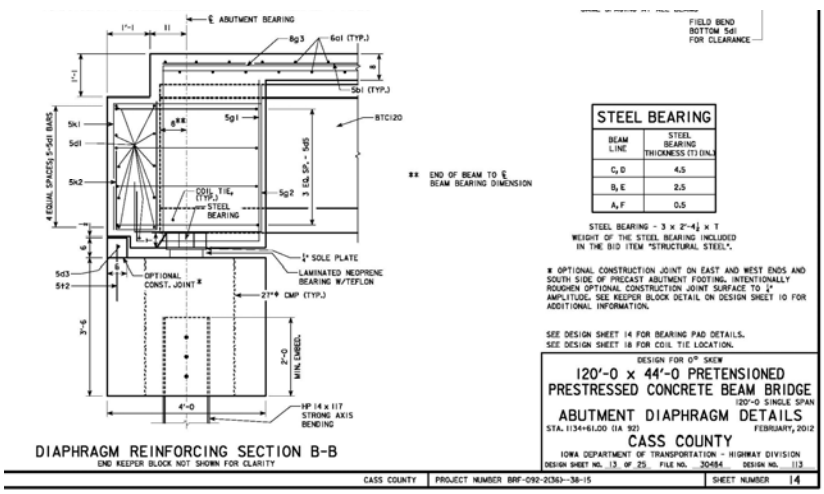
Proposed Replacement

- Pretensioned, prestressed concrete beam bridge

Plan Design and Details

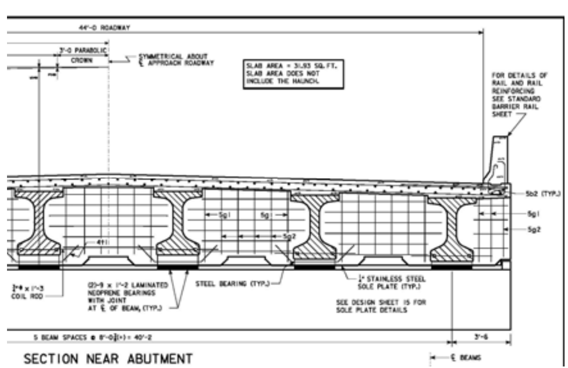
- Semi-integral abutment details
- Abutment diaphragm
  - Jacking pockets for lifting
  - Block for pushing/pulling the prefabricated superstructure
- Precast abutment footing
  - H-Pile connections
- Precast wingwalls
  - H-Pile connections

Semi-Integral Abutment

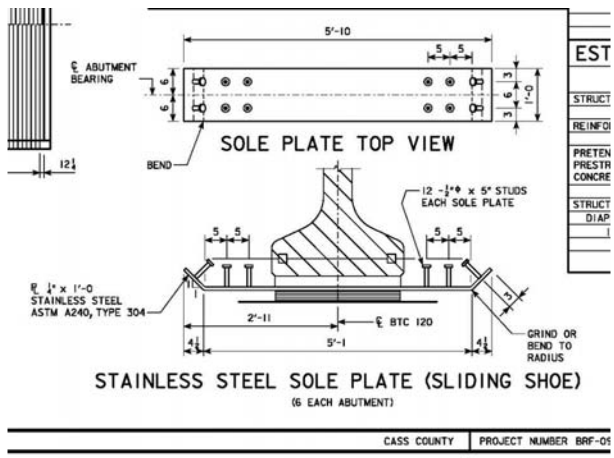


Sliding Pad

- Engineer's sliding concept
- Contractor elected to use commercially available rollers



Sliding Shoe



Critical Closure Schedule

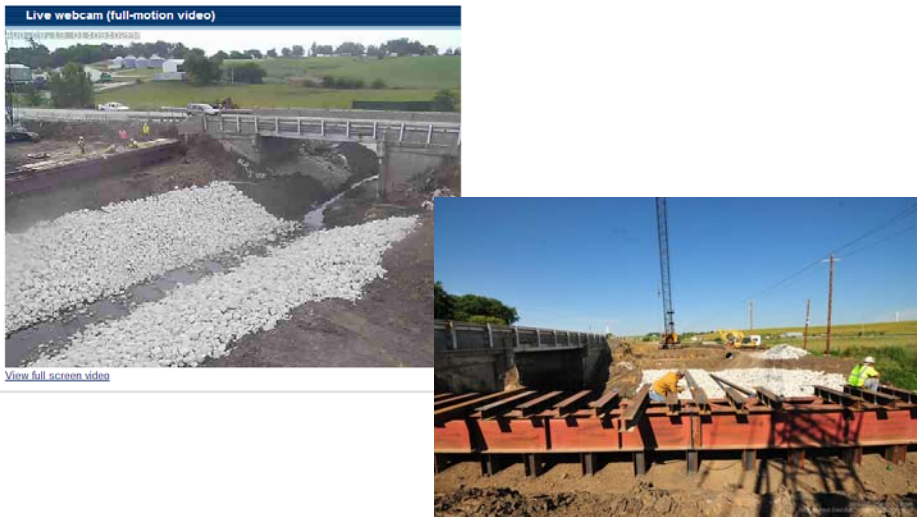
	Day								
Activity	1	2	3	4	5	6	7	8	9
Start Critical Closure	9/27/2013								
Bridge Removal and Grading	■								
Pile Driving	■	■	■						
Revetment		■	■	■					
Abutment Footing			■						
Bridge slide				■	■				
Precast wings					■				
Granular Backfill						■			
Bridge Barrier Rail						■			
Approach paving							■		
Barrier End Sections							■		
Steel Guardrail								■	
Longitudinal Grooving									■
Pavement Marking									■
Finish Critical Closure									10/6/2013

Lessons Learned

- Let ABC projects similar to steel bridges, in the fall with time for the contractor to gather resources
- Offer precast/CIP options for substructure
- Be prepared to fully evaluate impact of contractor method changes
- Do not allow reuse of laminated neoprene bearings
- Add a specification requiring falsework design engineer to inspect and accept falsework construction

Lessons Learned

- More design and review time required for first SIBC project than anticipated
- First time design team time
  - Design engineer – 97 hours
  - Detailer – 338 hours
  - Check engineer – 168 hours
  - Total – 603 hours
- First time submittal review engineer – 137 hours
  - Structural steel
  - Falsework
  - Precast wingwalls
  - Move plans and calculations
  - Move procedures
- It is anticipated the time required will be greatly reduced with subsequent projects

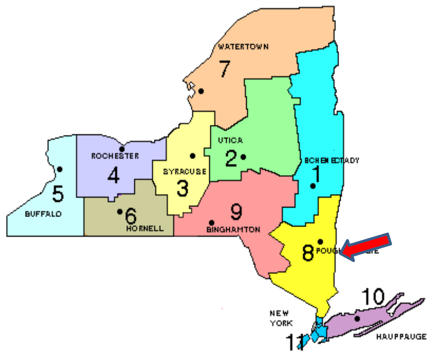

Live webcam (full-motion video)
View full screen video

Time Lapse Video

Case Study: Dingle Ridge Road

New York Department of Transportation

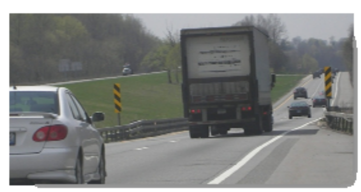
Project Location



- I-84 about 50 miles north of New York City
- 1 mile from CT border

Why ABC?

- Over 75,000 ADT
- One construction season for each bridge
- Traffic impact up to 2 years
- Seven acres of temporary impact
- Dozens of other bridges on NY I-84 corridor could benefit from ABC/slide-in construction



Why SIBC?

- Traditional methods would have required
  - Temporary bridge in the median
  - Substantial cross-over roadways
- Existing bridges are too narrow for cross-overs with two-way traffic
- Elevation differences between EB & WB roadways makes cross-overs more difficult
- Additional cost of approximately $2.0 M

Delivery Method

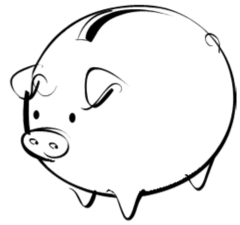
- Design-bid-build
  - Bridge design: HNTB
  - Highway design: NYSDOT Region8
  - Contractor: Yonkers Contracting, NY
  - Precaster: Dailey Precast, Vermont
  - Slide contractor: Barnhart / Marino
  - Temp structures: Siefert Associates, NY
  - Design funding: SHRP 2
  - Construction funding: NYSDOT and Highways for Life

SHRP2 STRATEGIC HIGHWAY RESEARCH PROGRAM

HIGHWAYS FOR LIFE Accelerating Innovation for the American Driving Experience.

Cost Savings with ABC

- Over $1.2 M in user delay cost savings by using ABC (Source: NYSDOT)
- $2 m cost savings from elimination of cross-overs, temporary bridge (Source: NYSDOT)
- Savings in work-zone accidents costs
- Cost for temporary supports and lateral slide: $1.06 M for both bridges



BID / ABC Schedule

- Low bid: Yonkers Contracting, New York
- Contract award January 2013
- $10.2 M (total cost); (bridge cost $6.1 M)
- Bid for temp. supports & lateral slide: $1.06 M
- Replaced westbound bridge: 9/21/13
- Replaced eastbound bridge: 10/19/13
- ABC window: 5 PM Saturday to 1 PM Sunday (20 hours)

Bridge Slide

Slide-In Construction

- Traffic disruption on I-84 reduced from two years to two weekend nights
- Dingle Ridge Road (low volume local road) was closed for 5 days

Pre Slide

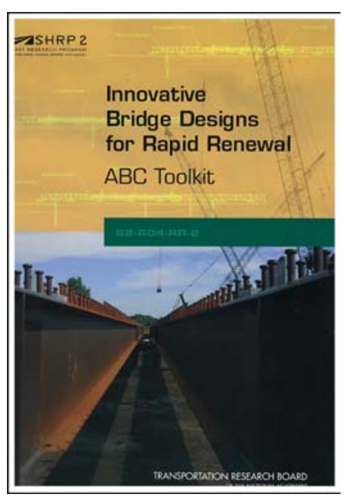
Slide Operation

Traffic Control

- Not an interchange – ramp detours not available
- Route 6/202, parallel to I-84, used as the detour (3 miles)

Bridge Design

- Structure design guided by Innovative Bridge Designs for Rapid Renewal
- SHRP2 ABC Toolkit concepts used for:
  - Concrete NEXT beams (Double Tee)
  - Precast approach slabs
  - UHPC connections
- Toolkit is being extended to cover slide-in bridge construction concepts



Design - New Bridges

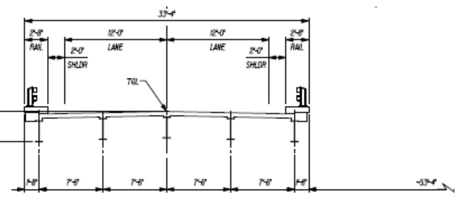
- Single span 80'; three lanes at 12' with shoulders
  - Original bridge was 3 spans
- Bridge width increased from 33'-4" to 57'-0"
- Use 3" asphalt wearing surface eliminates grinding
- Dingle Ridge Road passing beneath new bridges on 15.7% grade
- New bridges will be about two feet higher to maintain under-clearance
- Need to minimize new structure depth

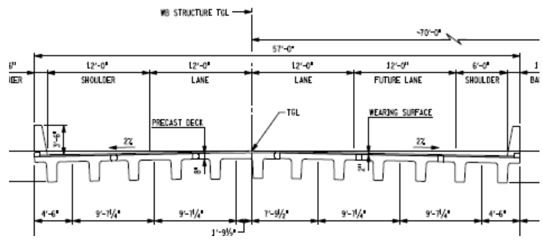
Design Challenges

- Complete slide in one weekend night
- Need to raise I-84 approaches as much as 2 feet during ABC window to satisfy under-bridge-clearance

Superstructure Sections

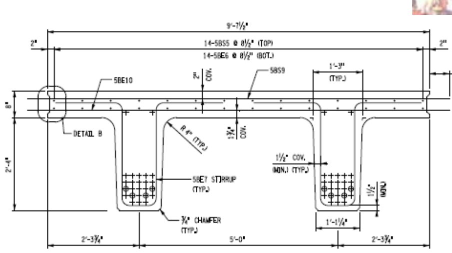
- 80 ft span
- Wider new bridge
- NEXT beam (double T beam) superstructure
- UHPC closure pours
- Precast approach slabs





Superstructure Sections

- NEXT deck beams
- 36 inch deep sections
- 9'-8" flange; 8" thick
- f'c = 10 ksi
- 1.8 klf



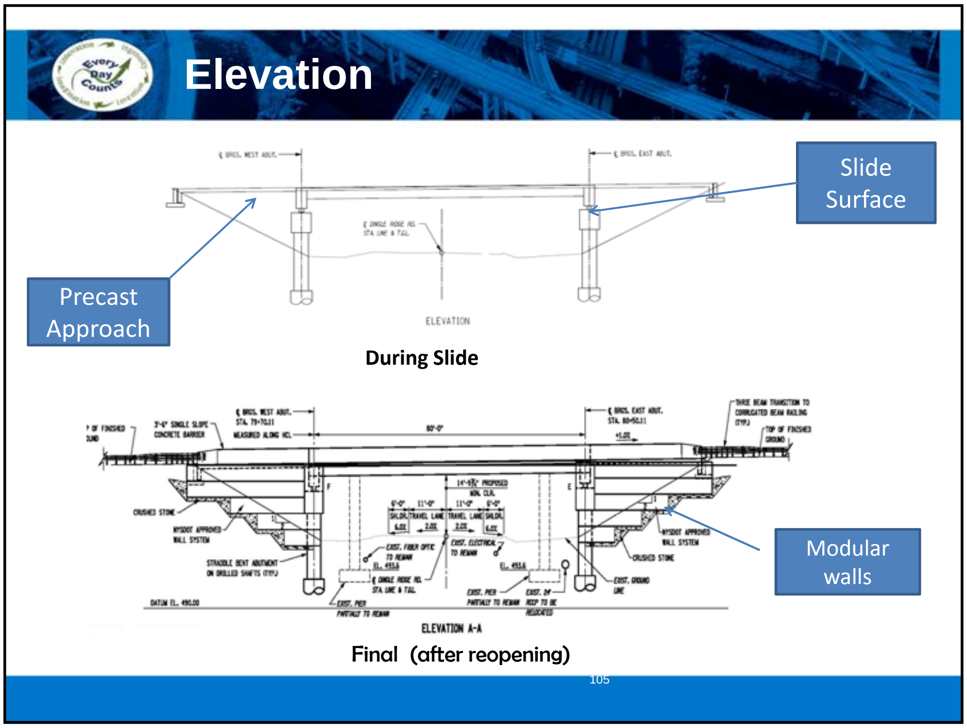
UHPC Connections

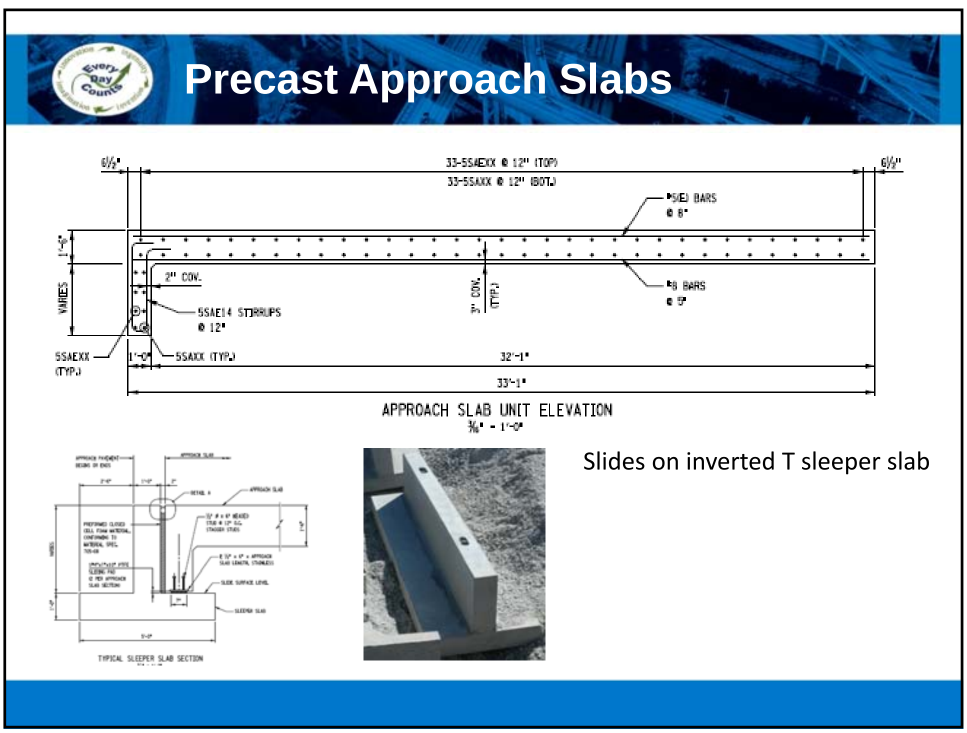
6” width

Compressive strength:
20,000 to 30,000 psi

Deck Waterproofing

- Spray-applied waterproofing membrane placed before the slide
- 3” asphalt overlay


Elevation
Slide
Surface
Precast
Approach
ELEVATION
During Slide
Modular
walls
ELEVATION A-A
Final (after reopening)
105


Precast Approach Slabs
33-5SAEXX @ 12" (TOP)
33-5SAXX @ 12" (BOT.)
2" COV.
5SAE14 STIRRUPS
@ 12"
5SAEXX
(TYP.)
5SAXX (TYP.)
32'-1"
33'-1"
APPROACH SLAB UNIT ELEVATION
TYPICAL SLEEPER SLAB SECTION
Slides on inverted T sleeper slab

Three Construction Stages

Stage 1: Pre slide period

- Complete substructures to slide elevation
- Construct new superstructure and approach slabs on temporary supports adjacent to existing bridge

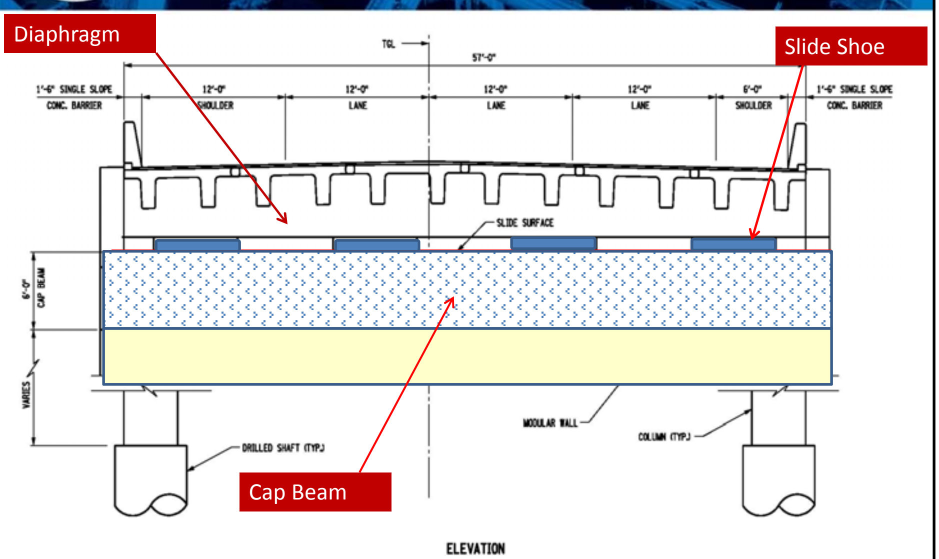
Stage 2: Slide period (20 hrs)

- Two weekends – Sept & Oct 2013
- Demolish bridge
- Slide in new bridge & approach slabs
- Raise approach roadways by over 2 ft

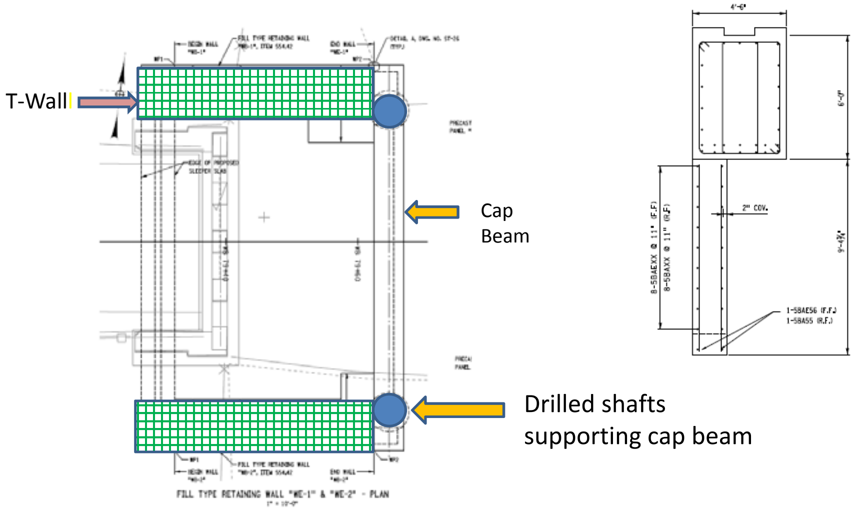
Stage 3: Post slide period

- Place flowable fill under approach slabs
- Remove temporary supports
- Complete approach roadway work

Straddle Bent Abutment



Abutment & Wingwalls



New Foundation

Foundation Construction

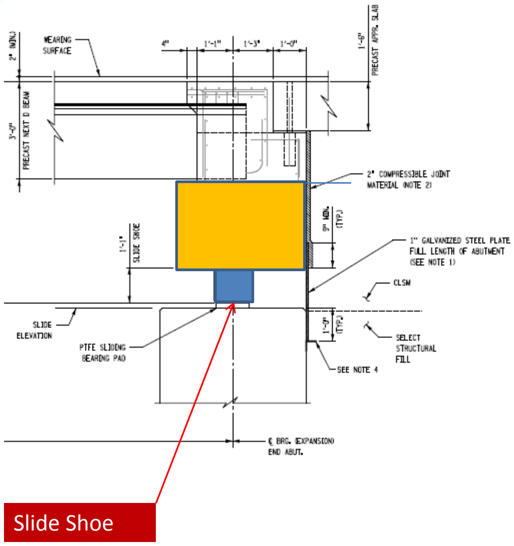
Drilled shafts outside existing footprint

Temporary Support

- Temporary bents on H piles
- Slide system

- Contractor designed
- Always connect temporary bents to the abutment

End Diaphragms & Slide Shoes

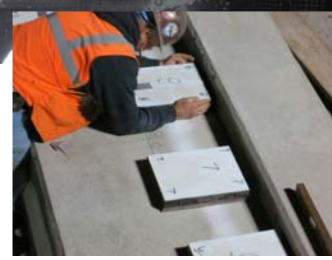


Slide Shoe

New Bridges

Abutment Slide Surface

Stainless steel on 16 gage PTFE bonded to elastomeric bearing pad

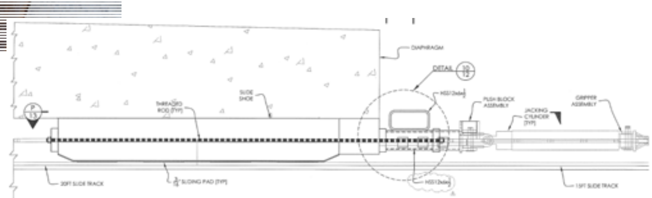


Approach Slab Slide Surface

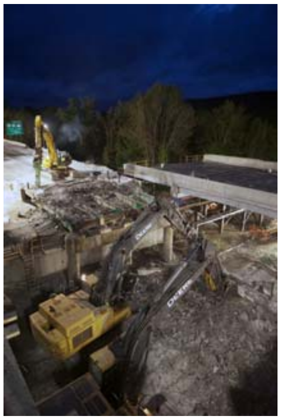
Stainless steel on PTFE pads

Inverted T Sleeper Slabs

Push/Pull Jacks at Abutments



Rapid Demolition – 4 Hours



- Chop and drop
- Local road below closed

Lateral Slide – Oct 21, 2013

Raising of Approach Roadways

- Done within slide period
- Slow compared to demo and slide

Both bridge slides completed 10 months after NTP!

View from Dingle Ridge Road

Lessons Learned

- Focus on roadway approaches as much as structure slide-in
- Need for displacement control during slide
- Importance of camber control in P/S beams
- With full depth precast P/S sections its recommended to use asphalt overlay

ABC Benefits

- Cost savings
- Minimizes road closure (2 weekend nights)
- Improved work zone safety
- Reduced impact to NYC watershed

Time Lapse Video

Case Study: Elk Creek

Oregon Department of Transportation

Location

Project Overview

- Design Build, Best Value Selection
- Winning team proposed 2 slide-ins to eliminate expensive detours and flagging
- Winning bid: approximately $50,000,000
- Engineers estimate: approximately $53,000,000
- Actual project duration: 32 months
- Estimated project duration: 54 months

Why SIBC?

Crossing No. 3

- 2-lane detour very expensive and high risk
  - Long detour bridge with high bents or shorter detour with potentially unstable rock cut presenting high risk of unknown resultant solution
  - High risk due to temporary bents within narrow stream channel
  - Very little working room left on East end
- Rapid replacement would score higher and guaranteed full incentive

- Reduced risk of unknowns by avoiding cut slopes and potential geologic instabilities

Why SIBC?

Crossing No. 4

- Single-lane detour problematic
  - A two-lane detour was impossible
  - Staging at tunnel portal would have required temporary signal or constant flagging
  - Analysis demonstrated temporary traffic signal would back traffic up across Crossing No. 3 – negative in proposal
  - 180 calendar days to complete new bridge

- Rapid Replacement, which was not envisioned in the procurement documents for these sites, would score higher and guaranteed full incentive

Crossing 3

- Three-span continuous steel plate girder
- Translation accomplished by support at two interior points with end spans cantilevered

Crossing 4

- Two-span prestressed concrete deck girder bridge
- Translation supported at four points

Crossing 4

Keys to success

- Reduction in construction time offsetting additional SIBC costs
- Reduction In MOT time resulting in schedule savings and good public relations
- Elimination of flagging, 180 days one way traffic and traffic shifts – cost savings
- Elimination of a significant temporary bridge carrying public traffic – risk reduction
- Coordination and cooperation with the owner and local communities

Keys to success

- Performance based procurement specifications allowing for innovation and an engineered solution
- Maintained traffic on alignment throughout, greatly enhancing traveler safety and reducing risk

Community Outreach

- Instrumental in providing information to traveling public
- Initiative with local schools
- Student pylon designs
  - $500 scholarship
- Time capsule

Picture Courtesy of Structural Engineer Magazine

Contractor Obstacles on DBB

- Contract issues
  - Design modifications to complete the slide (Will the owner accept the changes?)
  - Contract documents may preclude a complete closure. Will an owner accept a complete overnight closure in place of months of lane restrictions?
  - Are additional environmental clearances or permits required?
- ATC process provides a viable method to bid
- Site concerns
- Reduction in quality
- Design concerns
- Cost concerns
- Increase in risk
- Contract issues

Time Lapse Video

“FHWA Slide”

www.fhwa.dot.gov/construction/sibc/

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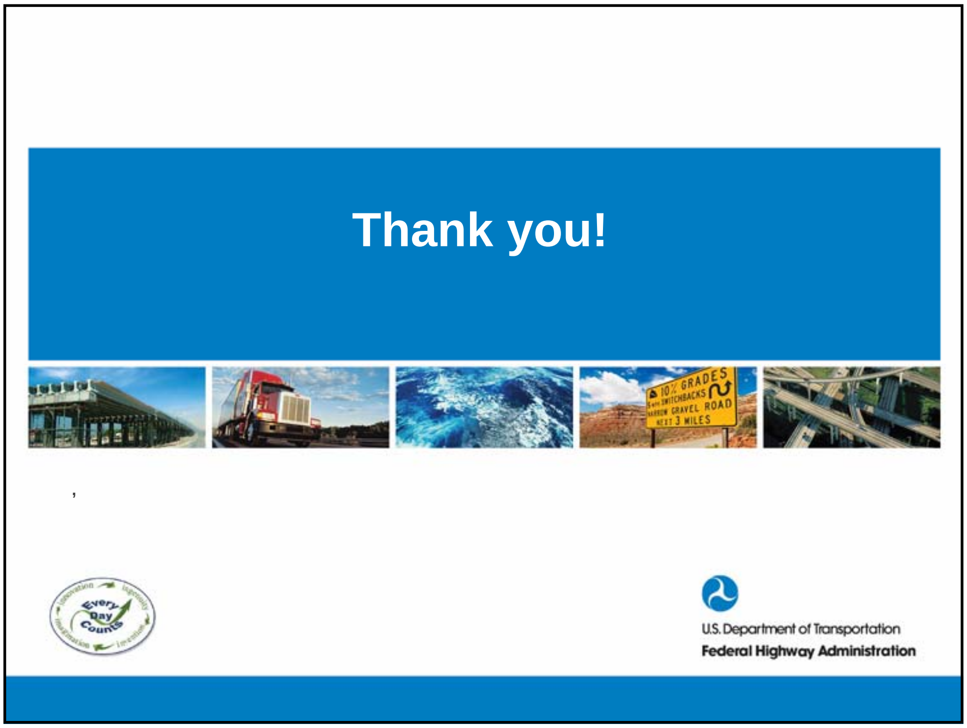
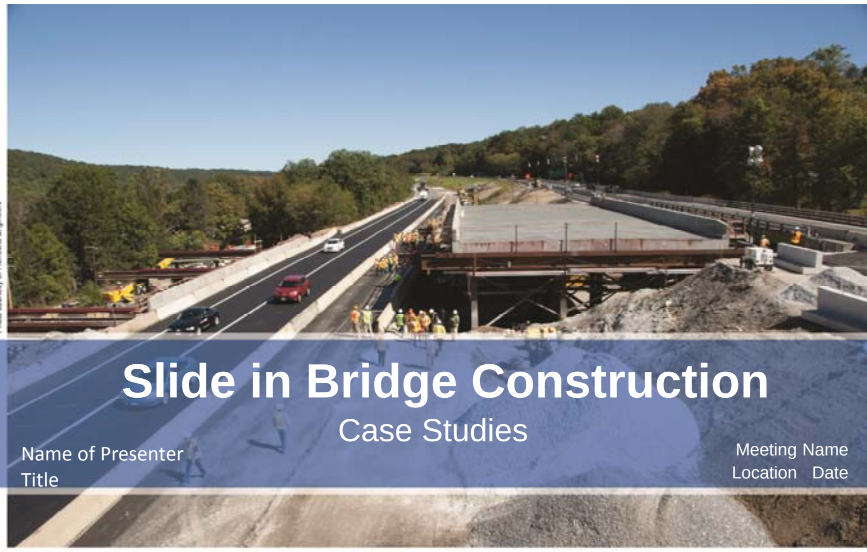
U.S. Department of Transportation
Federal Highway Administration


Thank you!
10% GRADES
SWITCHBACKS
NARROW GRAVEL ROAD
NEXT 3 MILES
Every Day Counts
U.S. Department of Transportation
Federal Highway Administration

PRESENTATION HANDOUTS:

COURSE 5 SIBC CASE STUDIES



Slide in Bridge Construction

Case Studies

Name of Presenter
Title

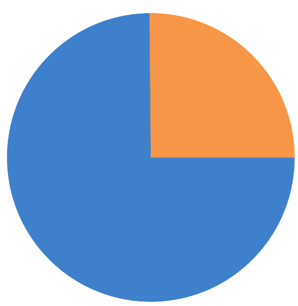
Meeting Name
Location Date

U.S. Department of Transportation
Federal Highway Administration

1

Introduction

U.S. bridges



In need of rehabilitation, repair, or replacement

Background

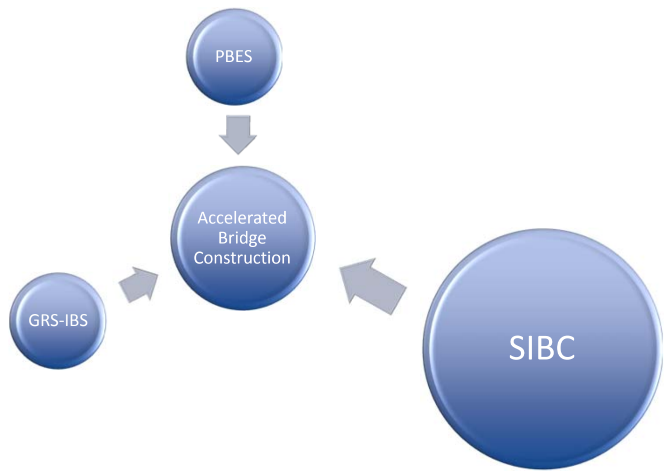
Deploy underutilized innovations to:

- Shorten delivery of highway projects
- Enhance roadway safety
- Reduce congestion
- Improve environmental sustainability

EDC-2 Initiative

EDC-2 launched in 2012 to shorten delivery time using new technologies

EDC-2 Initiative



Agenda

- Definition and benefits of SIBC
- Case studies

What is SIBC?

- ABC method also known as known as lateral sliding or skidding
- New bridge (normally) built parallel to existing bridge on temporary supports
- New bridge slid into place after
  - New substructure constructed
  - Old bridge demolished
  - Moved laterally using hydraulics or a winch. Some minor vertical jacking is typically needed.

What is SIBC?

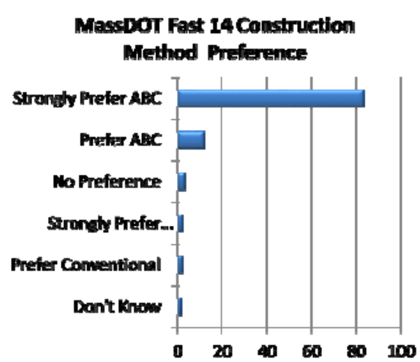
- Reduced disruption if substructure can be constructed below the existing bridge
- Minimal disruption likely requires innovative foundation systems
  - Drilled shafts outside footprint of existing bridge
  - Micro or mini piles
  - Integrating cap beams
  - Spread footings
- Prefabricated substructure units

What is SIBC?

- Can be used for temporary bypass bridges
  - Temporary substructure must be designed for live and other transient loads

Benefits

- What is driving the use of SIBC?
  - Increased traffic demands
  - Increasing congestion
  - Public demand for rapid delivery of projects
  - Safety
  - Societal costs
  - Mobility
  - Environmental impact
  - Lower cost and less risk when compared to other structure placement methods (e.g., SPMT)



Benefits

- Offers non-traditional site options
- Eliminates crossovers, shoo-flies, staged construction, and long term detours
  - Can result in lower construction costs/bid price
- Reduces mobility impacts

Benefits

- Promotes user and worker safety
- Better contractor "buy-in" when compared to other ABC methods
- Could reduce environmental impact

Benefits

- Removes bridge construction from critical path
  - May lead to better quality end product
- Involves public in reducing societal costs
  - Results in greater "buy-in" in the overall project
- Road closures better managed
  - Dates and duration are more predictable

Case Study: Massena, IA

Iowa Department of Transportation

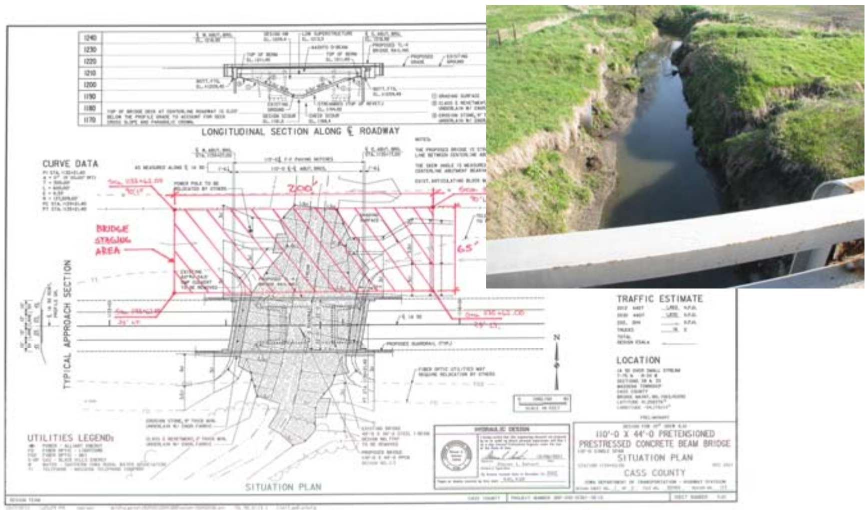
Location

- IA 92 over small stream, 1.0 miles west of IA 148

Why ABC?

- 13 mile detour – 7 mile out-of-distance travel
- AADT (2012) – 1,460 with 16% trucks
- User costs for 180-day detour
  - Indirect = $437,000
  - Direct = $15,000
    - County road maintenance
    - Detour signage

Why SIBC?



Delivery Method and Cost

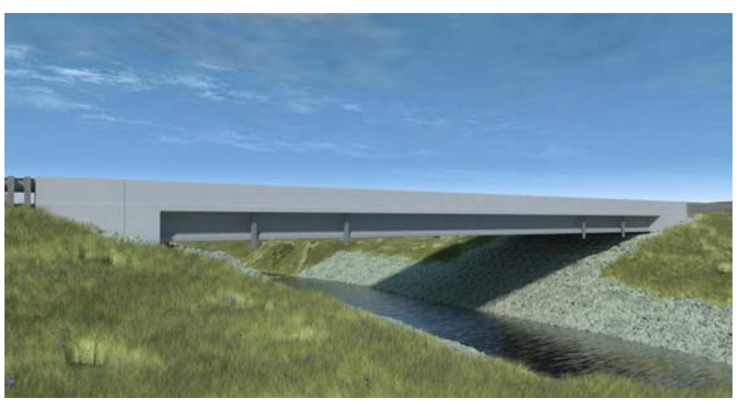
- Design-bid-build
  - Design completed by DOT with external peer review
  - Peer exchange of information from Utah DOT was critical
  - Let April 16, 2013
- Cost
  - Winning bid - $1,300,000
  - Unit cost - $112/SF
    Historic bridge unit cost - $85/SF

Existing Structure

- 40’ x 30’ steel I-beam
- Constructed – 1930
- Reconstructed – 1949
- Overlay – 1968
- Retrofit rail – 1992
- Overlay – 1998
- Structurally deficient – sufficiency rating=38.2

Proposed Replacement

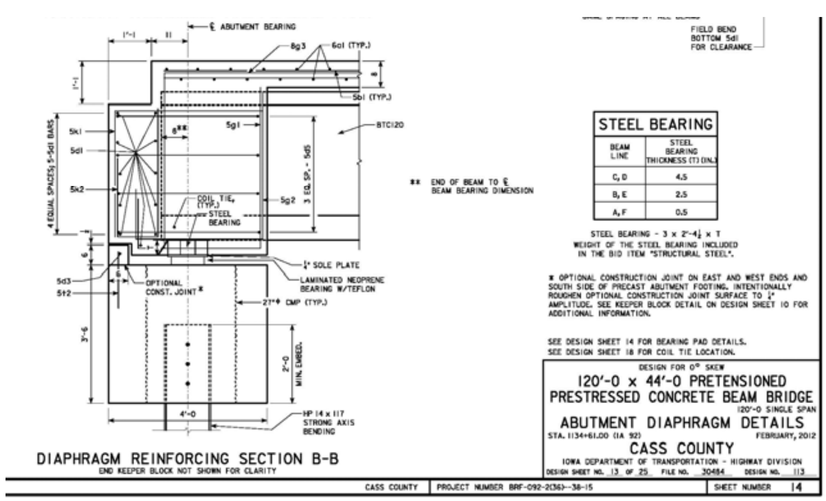
- Pretensioned, prestressed concrete beam bridge



Plan Design and Details

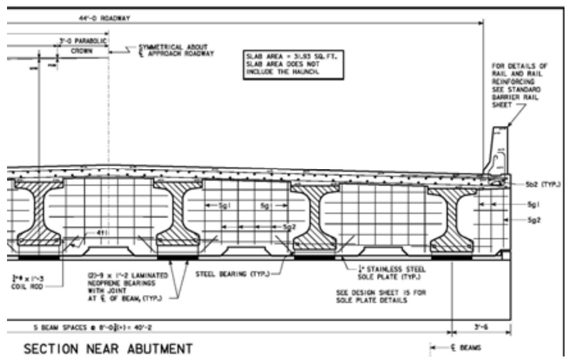
- Semi-integral abutment details
- Abutment diaphragm
  - Jacking pockets for lifting
  - Block for pushing/pulling the prefabricated superstructure
- Precast abutment footing
  - H-Pile connections
- Precast wingwalls
  - H-Pile connections

Semi-Integral Abutment

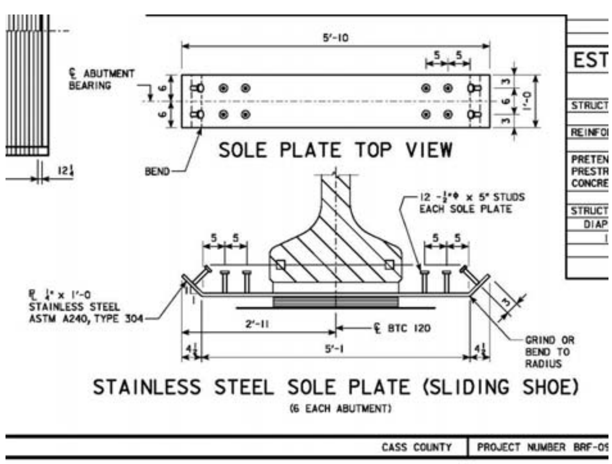


Sliding Pad

- Engineer's sliding concept
- Contractor elected to use commercially available rollers



Sliding Shoe



Critical Closure Schedule

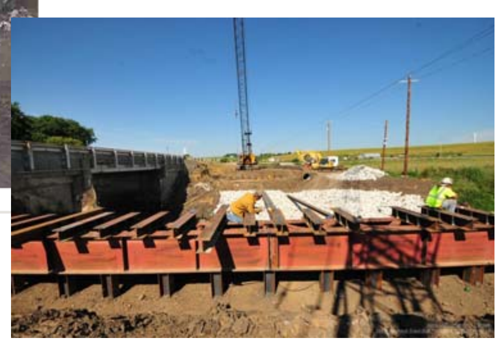
	Day								
Activity	1	2	3	4	5	6	7	8	9
Start Critical Closure	9/27/2013								
Bridge Removal and Grading	■								
Pile Driving	■	■	■						
Revetment		■	■	■					
Abutment Footing			■						
Bridge slide				■	■				
Precast wings					■				
Granular Backfill						■			
Bridge Barrier Rail						■			
Approach paving							■		
Barrier End Sections							■		
Steel Guardrail								■	
Longitudinal Grooving									■
Pavement Marking									■
Finish Critical Closure									10/6/2013

Lessons Learned

- Let ABC projects similar to steel bridges, in the fall with time for the contractor to gather resources
- Offer precast/CIP options for substructure
- Be prepared to fully evaluate impact of contractor method changes
- Do not allow reuse of laminated neoprene bearings
- Add a specification requiring falsework design engineer to inspect and accept falsework construction

Lessons Learned

- More design and review time required for first SIBC project than anticipated
- First time design team time
  - Design engineer – 97 hours
  - Detailer – 338 hours
  - Check engineer – 168 hours
  - Total – 603 hours
- First time submittal review engineer – 137 hours
  - Structural steel
  - Falsework
  - Precast wingwalls
  - Move plans and calculations
  - Move procedures
- It is anticipated the time required will be greatly reduced with subsequent projects

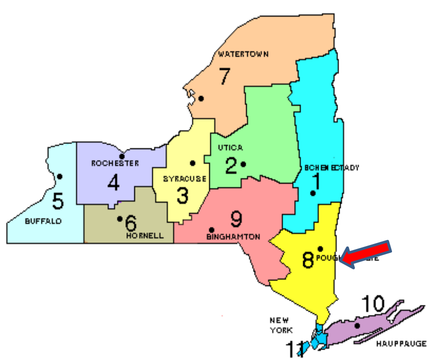


Time Lapse Video

Case Study: Dingle Ridge Road

New York Department of Transportation

Project Location



- I-84 about 50 miles north of New York City
- 1 mile from CT border

Why ABC?

- Over 75,000 ADT
- One construction season for each bridge
- Traffic impact up to 2 years
- Seven acres of temporary impact
- Dozens of other bridges on NY I-84 corridor could benefit from ABC/slide-in construction

Why SIBC?

- Traditional methods would have required
  - Temporary bridge in the median
  - Substantial cross-over roadways
- Existing bridges are too narrow for cross-overs with two-way traffic
- Elevation differences between EB & WB roadways makes cross-overs more difficult
- Additional cost of approximately $2.0 M

Delivery Method

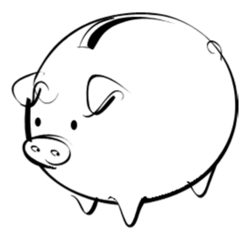
- Design-bid-build
  - Bridge design: HNTB
  - Highway design: NYSDOT Region8
  - Contractor: Yonkers Contracting, NY
  - Precaster: Dailey Precast, Vermont
  - Slide contractor: Barnhart / Marino
  - Temp structures: Siefert Associates, NY
  - Design funding: SHRP 2
  - Construction funding: NYSDOT and Highways for Life

SHRP2 STRATEGIC HIGHWAY RESEARCH PROGRAM

HIGHWAYS FOR LIFE

Cost Savings with ABC

- Over $1.2 M in user delay cost savings by using ABC (Source: NYSDOT)
- $2 m cost savings from elimination of cross-overs, temporary bridge (Source: NYSDOT)
- Savings in work-zone accidents costs
- Cost for temporary supports and lateral slide: $1.06 M for both bridges



BID / ABC Schedule

- Low bid: Yonkers Contracting, New York
- Contract award January 2013
- $10.2 M (Total Cost); (Bridge cost $6.1 M)
- Bid for temp. supports & lateral slide: $1.06 M
- Replaced westbound bridge: 9/21/13
- Replaced eastbound bridge: 10/19/13
- ABC window: 5 PM Saturday to 1 PM Sunday (20 hours)

Bridge Slide

Slide-In Construction

- Traffic disruption on I-84 reduced from two years to two weekend nights
- Dingle Ridge Road (low volume local road) was closed for 5 days

Pre Slide

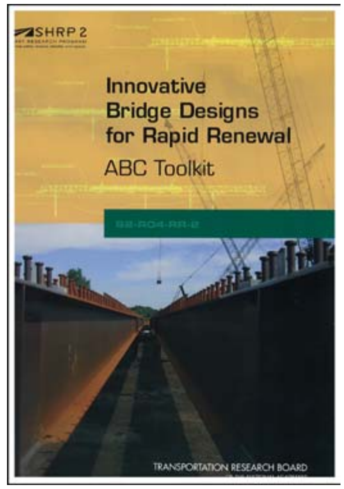
Slide Operation

Traffic Control

- Not an interchange – Ramp detours not available
- Route 6/202, parallel to I-84, used as the detour (3 miles)

Bridge Design

- Structure design guided by Innovative Bridge Designs for Rapid Renewal
- SHRP2 ABC Toolkit concepts used for
  - Concrete NEXT beams (Double Tee)
  - Precast approach slabs
  - UHPC connections
- Toolkit is being extended to cover slide-in bridge construction concepts



Design - New Bridges

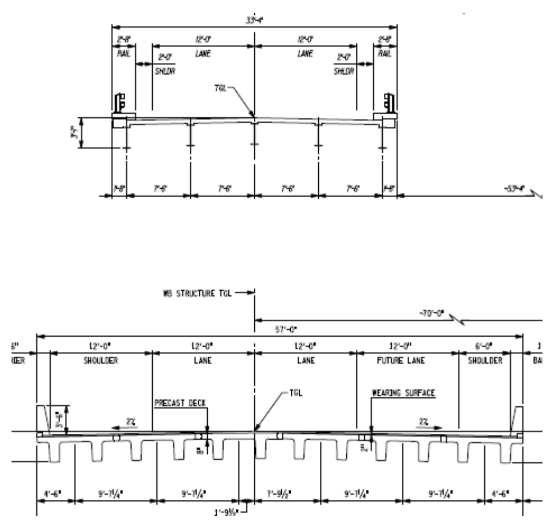
- Single span 80'; three lanes at 12' with shoulders
  - Original bridge was 3 spans
- Bridge width increased from 33'-4" to 57'-0"
- Use 3" asphalt wearing surface eliminates grinding
- Dingle Ridge Road passing beneath new bridges on 15.7% grade
- New bridges will be about two feet higher to maintain under-clearance.
- Need to minimize new structure depth

Design Challenges

- Complete slide in one weekend night
- Need to raise I-84 approaches as much as 2 feet during ABC window to satisfy under-bridge-clearance

Superstructure Sections

- 80 ft span
- Wider new bridge
- NEXT beam (double T beam) superstructure
- UHPC closure pours
- Precast approach slabs



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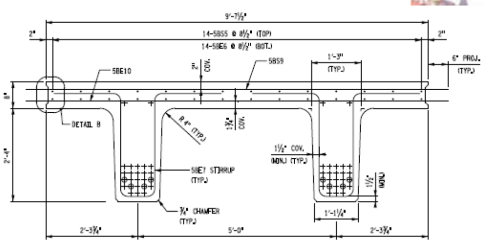
Superstructure Sections

- NEXT deck beams
- 36 inch deep sections
- 9'-8" Flange; 8" thick
- f'c = 10 ksi
- 1.8 klf



UHPC Connections

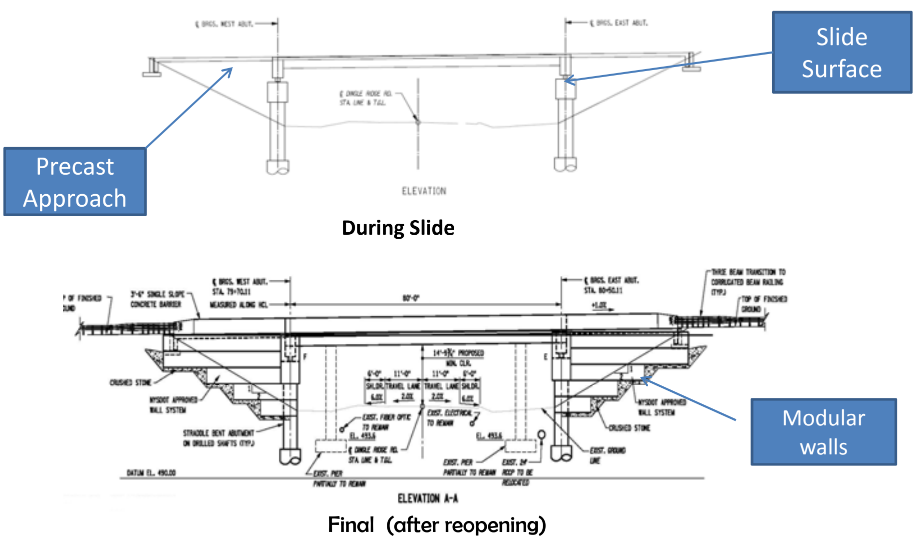
6" width

Compressive strength:
20,000 to 30,000 psi

Deck Waterproofing

- Spray-applied waterproofing membrane placed before the slide
- 3" asphalt overlay

Elevation



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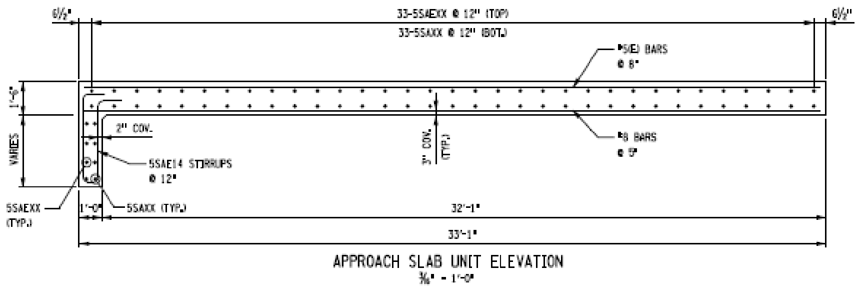
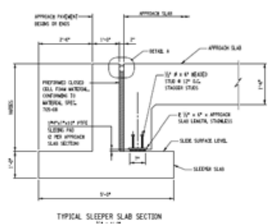
Precast Approach Slabs





Slides on inverted T sleeper slab

Three Construction Stages

Stage 1: Pre slide period

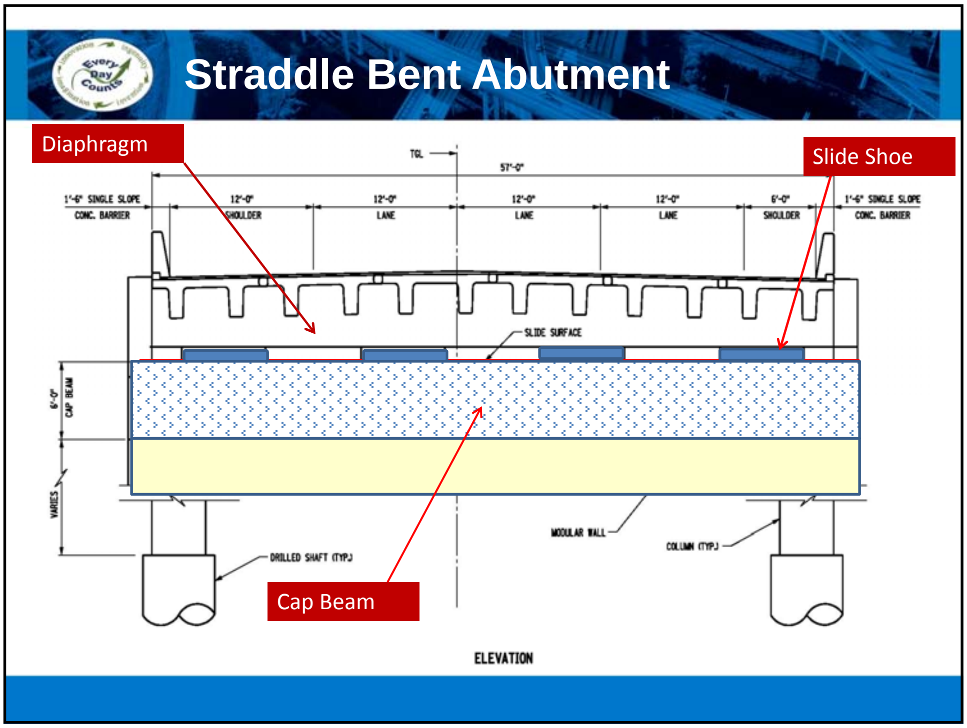
- Complete substructures to slide elevation
- Construct new superstructure and approach slabs on temporary supports adjacent to existing bridge

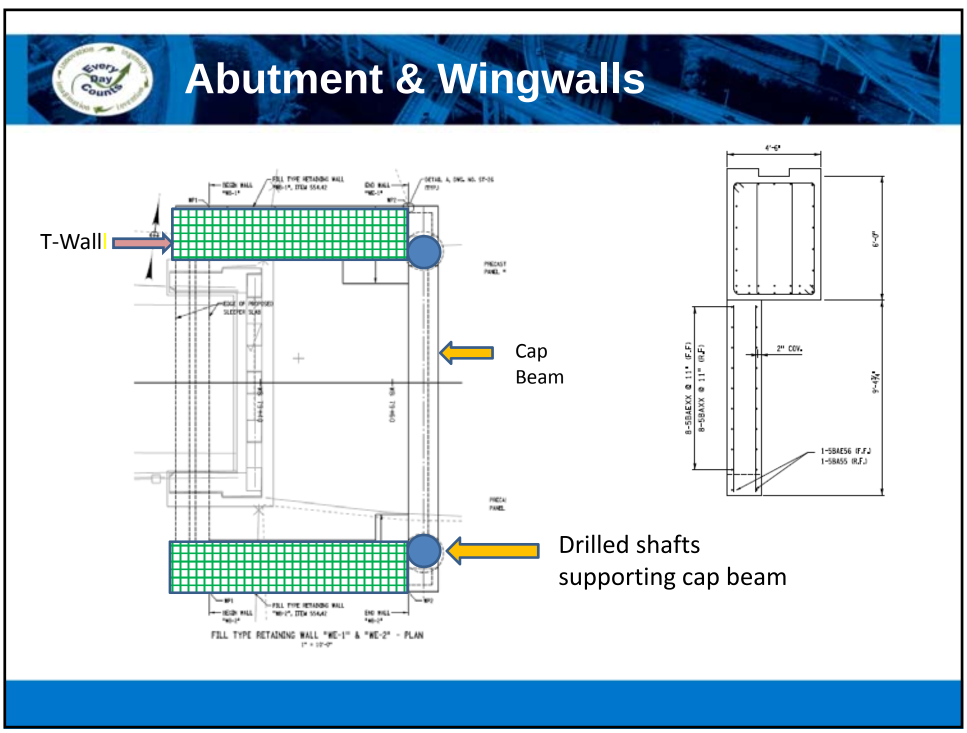
Stage 2: Slide period (20 hrs)

- Two weekends – Sept & Oct 2013
- Demolish bridge
- Slide in new bridge & approach slabs
- Raise approach roadways by over 2 ft

Stage 3: Post slide period

- Place flowable fill under approach slabs
- Remove temporary supports
- Complete approach roadway work


Straddle Bent Abutment
Diaphragm
Slide Shoe
TGL
57'-0"
1'-6" SINGLE SLOPE CONC. BARRIER
12'-0" SHOULDER
12'-0" LANE
12'-0" LANE
12'-0" LANE
6'-0" SHOULDER
1'-6" SINGLE SLOPE CONC. BARRIER
SLIDE SURFACE
6'-0" CAP BEAM
VARIES
MODULAR WALL
COLUMN (TYP.)
DRILLED SHAFT (TYP.)
Cap Beam
ELEVATION


Abutment & Wingwalls
T-Wall
Cap Beam
Drilled shafts supporting cap beam
FILL TYPE RETAINING WALL "WE-1" & "WE-2" - PLAN

New Foundation

Foundation Construction

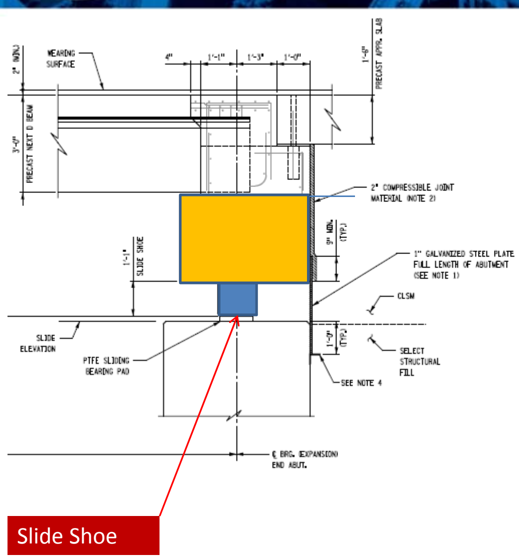
Drilled shafts outside existing footprint

Temporary Support

- Temporary bents on H piles
- Slide system

- Contractor designed
- Always connect temporary bents to the abutment

End Diaphragms & Slide Shoes

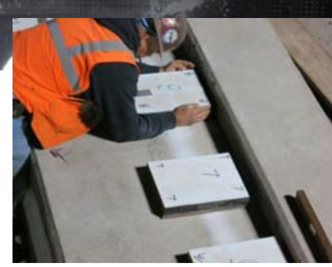


Slide Shoe

New Bridges

Abutment Slide Surface

Stainless steel on 16 gage PTFE
bonded to elastomeric bearing pad

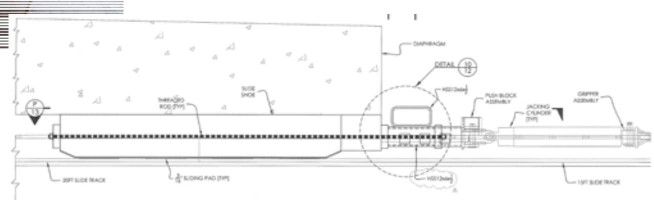


Approach Slab Slide Surface

Stainless steel on PTFE pads

Inverted T Sleeper Slabs

Push/Pull Jacks at Abutments



Rapid Demolition – 4 Hours

- Chop and drop
- Local road below closed

Lateral Slide – Oct 21, 2013

Raising of Approach Roadways

- Done within slide period
- Slow compared to demo and slide

Both bridge slides completed 10 months after NTP!

View from Dingle Ridge Road

Lessons Learned

- Focus on roadway approaches as much as structure slide-in
- Need for displacement control during slide
- Importance of camber control in P/S beams
- With full depth precast P/S sections its recommended to use asphalt overlay

ABC Benefits

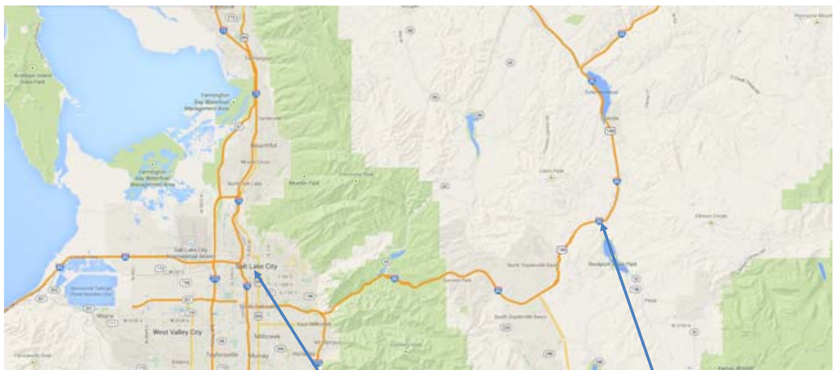
- Cost savings
- Minimizes road closure (2 weekend nights)
- Improved work zone safety
- Reduced impact to NYC watershed

Time Lapse Video

Case Study: Wanship

Utah Department of Transportation

Project Location



Why ABC and SIBC?

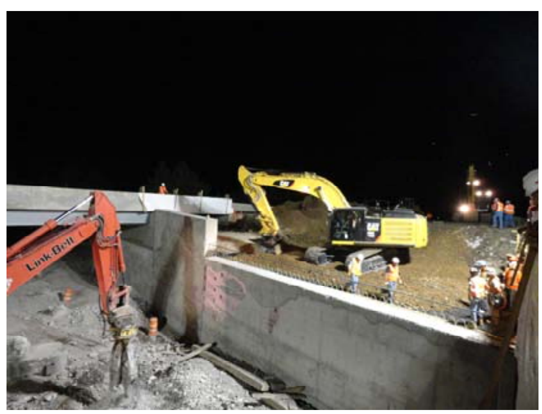
- Traffic limitations
  - Mainline interstate
  - High truck traffic
  - Recreation traffic
- Available staging areas
- CRAVE study recommended

Project Overview

- Replacement of EB & WB I-80 at Wanship
- Replaced 3 span with single span structure
- Full retaining abutment in center with full height wingwalls
  - Constructed while existing bridge in service
- Built superstructures to the side of existing and slid to final location

Project Overview

- All thread jacking/sliding system
- Ramps used as detour
- Spread footings



Design Aspects

- Vertical clearance
  - Raise I-80 or lower SR-32

Design Aspects

- Reinforcing
  - Stainless steel

Design Aspects

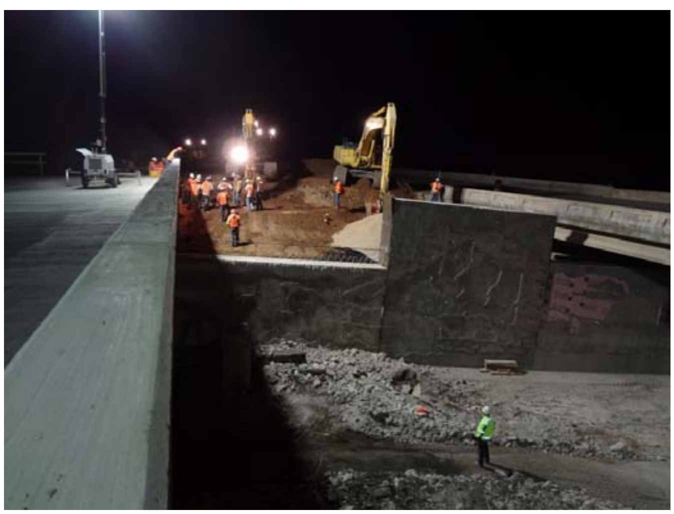
- Relationship to existing structure
  - Sleeper slab location
  - Earth work
  - Approach slab

Submittals

- Contractor submittals
- Designed with specific slide system in mind
- Tracks not required with contractors proposed system
- Modified design required changes to end diaphragms and center retaining wall
- All changes subject to review and approval

Jacking System

Jacking System



Jacking System

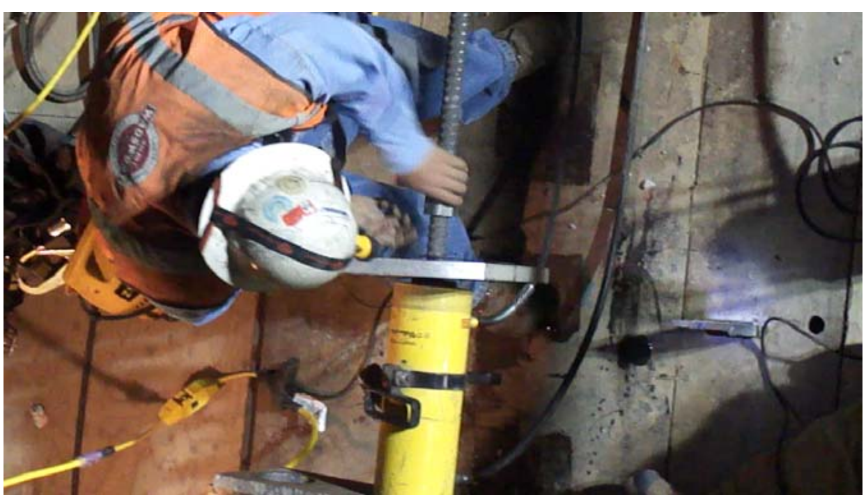
Jacking System

Jacking System

Jacking System

Jacking System

Jacking Video



Alignment Control

- Tracked alignment along the abutment
- Measured gap between the sleeper and the approach slab

Alignment Control

Closure Times

- Closed 16 hours for westbound
- Partial slide the day before the closure
  - One lane remained open on I-80

Closure Times

- Closed 18 hours for eastbound
- Completed move in one night
- Limited to one night due to the condition of the existing structure

Lessons Learned

- Sleeper slab placement
- Full longer closure is preferred to two partial closures
- Wider shorter shoe can be used if track system is not used
- Embed plate in top of abutment
- Choose form liners that are easy to match up in closure pour areas
- Very detailed and tight schedules
- Engineers and contractors closely teamed with same project goals
- Focus on roadway approaches as much as structure move-in
- Proactive detour planning with the DOT
- Phased first move if overnight full closure

Case Study: Elk Creek

Oregon Department of Transportation

Location

Project Overview

- Design Build, Best Value Selection
- Winning team proposed 2 slide-ins to eliminate expensive detours and flagging
- Winning bid: approximately $50,000,000
- Engineers estimate: approximately $53,000,000
- Actual project duration: 32 Months
- Estimated project duration: 54 Months

Why SIBC?

Crossing No. 3

- 2-lane detour very expensive and high risk
  - Long detour bridge with high bents or shorter detour with potentially unstable rock cut presenting high risk of unknown resultant solution
  - High risk due to temporary bents within narrow stream channel
  - Very little working room left on east end
- Rapid replacement would score higher and guaranteed full incentive

- Reduced risk of unknowns by avoiding cut slopes and potential geologic instabilities

Why SIBC?

Crossing No. 4

- Single-lane detour problematic
  - A two-lane detour was impossible
  - Staging at tunnel portal would have required temporary signal or constant flagging
  - Analysis demonstrated temporary traffic signal would back traffic up across Crossing No. 3 – negative in proposal
  - 180 calendar days to complete new bridge

- Rapid replacement, which was not envisioned in the procurement documents for these sites, would score higher and guaranteed full incentive

Crossing 3

- Three-span continuous steel plate girder
- Translation accomplished by support at two interior points with end spans cantilevered

Crossing 4

- Two-span prestressed concrete deck girder bridge
- Translation supported at four points

Crossing 4

Keys to success

- Reduction in construction time offsetting additional SIBC costs
- Reduction In MOT time resulting in schedule savings and good public relations
- Elimination of flagging, 180 days one way traffic and traffic shifts – cost savings
- Elimination of a significant temporary bridge carrying public traffic – risk reduction
- Coordination and cooperation with the owner and local communities

Keys to success

- Performance based procurement specifications allowing for innovation and an engineered solution
- Maintained traffic on alignment throughout, greatly enhancing traveler safety and reducing risk

Community Outreach

- Instrumental in providing information to traveling public
- Initiative with local schools
- Student pylon designs
  - $500 scholarship
- Time capsule

Picture Courtesy of Structural Engineer Magazine

Contractor Obstacles on DBB

- Contract issues
  - Design modifications to complete the slide (Will the owner accept the changes?)
  - Contract documents may preclude a complete closure. Will an owner accept a complete overnight closure in place of months of lane restrictions?
  - Are additional environmental clearances or permits required?
- ATC process provides a viable method to bid
- Site concerns
- Reduction in quality
- Design concerns
- Cost concerns
- Increase in risk
- Contract issues

Time Lapse Video

Case Study: Mesquite

Nevada Department of Transportation

Location

I-15 over Falcon Ridge Parkway in Mesquite, NV

Why ABC?

- High traffic volume that justified paying more for faster construction
  - Freight = 25% of vehicles
- Lack of viable alternate routes
- No need for crossovers and detours
- Precast materials could be used
- Cost savings

Why SIBC?

- Plentiful existing right-of-way adjacent to final location
- Added safety building the bridge out of live traffic

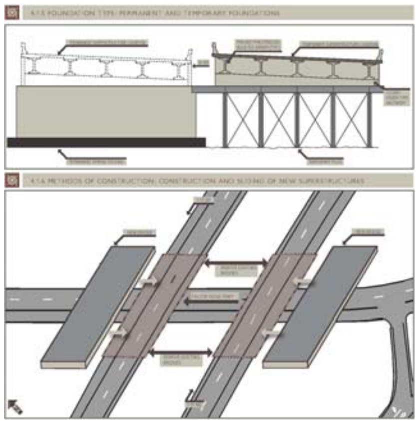
Delivery Method and Cost

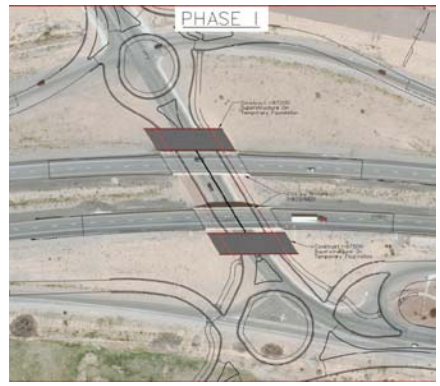
- Design-build
  - Contractor: W.W. Clyde
  - Engineer: Horrocks Engineers
  - Owner: Nevada DOT
- Construction began 1 month after NEPA approval
- Completed 6 months ahead of engineer's estimated schedule
- Total interchange reconstruction = $15 million
  - Original estimate without ABC = $25 million

Project Elements

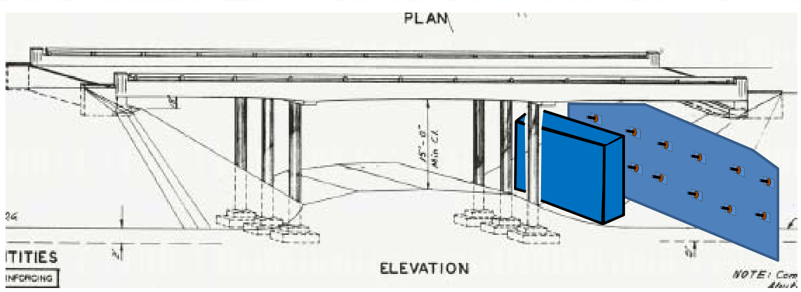
- Falcon Ridge widening and extension to Leavitt
- Lighting, signing, landscaping, and shared use path
- Construct two roundabouts
- Ramp improvements
- Drainage facilities
- Demolish existing bridges
- Construct two new bridges

Slide Schematic



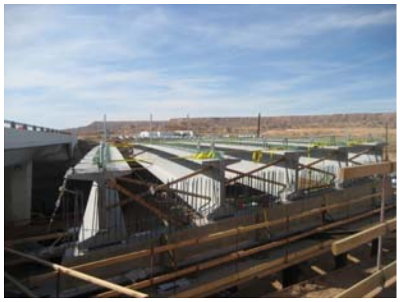


SIBC Procedure



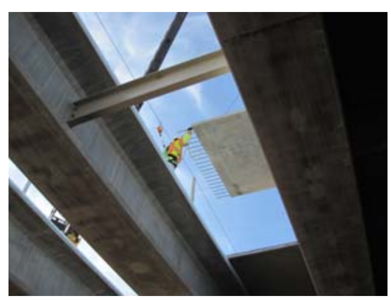
- Construct soil nail wall in front of existing abutment
- Construct new abutments under existing bridge
- Construct superstructure adjacent to existing bridge
- Demolish existing bridge
- Slide new bridge into place

Precast Concrete I-Girders



- Construction and assembly of new structures adjacent to each existing bridge
- UDOT bulb tee
- Fabricated concurrently with other construction activities

Precast Concrete Deck Panels



- Fabricated concurrently with other construction activities
- Eliminated the need for deck forming system

Bridge Demolition

Bridge Slide Process

Bridge Slide Process

Steel wide flange beam with pads

Bridge Slide Process

Hydraulic jacks - one on each abutment

Bridge Slide Process

Operating jacks

Bridge Slide Process

Fill and pave the approaches

Aerials of Bridge Progress

December 16, 2011

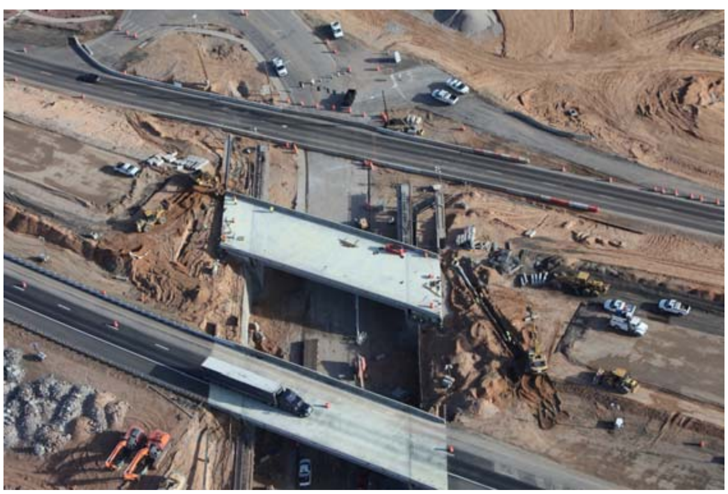
Aerials of Bridge Progress

January 10, 2012

Aerial of Bridge Progress

January 11, 2012

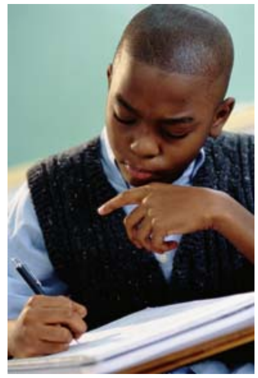
Aerials of Bridge Progress



January 24, 2012

Lessons Learned

- Design-build offered a solution that was not otherwise considered
- ABC provided a means for saving considerable time and money
- Building off-line increased the safety for workers and the traveling public
- Contingency measures pay off



Project Video

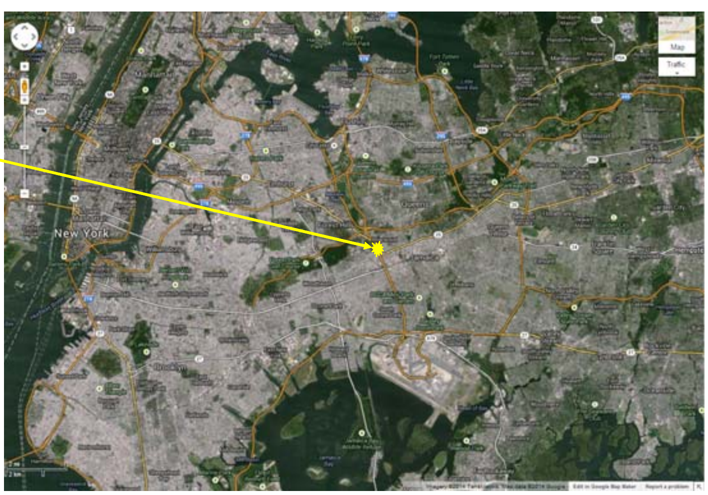
NEVADA DOT

Case Study: Jamaica Ave

New York Department of Transportation

Location

Project Location



Location

Why ABC and SIBC?

- High local volumes – more than 1,100 VPH (peak)
- High expressway volumes (160,000 on VWE)
- Difficult to detour over extended period
- Problematic to stage due to highly congested area
- Must maintain access to Jamaica Hospital

Existing Structure

- Two span
- 110 feet long

Proposed Replacement

- Remove and relocate abutments
- Remove and replace center pier stem
- Slide old bridge out of the way
- Slide new two-span continuous bridge (138 feet long) into place

Lateral Slide Benefits

- Potential to reduce overall construction time
- Substructure and superstructure can progress concurrently
- Improved quality of new structure
- Mitigated the impacts on the community and traffic

Design Challenges

- Interagency coordination
- Subway tracks – vibration monitoring, no loads transferred to subway at any time.
- Verizon phone lines – could not relocate
- Utility relocation – utility bridge
- Substructure design – spatial constraints
- Camber adjustments due to temporary support locations
- First LRFD superstructure
- Limited window for rolling
- Rolling scheme was fully designed – slid on fixed rollers
- Special specifications

Construction Challenges

- Unconventional for roadway bridges – unknowns
- Demolition while maintaining traffic
- Erection and demo over traffic
- Asbestos abatement
- Utilities
- Proximity to JFK Airport
- Hours of closure – roll-in had to be completed in one weekend

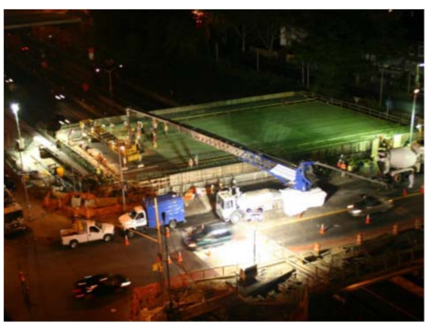
Public Outreach

- Substantial public outreach campaign began 3-4 weeks in advance of construction
- Communicated project details via letters, meetings, etc. to:
  - Area elected officials
  - Service agencies (PANYNJ, NYPD, FDNY, MTA)
  - Hospitals
  - JFK Airport interests (Taxi and Limousine Commission, airlines, airport employees, private bus companies, trucking companies)
- Broadcast of press release/travel advisory to Tri-State media outlets and coordination of area-wide VMS signs (NY, NJ, CT)

Public Outreach

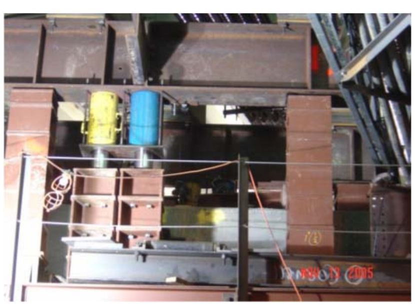
- Posted construction details on State and City websites
- Notifications to area residents, community boards and businesses on Jamaica Avenue
- Produced extensive radio advertisements
- Special efforts
  - Established 24/7 “Command Center” at Jamaica Hospital staffed by NYSDOT, NYCDOT, NYPD, FDNY, and hospital Emergency Services. The center remained activated for four days to monitor and report on the status of the work and address any critical situations

Construction Photos



Construction Photos

Construction Photos



Construction Photos

New Bridge with Traffic

“FHWA Slide”

www.fhwa.dot.gov/construction/sibc/

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Every Day Counts

U.S. Department of Transportation
Federal Highway Administration

Thank you!

,

Every Day Counts

U.S. Department of Transportation
Federal Highway Administration

PRESENTATION HANDOUTS:

COURSE 6 SIBC EXTENDED (HALF-DAY)

OVERVIEW FOR ALL AUDIENCES

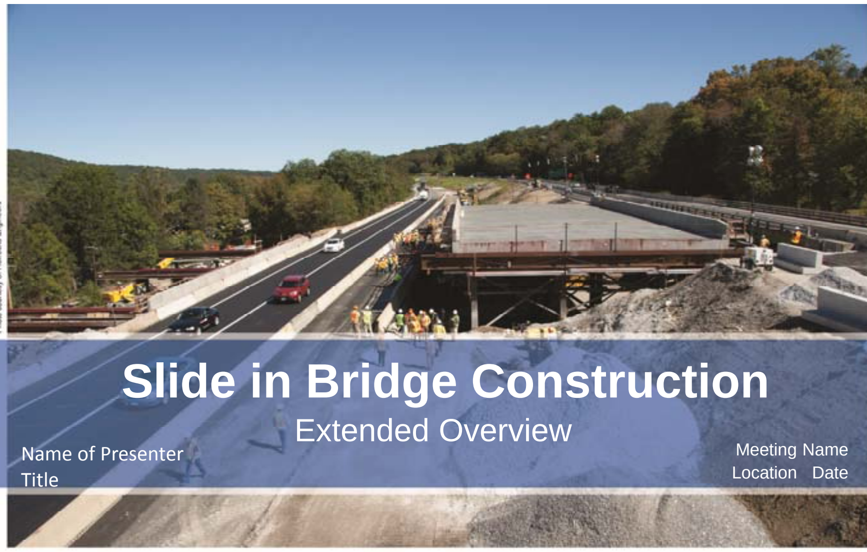


Photo courtesy of Horrocks Engineers

Slide in Bridge Construction

Extended Overview

Name of Presenter
Title

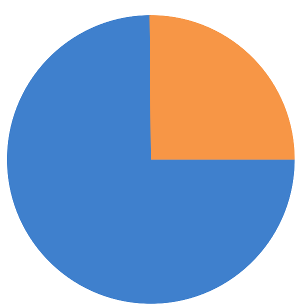
Meeting Name
Location Date

U.S. Department of Transportation
Federal Highway Administration

1

Introduction

U.S. bridges



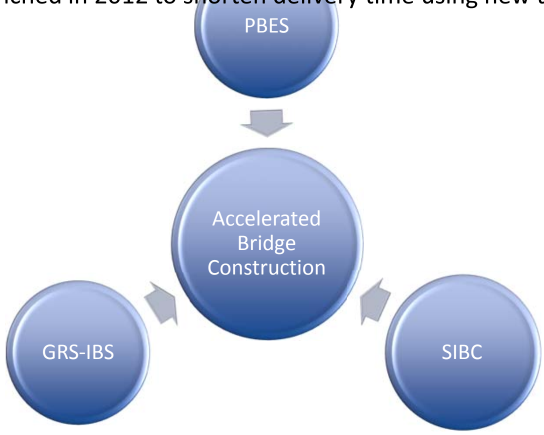
Background

Deploy underutilized innovations to

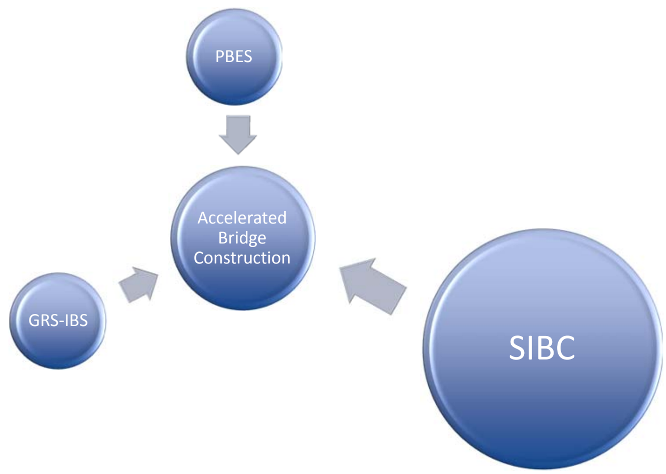
- Shorten delivery of highway projects
- Enhance roadway safety
- Reduce congestion
- Improve environmental sustainability

EDC-2 Initiative

EDC-2 Launched in 2012 to shorten delivery time using new technologies



EDC-2 Initiative



Agenda

Overview for owners, designers, and contractors

- Definition and benefits of SIBC
- Decision making and delivery methods
- Planning and designing for SIBC
- Submittals and temporary works
- Relations with media and public
- Case studies

What is SIBC?

- ABC method also known as known as lateral sliding or skidding
- New bridge (normally) built parallel to existing bridge on temporary supports
- New bridge slid into place after
  - New substructure constructed
  - Old bridge demolished
  - Moved laterally using hydraulics or a winch. Some minor vertical jacking is typically needed

What is SIBC?

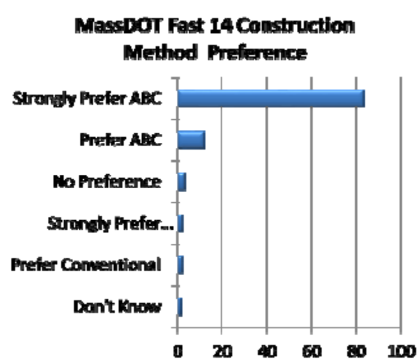
- Reduced disruption if substructure can be constructed below the existing bridge
- Minimal disruption likely requires innovative foundation systems
  - Drilled shafts outside footprint of existing bridge
  - Micro or mini piles
  - Integrating cap beams
  - Spread footings
- Prefabricated substructure units

What is SIBC?

- Can be used for temporary bypass bridges
  - Temporary substructure must be designed for live and other transient loads

Benefits

- What is driving the use of SIBC?
  - Increased traffic demands
  - Increasing congestion
  - Public demand for rapid delivery of projects
  - Safety
  - Societal costs
  - Mobility
  - Environmental impact
  - Lower cost and less risk when compared to other structure placement methods (e.g., SPMT)



Benefits

- Offers non-traditional site options
- Eliminates crossovers, shoo-flies, staged construction, and long term detours
  - Can result in lower construction costs/bid price
- Reduces mobility impacts

Benefits

- Promotes user and worker safety
- Better contractor "buy-in" when compared to other ABC methods
- Could reduce environmental impact

Benefits

- Removes bridge construction from critical path
  - May lead to better quality end product
- Involves public in reducing societal costs
  - Results in greater "buy-in" in the overall project
- Road closures better managed
  - Dates and duration are more predictable

Project Highlight

I-84 at Dingle Ridge Road – New York

- Cost savings
  - Over $1.2 M in user delay cost savings by using ABC (Source: NYSDOT)
  - $2 M cost savings from elimination of cross-overs, temporary bridge (Source: NYSDOT)
  - Savings in work-zone accidents costs

Potential Challenges

- Internal resistance in the DOT
- Finding experienced contractors or heavy lift engineer
  - Mitigated through education
  - Becoming less of a challenge as more projects are bid nationwide
- Public interest
  - Spectators on the job site

Potential Challenges

- Curved bridges; high skews
- Vertical profile changes
- Lack of space adjacent to bridge
- Traffic management plans
  - A need to be fluid and/or a have a contingency plan in place

Potential Challenges

- Possible contractor limitations
  - Forethought, significant temporary shoring, and unconventional schedules are required
- Time commitment
  - Requires 24 hour commitment of the contractor/design/owner team during slide operations
- Worker fatigue
  - Extended time for contractor, owner, and designer

Potential Challenges

- Difficult foundations/substructures
- Equipment breakdowns
- Speed of approach work completion
- Surveying mistakes
- Public spectators

Project Highlight

Elk Creek – Oregon

- Site concerns
  - Mountainous terrain surrounding bridge construction site
  - Slides can be effective even in very confined locations

Factors of Interest

- ADT/ADTT
- Facility crossed
  - Railroad/roadway
  - Navigable waterway
  - Evacuation route
- Detour length
  - Duration and viability
- Environmental
  - Limits on when
  - Limits on how

Factors of Interest

- On critical path of entire project
- Available right of way for bridge construction
- Traffic analysis
- Contractor’s work area and ingress/egress ability

Costs

- Direct vs. indirect
  - Account for agency and other indirect cost savings during decision making (CEI labor, flagging, field office, etc.)
- Avoided costs (detours)
- Reduced inflation costs
  (i.e., decreased construction time)

Project Highlight

Mesquite Interchange - Nevada

- Project costs
  - Total interchange reconstruction = $15 million
  - Original estimate without ABC = $25 million

Knowledge Check

In SIBC, the new bridge is constructed parallel to the existing bridge on temporary **supports.**

Knowledge Check

What types of innovative foundations systems are commonly used to minimize disruption?

- Drilled shafts outside footprint of existing bridge
- Micro or mini piles
- Integrating cap beams
- Spread footings
- All of the above

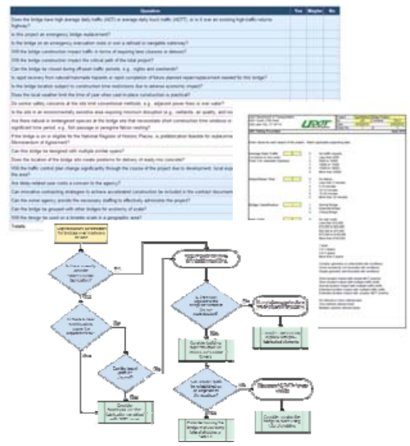
Knowledge Check

True or false: SIBC can eliminate crossovers, shoo-flies, staged construction, and long term detours resulting in lower construction costs/bid price?

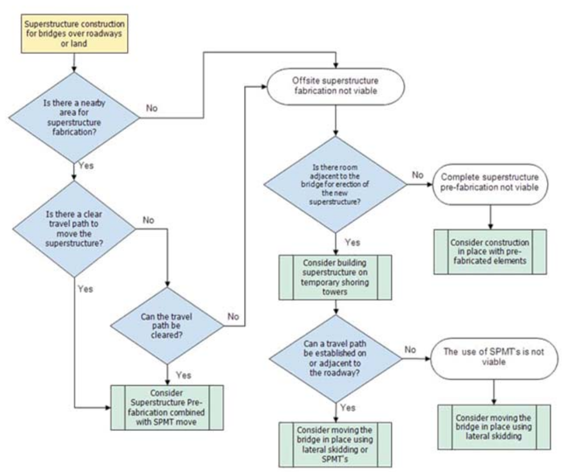
TRUE

Decision Making

- Tools exist to help owners decide when and where to use ABC and what type of ABC to use
- Tools come in five primary forms
  - Flowcharts
  - Weighted Scoring Method
  - Matrix
  - Narratives to describe the situation
  - Analytical Hierarchy Process (AHP)



Flowchart Method



Weighted Scoring Method

Utah Department of Transportation 4501 South 2700 West Salt Lake City, UT 84114	UDOT	Project: Hypothetical Bridge Project
		By: JJS Checked: CELS
		Date: 8/30/2010 8/30/2010
		Sheet No. 1 of 3

ABC Rating Procedure — June 2010

Enter values for each aspect of the project. Attach applicable supporting data.

Average Daily Traffic Combined on and under Enter 5 for Interstate Highways	5	0	No traffic impacts
		1	Less than 5000
		2	5000 to 10000
		3	10000 to 15000
		4	15000 to 20000
		5	More than 20000
Delay/Detour Time	2	0	No delays
		1	Less than 5 minutes
		2	5-10 minutes
		3	10-15 minutes
		4	15-20 minutes
		5	More than 20 minutes
Bridge Classification	1	1	Normal Bridge
		3	Essential Bridge
		5	Critical Bridge
User Costs	4	0	No user costs
		1	Less than $10,000
		2	$10,000 to $50,000
		3	$50,000 to $75,000
		4	$75,000 to $100,000
		5	More than $100,000
Economy of Scale (total number of spans)	2	0	1 span
		1	2 to 3 spans
		2	4 to 5 spans
		3	More than 5 spans
Use of Typical Details	1	1	Complex geometry or unfavorable site conditions
		3	Some complexity, but favorable site conditions
		5	Simple geometry and favorable site conditions
Safety	5	1	Short duration impact with simple MOT scheme
		2	Short duration impact with multiple traffic shifts
		3	Normal duration impact with multiple traffic shifts
		4	Extended duration impact with multiple traffic shifts
		5	Extended duration impact with complex MOT scheme
Railroad Impacts	0	0	No railroad or minor railroad spur
		3	One mainline railroad track
		5	Multiple mainline railroad tracks

Utah Department of Transportation 4501 South 2700 West Salt Lake City, UT 84114	UDOT	Project: Hypothetical Bridge Project
		By: JJS Checked: CELS
		Date: 8/30/2010 8/30/2010
		Sheet No. 2 of 3

ABC Rating Procedure — June 2010

Note: Do not adjust weight factors without prior consultation with UDOT Structures Division Project Manager

ABC RATING SCORE FACTORS AND WEIGHTS

	Score	Weight Factor	Adjusted Score	Maximum Score	Adjusted Score
Average Daily Traffic	5	10	50	5	50
Delay/Detour Time	2	10	20	5	50
Bridge Classification	1	5	5	5	25
User Costs	4	10	40	5	50
Economy of Scale	2	3	6	3	9
Use of Typical Details	1	3	3	5	15
Safety	5	10	50	5	50
Railroad Impacts	0	5	0	5	25
		Total Score	174	Max. Score	274

ABC Rating Score: 64

The ABC Rating Score is driven by the four most heavily weighted factors: Average Daily Traffic, Delay/Detour Time, User Costs and Safety. For a detailed explanation, review the narrative on page 4 of the ABC Decision Making Process.

Cost Considerations:
Calculate the following costs for use in determining the lowest total project cost

TOTAL PROJECT COST EVALUATION

	Alternative #1	Alternative #2
Construction Costs	$2,500,000	$3,000,000
User Costs	$1,000,000	$250,000
Total Project Cost	$3,500,000	$3,250,000

Matrix Method

Question	Yes	Maybe	No
Does the bridge have high average daily traffic (ADT) or average daily truck traffic (ADTT), or is it over an existing high-traffic-volume highway?			
Is this project an emergency bridge replacement?			
Is the bridge on an emergency evacuation route or over a railroad or navigable waterway?			
Will the bridge construction impact traffic in terms of requiring lane closures or detours?			
Will the bridge construction impact the critical path of the total project?			
Can the bridge be closed during off-peak traffic periods, e.g., nights and weekends?			
Is rapid recovery from natural/manmade hazards or rapid completion of future planned repair/replacement needed for this bridge?			
Is the bridge location subject to construction time restrictions due to adverse economic impact?			
Does the local weather limit the time of year when cast-in-place construction is practical?			
Do worker safety concerns at the site limit conventional methods, e.g., adjacent power lines or over water?			
Is the site in an environmentally sensitive area requiring minimum disruption (e.g., wetlands, air quality, and noise)?			
Are there natural or endangered species at the bridge site that necessitate short construction time windows or suspension of work for a significant time period, e.g., fish passage or peregrine falcon nesting?			
If the bridge is on or eligible for the National Register of Historic Places, is prefabrication feasible for replacement/rehabilitation per the Memorandum of Agreement?			
Can this bridge be designed with multiple similar spans?			
Does the location of the bridge site create problems for delivery of ready-mix concrete?			
Will the traffic control plan change significantly through the course of the project due to development, local expansion, or other projects in the area?			
Are delay-related user costs a concern to the agency?			
Can innovative contracting strategies to achieve accelerated construction be included in the contract documents?			
Can the owner agency provide the necessary staffing to effectively administer the project?			
Can the bridge be grouped with other bridges for economy of scale?			
Will the design be used on a broader scale in a geographic area?			
Totals:			

* Example taken from PBES Framework for Decision Making. Intended for illustrative purposes only.

Narrative Method

- Through a series of short descriptive narratives, an owner can be guided to a more plausible method of construction
- The method is composed of five unique components:
  - The problem
  - Defining the solutions
  - Deciding the solution
  - Product realization
  - Final product

AHP Decision Making Tool

- Designed to select the best option from a set of alternatives
  - Compares ABC vs. conventional
  - Compares ABC alternatives
- Performs pairwise comparisons to rank alternatives
- Inputs and outputs are both qualitative and quantitative
- The tool is best used when completed independently by several people then combined for final collaboration
  - Creates excellent dialog
  - Qualitative input by different staff can lead to varied results. A consistent approach and same staff for each decision process is suggested

Knowledge Check

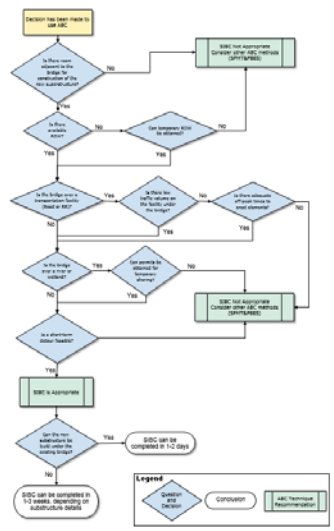
Which decision making tool assigns a value or score to what would otherwise only be a subjective decision?

Weighted Scoring Method

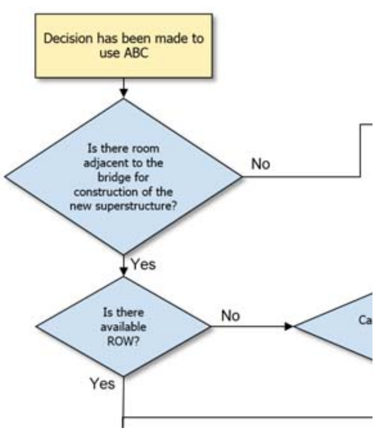
When to Use SIBC

- Ideal conditions for SIBC
  - Wide, flat area(s) adjacent to original structure
- Factors to be considered
  - Limited ROW
  - Terrain around existing bridge is rugged
  - Geotechnical conditions cannot adequately support temporary works
  - Alignment restrictions
  - Utilities

SIBC Flowchart Method



Sites Suitable for SIBC



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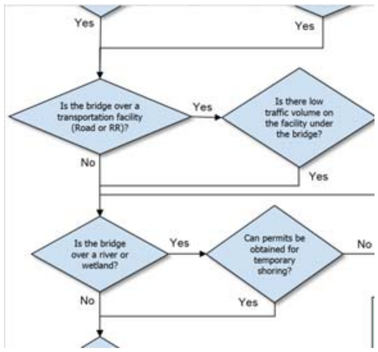

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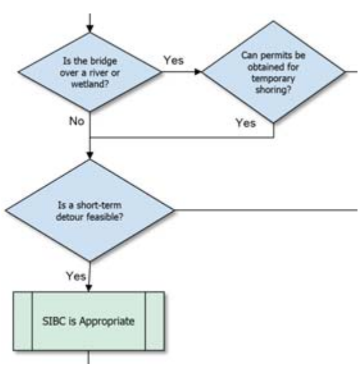


Delivery Methods/Contracting

- Not all options are available in all locations – some governments prohibit certain contracting methods
- Design-bid-build
- Design-build
- Construction manager/general contractor (CM/GC)
- A+B contracting
- And value engineering should always be an option

Design-Bid-Build

- Separate contracts for design and build
- Selection based on lowest total construction cost
- A complete design must be developed prior to bid
  - Temporary shoring design is still undertaken by the contractor

Design-Bid-Build

- Advantages
  - Widely applicable and well understood
  - Clearly defined roles for parties involved
  - Competitive bidding process
- Disadvantages
  - Lack of input from contractor
  - Delay claims and disputes are common
  - Change orders are common
  - SIBC is new to most designers

Design-Build

- Brings the design and construction under one contract for one team
- Owner gives up much of the control over the design and construction processes. Owner must communicate expectations very clearly
- Owner typically does some up-front design work prior to bidding
- Owner must then define fundamentals of what is expected in terms of performance, etc.

Design-Build

- Advantages
  - Faster project delivery in many cases
  - Design can be tailored to contractors experience
  - May promote innovative design thinking
  - Can benefit from contractor SIBC experience
  - Change orders are minimized
- Disadvantages
  - Outcomes must be clearly communicated
  - Owner relinquishes control; designer is working for the contractor and not the owner. DB team takes on more risk
  - Team must complete some design “at their expense” in order to bid
  - Cost savings, if any, can vary

CM/GC

- Similar to design-build in that the contractor and designer work together
- However, each has their own contract with owner; and the owner is an integral part of the team
- Both designer and contractor are independently selected by the owner
- Risks are identified and managed

CM/GC

- Advantages
  - Fast project delivery
  - No significant up-front design needed
  - Design can be tailored to contractor capabilities
  - Lower construction costs possible
  - Change orders are minimized
- Disadvantages
  - Question as to how to select contractor without a design
  - Must be a checks-and-balances system to verify bid costs
  - Cost negotiations

A+B

- Combines base bid price and a value to a time component
- Winning bid is the combination considered to be of best overall value
  - A = dollar bid for the contract work items
  - B = usually road user costs associated with user delays
- Contractor is only paid the A component

A+B

- Advantages
  - Contractor’s schedule must minimize construction time and delays
- Disadvantages
  - Contract changes are magnified
  - More resources may be required for contract administration

Project Highlight

Design-Build

- Mesquite Interchange
  - Team proposed slide
  - Saved 6 mo. and $10 M
- Elk Creek
  - Team proposed slide
  - Saved 22 mo. And $3M

Knowledge Check

Can any delivery method option be used in all locations?

No

Some governments prohibit
certain contracting methods.

Planning for SIBC

- The owner must ensure that there is sufficient right-of-way at the site for likely SIBC equipment
- Great care must be given to determining acceptable length of closures
  - Incentives and disincentives must be appropriately defined. Too high or too low can have undesired consequences
- Expectations with respect to “traffic impact” must be defined
  - On bridge
  - Below bridge
- The owner and contractor should involve the public from very early on
- Naming or branding the project or program (i.e., “Accelerated Bridge Program”) early on should be considered because it is likely to be named by the media or public regardless

Planning for SIBC

- The programming of costs should recognize that higher costs may be realized
- Owner must define needed submittals and provide project specifications that define the desired design criteria
- It is likely that a great level of attention to creating and reviewing specifications will be required of the owner especially on the first project. The same is also true for contractor submittals
- The owner needs to devise a reasonable project timeline where the SIBC period is conducive to submission, review, weather, and closure timing

Planning for SIBC

- Once construction begins the owner must be willing to dedicate additional resources to construction inspection
  - Inspectors must have a clear understanding of what is desired, what is acceptable and what isn't
  - Must be prepared for inspectors to work long hours
- The contractor must be willing and able to commit more resources than normal during the slide or other critical operations
- The contractor should be required to effectively communicate means and methods with an assembly plan so that the owner, designer, and others understand and can verify
- The contractor must have a fluid and efficient communication plan both before and during construction

Planning for SIBC

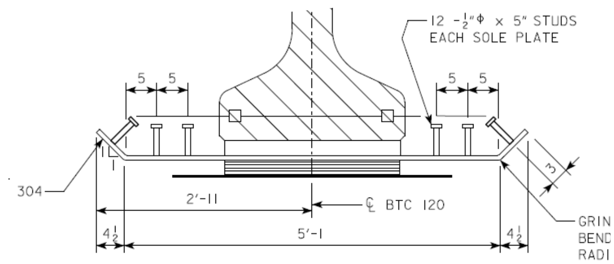
- The contractor must have a contingency plan
  - Emergency response
  - Equipment failure
  - Extended detour time
  - Accident on detour
  - Severe weather

Design and Detailing

- In general, loads from sliding operations are similar to normal service life loads though jacking force loads should be addressed in design
  - Special attention is required for the design and detailing of the push and jacking locations
  - The use of concrete integral diaphragms are useful in dealing with this issue
- Typically a bridge designer can relate slide operations to other maintenance operations
  - Lifting from slide bearings to final position is similar to replacing a bearing

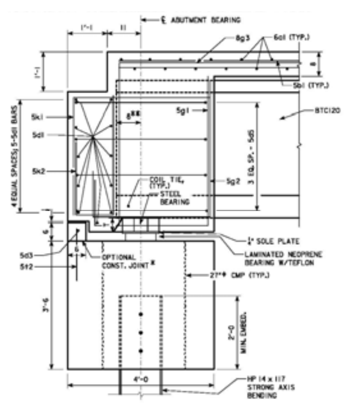
Design and Detailing

- Details are dependent on the slide system used
- Detailing of slide shoes and bearings required
- Jacking locations needed for bearing change-out.



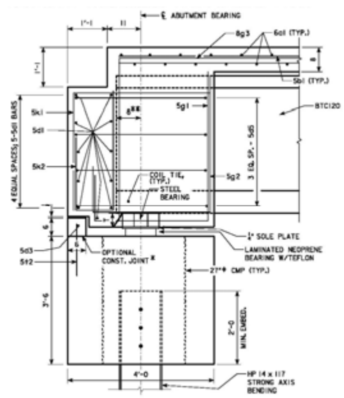
Design and Detailing

- Owner should be open to contractor suggestions for modifications of the design to accommodate specific construction processes
  - Include notes in contract to allow for contractor submitted alternate slide shoes and jacking locations
- Semi-integral abutments can be used to facilitate detail; substructure needs to be designed appropriately

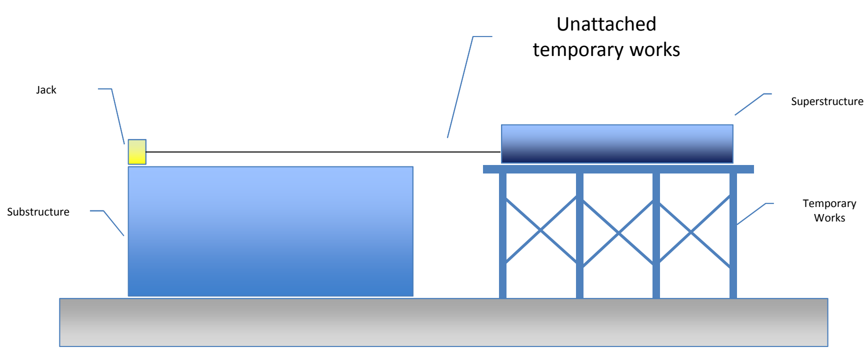


Design and Detailing

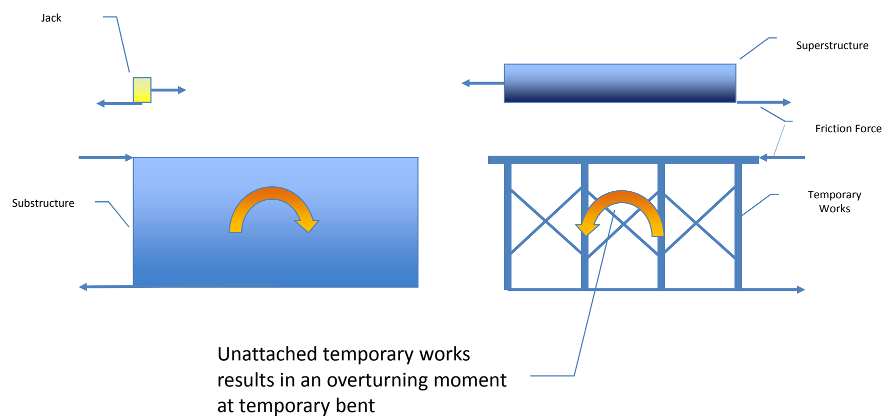
- Detail adjustability on the bearings to provide uniform loading on all bearings
- Need for slide displacement monitoring and controls
- Temporary works structure should be attached to substructure



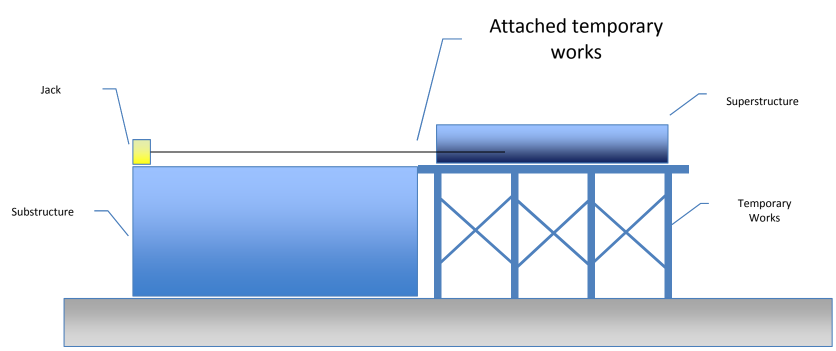
Force Diagram



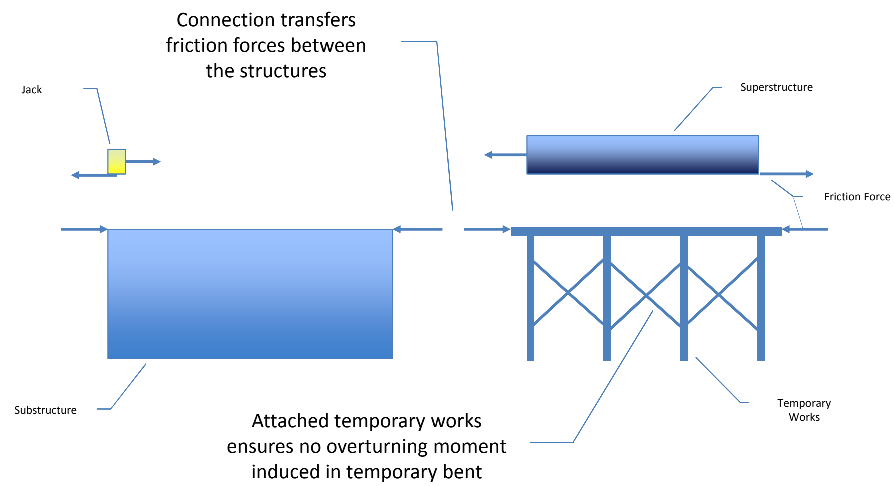
Force Diagram



Force Diagram

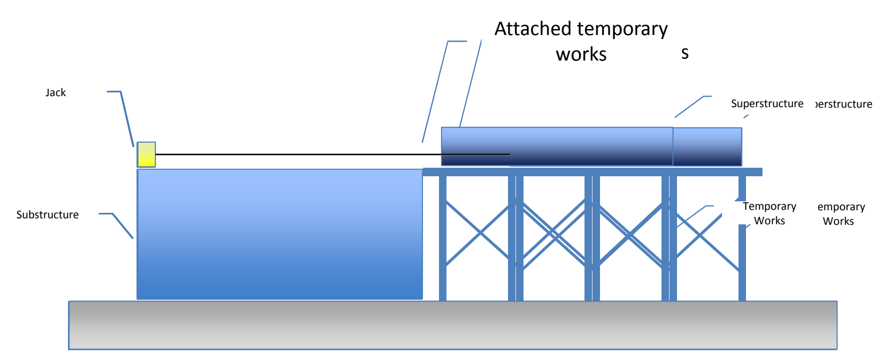


Force Diagram



Knowledge Check

Which is a better method for constructing temporary works?



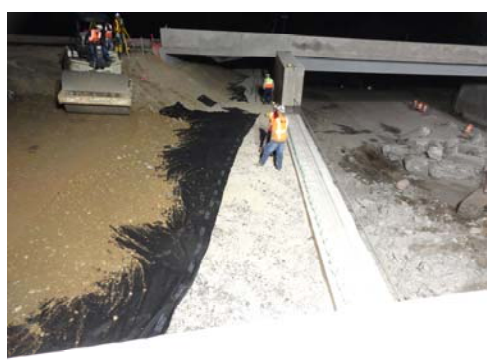
Project Highlight

Massena – Iowa

- Semi-integral abutment acts as jacking location
- Temporary works attached to permanent substructure

Approach Slab

Attention to approach slab design and construction should be a priority and not an afterthought



Approach Slab Options

- Approach slabs slid with bridge (Utah method)
  - Fast, but expensive
- Precast approach slabs placed after the slide
  - Some states have problems setting slabs
  - Consider the use of flowable fill under the ends of the slab
- CIP approach slabs
  - Can be built in 2 days
  - Need time to cure
- Buried approach slabs (European method)

Specifications

- Requirements for an assembly plan should be included
- Consider prequalification of high early strength grout
- Review field welding specifications
- Reasonable tolerances should included
  - Consider thermal expansion and contraction


Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
PREFABRICATED BRIDGE SUPERSTRUCTURE MOVE

Cass County

Effective Date

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

DESCRIPTION.

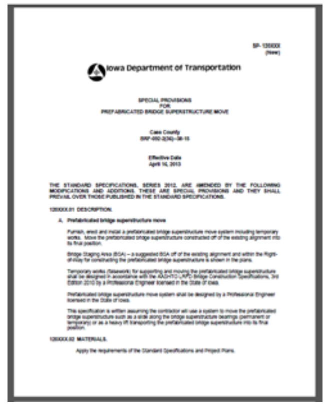
A. Prefabricated bridge superstructure move

MATERIALS.

Apply the requirements of the Standard Specifications and Project Plans.

Specifications

- Pay special attention to contractual specifications (incentives/disincentives, liquidated damages, etc.)
- Requirements for timing of plan submissions and reviews should be included
- Prequalify slide contractor and slide system


SP-120XXX
(New)

Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
PREFABRICATED BRIDGE SUPERSTRUCTURE MOVE

Cass County

Effective Date
April 16, 2013

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

120XXX.01 DESCRIPTION.

A. Prefabricated bridge superstructure move

120XXX.02 MATERIALS.

Apply the requirements of the Standard Specifications and Project Plans.

Specifications

- Need for rehearsal slide prior to final slide
- Contingency plan during slide-in
- Detailed CPM schedule for slide-in
- Submittal of slide system working drawings

	Day								
Activity	1	2	3	4	5	6	7	8	9
Start Critical Closure	9/27/2013								
Bridge Removal and Grading	■								
Pile Driving	■	■	■						
Revetment		■	■	■					
Abutment Footing			■						
Bridge slide				■	■				
Precast wings					■				
Granular Backfill						■			
Bridge Barrier Rail						■			
Approach paving							■		
Barrier End Sections							■		
Steel Guardrail								■	
Longitudinal Grooving									■
Pavement Marking									■
Finish Critical Closure									10/6/2013

Design of Temporary Works

- Temporary works usually lies within the contractor's responsibilities, including foundation design. Possibly different if live load on temporary works is intended
- Must be completed by a competent, registered professional engineer
- Geotechnical investigation should be the responsibility of the engineer of record
  - Reports should consider both deep and shallow foundations
  - Design parameters should be included in the contract documents

Design of Temporary Works

- Additional geotechnical borings at falsework locations may be required to ensure that the temporary foundation system operates as desired/needed
  - The contractor should be required to hire a geotechnical engineer if the proposed foundations are different than what is described in the geotechnical report
- Codified resources
  - Guide Design Specifications for Bridge Temporary Works
  - Temporary substructure according to AASHTO for temporary bridges
  - Design for full seismic, wind or other probability based design loads may not be needed
- Engineer of record for the temporary works will be responsible for the acceptance of that portion of the project

Design of Temporary Works

- Engineer of record should have ways of verifying certification of materials used for temporary works
- It is recommended to hold a pre-bid meeting
  - Sample temporary works drawings should be provided to contractors new to SIBC
- The construction of the superstructure on the falsework is nearly identical to that of conventional construction

Design of Temporary Works

- Accurate estimation of jacking forces is critical
- Where the jacking forces will be applied is equally critical. Design engineer must consider localized effects during design
- Engineer must recognized that lateral slides rarely go perfectly lateral. Racking or binding increases concentrated loads at the jacking points. Connections must be appropriately designed
- Temporary works frame needs to be attached to permanent substructure
- Provide jacking locations for vertical adjustment of superstructure

Design of Temporary Works

- Minimize differential settlements
- All loads are transient and changing. Therefore analysis must be completed at each state and stage
- Differential displacement must be minimized to the extent possible
- P-delta forces might need to be considered. When critical, additional bracing should be provided
- Some critical loading cases will be for horizontally and vertically applied jacking loads

Design of Temporary Works

The engineer must make a very good estimation of the coefficient of friction (static and kinetic) expected during the slide. Verify during rehearsal slide.

Slide Mechanism	Estimated Lateral Force Required*
PTFE coated neoprene bearing pads	10% of vertical load
Heavy duty rollers	5% of vertical load**

* Recommended 5% minimum design load in any case
** Possibility of roller binding occurring increasing lateral force required

Design of Temporary Works

Transition from temporary support to permanent structure must be designed to accommodate the transient load and possible differential deflection

Knowledge Check

Who is typically responsible for the design of temporary works for slide in bridge construction?

Contractor

Knowledge Check

What percentage of vertical load can be considered a good estimate for the forces required to slide a bridge superstructure on PTFE coated neoprene bearing pads?

- 5%
- 10%
- 15%
- 20%
- 25%

SIBC Slide Methods

SIBC Hardware

- Rollers
- Skids
- PTFE pads
- Hydraulic rams
- Hydraulic threaded bars
- Vertical jacking hardware

Power Systems

- Hydraulic jack
- Hydraulic push/pull jack
- Winches
- Cranes
- Other equipment

Submittals

- Slide system
- Slide plan
  - Hour by hour schedule
  - Communication plan
  - Contingency plan
- Contractor’s ingress/egress plan
- Temporary works
  - Separate temporary supports and actual slide

Media/Public Relations

- Develop a media plan
- Communicate that additional costs will replace months of inconvenience
- Allow adequate time for the public to make alternative plans during the most inconvenient times
- Communicate with the community prior to setting the schedule
- If traffic is variable, do extensive traffic counts to find the least amount of traffic, then select closure period appropriately
- Reach out through local news, websites, mailings, PR, meetings, Twitter, Facebook, etc.

Media/Public Relations

- Pay special attention to businesses and others directly adjacent to the site
- Use VMS in advance of the project to convey the plans
- If safely accomplished, invite and encourage the public to attend the slide
- Provide engineers and communications specialists to answer questions during construction
- Conduct feedback surveys from users after the slide-in

Project Highlight

Jamaica Ave – New York

- Substantial public outreach campaign began 3-4 weeks in advance of construction
- Communicated project details via letters, meetings, radio
- Posted construction details on State and City websites
- Broadcast of press release/travel advisory to media outlets and coordination of area-wide VMS signs

Knowledge Check

What methods of communication effectively convey the message to the general public regarding road closure times and durations for a slide in bridge project?

- Local news
- Websites
- Mailings
- Meetings
- Social Media
- VMS
- All of the above

Case Study: Massena, IA

Iowa Department of Transportation

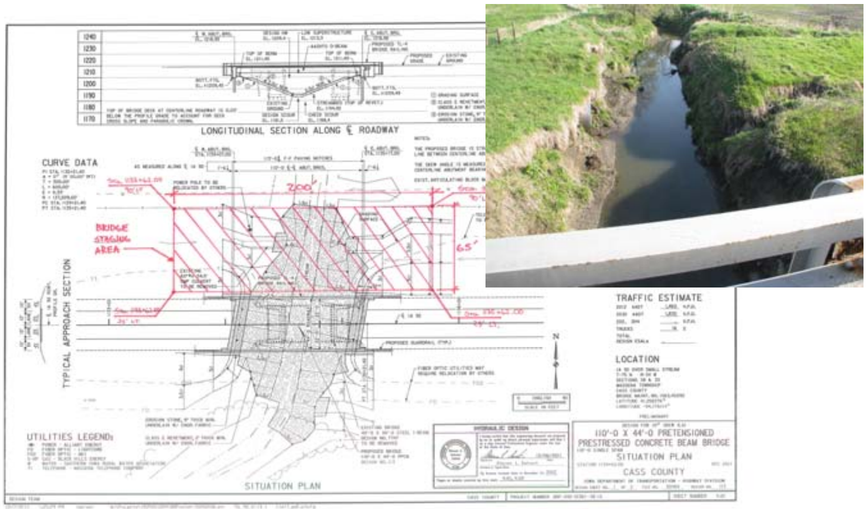
Location

- IA 92 over small stream, 1.0 miles west of IA 148

Why ABC?

- 13 mile detour – 7 mile out-of-distance travel
- AADT (2012) – 1,460 with 16% trucks
- User costs for 180-day detour
  - Indirect = $437,000
  - Direct = $15,000
    - County road maintenance
    - Detour signage

Why SIBC?



Delivery Method and Cost

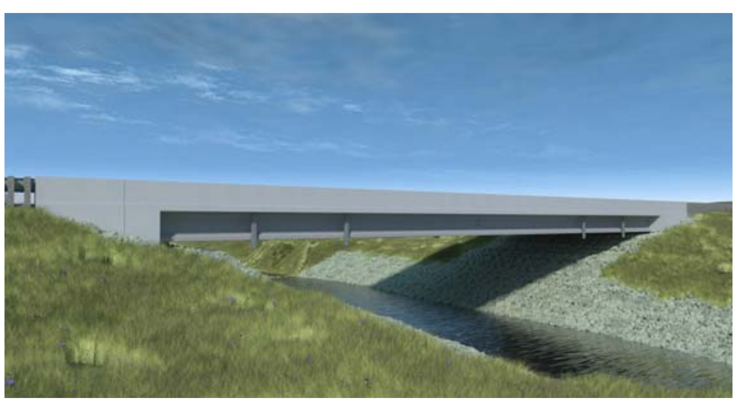
- Design-bid-build
  - Design completed by DOT with external peer review
  - Peer exchange of information from Utah DOT was critical
  - Let April 16, 2013
- Cost
  - Winning bid - $1,300,000
  - Unit cost - $112/SF
    Historic bridge unit cost - $85/SF

Existing Structure

- 40’ x 30’ steel I-beam
- Constructed – 1930
- Reconstructed – 1949
- Overlay – 1968
- Retrofit rail – 1992
- Overlay – 1998
- Structurally deficient – sufficiency rating=38.2

Proposed Replacement

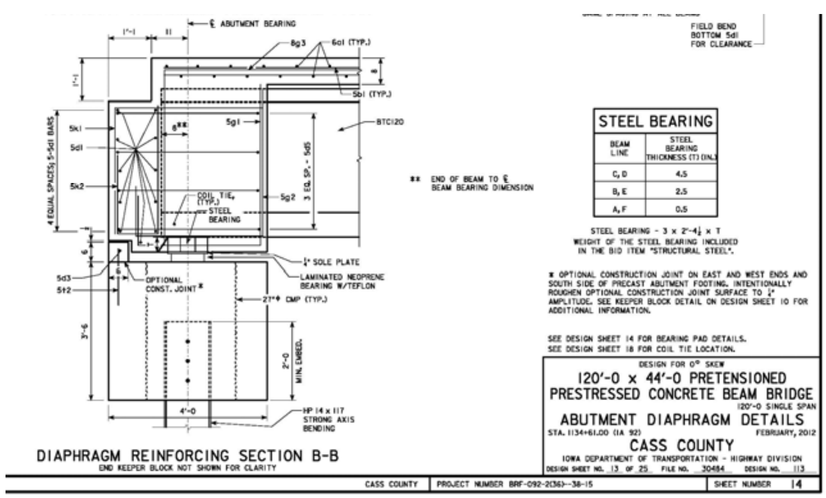
- Pretensioned, prestressed concrete beam bridge



Plan Design and Details

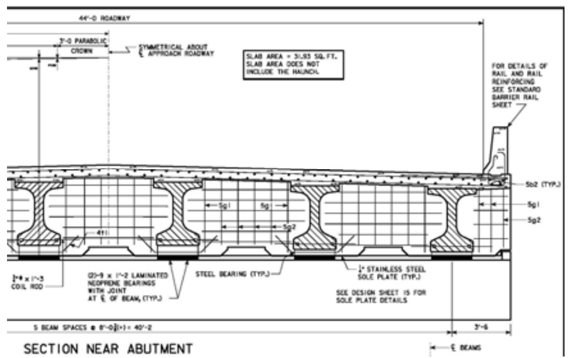
- Semi-integral abutment details
- Abutment diaphragm
  - Jacking pockets for lifting
  - Block for pushing/pulling the prefabricated superstructure
- Precast abutment footing
  - H-Pile connections
- Precast wingwalls
  - H-Pile connections

Semi-Integral Abutment

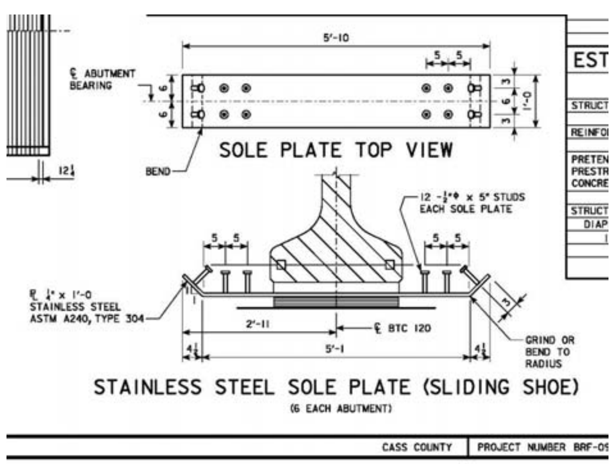


Sliding Pad

- Engineer's sliding concept
- Contractor elected to use commercially available rollers



Sliding Shoe



Critical Closure Schedule

	Day								
Activity	1	2	3	4	5	6	7	8	9
Start Critical Closure	9/27/2013								
Bridge Removal and Grading									
Pile Driving									
Revetment									
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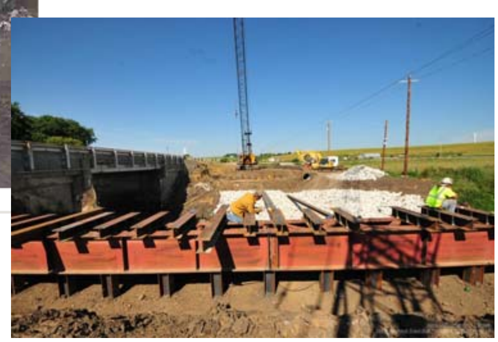
Granular Backfill									
Bridge Barrier Rail									
Approach paving									
Barrier End Sections									
Steel Guardrail									
Longitudinal Grooving									
Pavement Marking									
Finish Critical Closure									10/6/2013

Lessons Learned

- Let ABC projects similar to steel bridges, in the fall with time for the contractor to gather resources
- Offer precast/CIP options for substructure
- Be prepared to fully evaluate impact of contractor method changes
- Do not allow reuse of laminated neoprene bearings
- Add a specification requiring falsework design engineer to inspect and accept falsework construction

Lessons Learned

- More design and review time required for first SIBC project than anticipated
- First time design team time
  - Design engineer – 97 hours
  - Detailer – 338 hours
  - Check engineer – 168 hours
  - Total – 603 hours
- First time submittal review engineer – 137 hours
  - Structural steel
  - Falsework
  - Precast wingwalls
  - Move plans and calculations
  - Move procedures
- It is anticipated the time required will be greatly reduced with subsequent projects

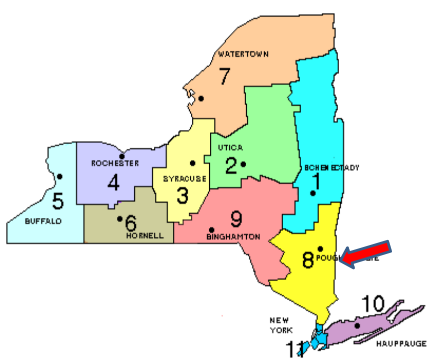


Time Lapse Video

Case Study: Dingle Ridge Road

New York Department of Transportation

Project Location



- I-84 about 50 miles north of New York City
- 1 mile from CT border

Why ABC?

- Over 75,000 ADT
- One construction season for each bridge
- Traffic impact up to 2 years
- Seven acres of temporary impact
- Dozens of other bridges on NY I-84 corridor could benefit from ABC/slide-in construction

Why SIBC?

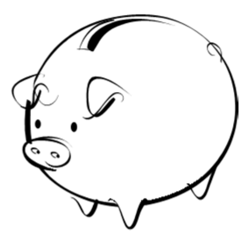
- Traditional methods would have required
  - Temporary bridge in the median
  - Substantial cross-over roadways
- Existing bridges are too narrow for cross-overs with two-way traffic
- Elevation differences between EB & WB roadways makes cross-overs more difficult
- Additional cost of approximately $2.0 M

Delivery Method

- Design-bid-build
  - Bridge design: HNTB
  - Highway design: NYSDOT Region8
  - Contractor: Yonkers Contracting, NY
  - Precaster: Dailey Precast, Vermont
  - Slide contractor: Barnhart / Marino
  - Temp structures: Siefert Associates, NY
  - Design funding: SHRP 2
  - Construction funding: NYSDOT and Highways for Life

Cost Savings with ABC

- Over $1.2 M in user delay cost savings by using ABC (Source: NYSDOT)
- $2 m cost savings from elimination of cross-overs, temporary bridge (Source: NYSDOT)
- Savings in work-zone accidents costs
- Cost for temporary supports and lateral slide: $1.06 M for both bridges



BID / ABC Schedule

- Low bid: Yonkers Contracting, New York
- Contract award January 2013
- $10.2 M (total cost); (bridge cost $6.1 M)
- Bid for temp. supports & lateral slide: $1.06 M
- Replaced westbound bridge: 9/21/13
- Replaced eastbound bridge: 10/19/13
- ABC window: 5 PM Saturday to 1 PM Sunday (20 hours)

Bridge Slide

Slide-In Construction

- Traffic disruption on I-84 reduced from two years to two weekend nights
- Dingle Ridge Road (low volume local road) was closed for 5 days

Pre Slide

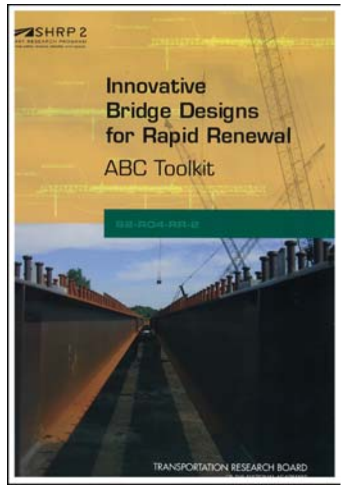
Slide Operation

Traffic Control

- Not an interchange – ramp detours not available
- Route 6/202, parallel to I-84, used as the detour (3 miles)

Bridge Design

- Structure design guided by Innovative Bridge Designs for Rapid Renewal
- SHRP2 ABC Toolkit concepts used for
  - Concrete NEXT beams (double tee)
  - Precast approach slabs
  - UHPC connections
- Toolkit is being extended to cover slide-in bridge construction concepts



Design - New Bridges

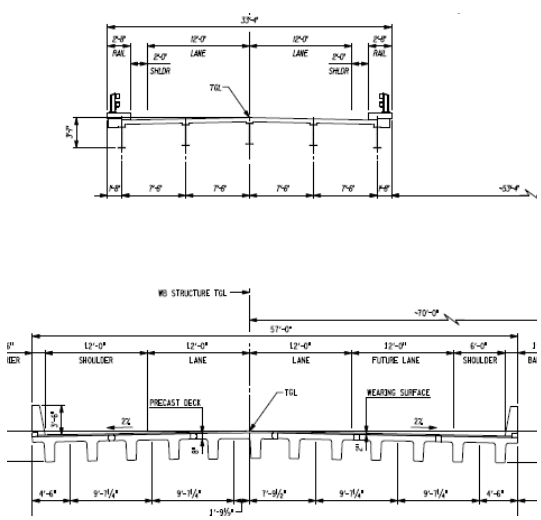
- Single span 80'; three lanes at 12' with shoulders
  - Original bridge was 3 spans
- Bridge width increased from 33'-4" to 57'-0"
- Use 3" asphalt wearing surface eliminates grinding
- Dingle Ridge Road passing beneath new bridges on 15.7% grade
- New bridges will be about two feet higher to maintain under-clearance.
- Need to minimize new structure depth

Design Challenges

- Complete slide in one weekend night
- Need to raise I-84 approaches as much as 2 feet during ABC window to satisfy under-bridge-clearance

Superstructure Sections

- 80 ft span
- Wider new bridge
- NEXT beam (double T beam) superstructure
- UHPC closure pours
- Precast approach slabs



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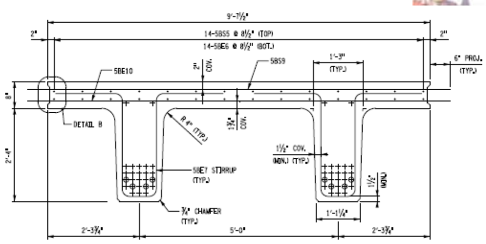
Superstructure Sections

- NEXT deck beams
- 36 inch deep sections
- 9'-8" flange; 8" thick
- f'c = 10 ksi
- 1.8 klf



UHPC Connections

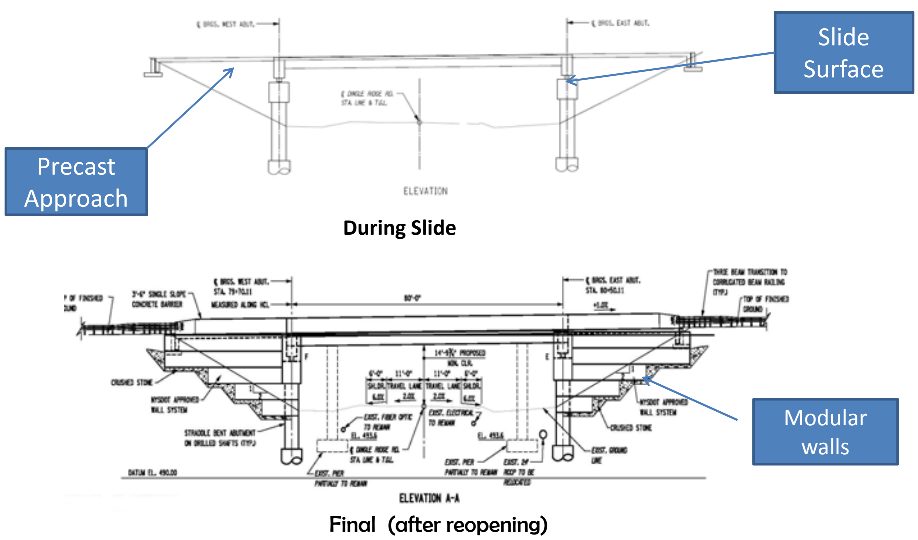
6" width

Compressive strength:
20,000 to 30,000 psi

Deck Waterproofing

- Spray-applied waterproofing membrane placed before the slide
- 3" asphalt overlay

Elevation



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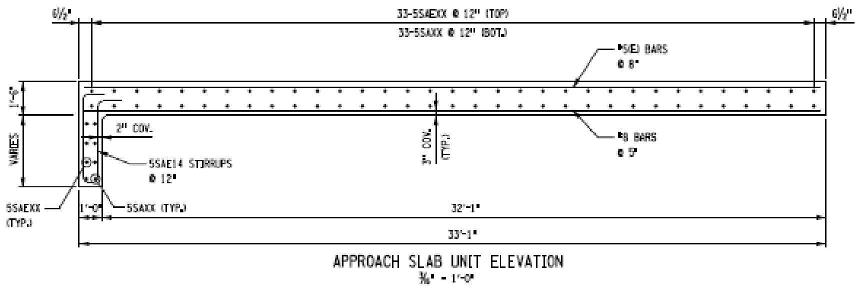
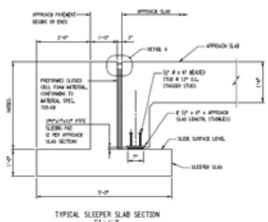
Precast Approach Slabs





Slides on inverted T sleeper slab

Three Construction Stages

Stage 1: Pre slide period

- Complete substructures to slide elevation
- Construct new superstructure and approach slabs on temporary supports adjacent to existing bridge

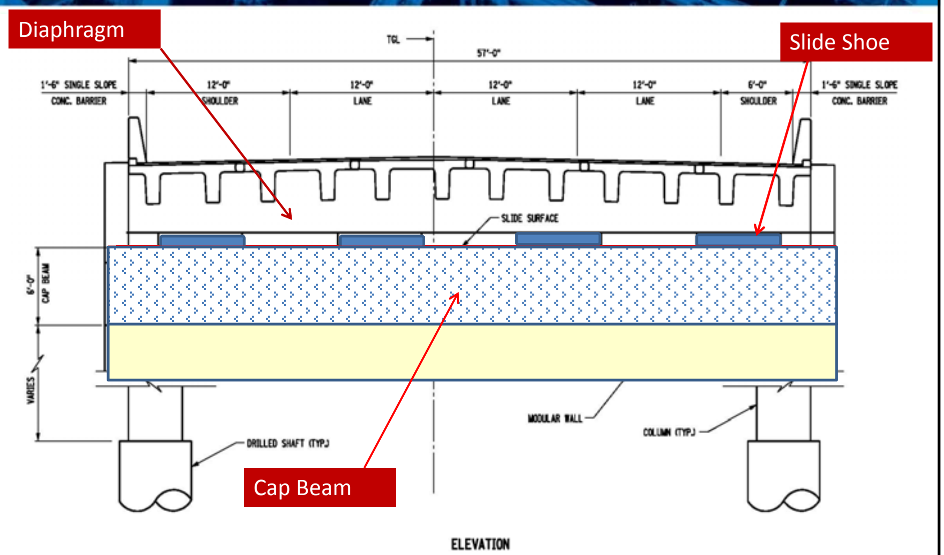
Stage 2: Slide Period (20 hrs)

- Two weekends – Sept & Oct 2013
- Demolish bridge
- Slide in new bridge & approach slabs
- Raise approach roadways by over 2 ft

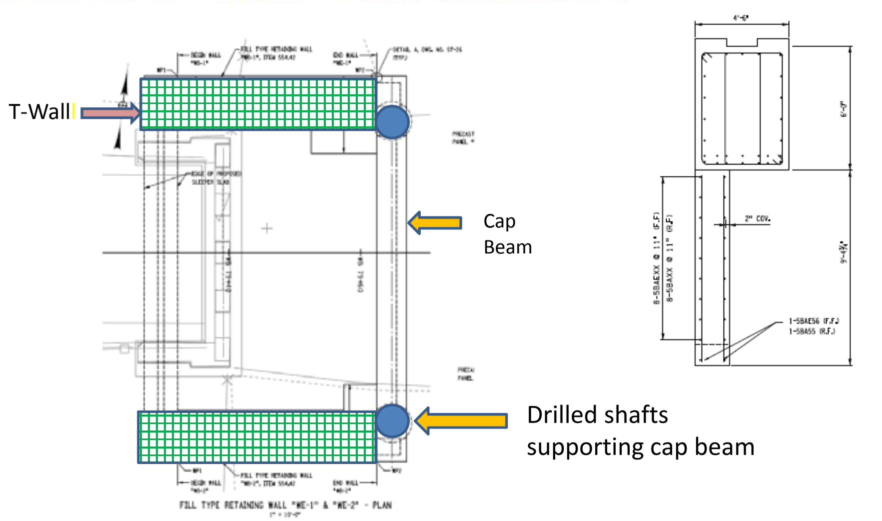
Stage 3: Post slide period

- Place flowable fill under approach slabs
- Remove temporary supports
- Complete approach roadway work

Straddle Bent Abutment



Abutment & Wingwalls



New Foundation

Foundation Construction

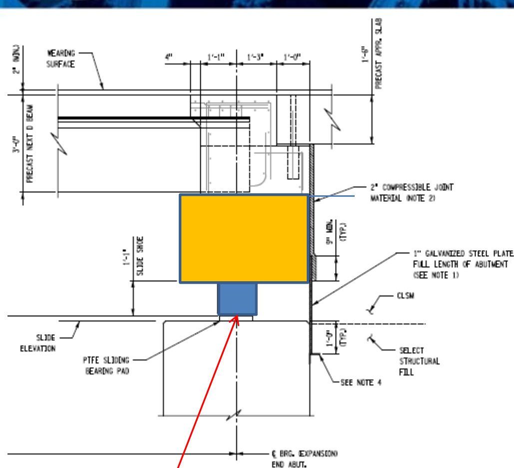
Drilled shafts outside existing footprint

Temporary Support

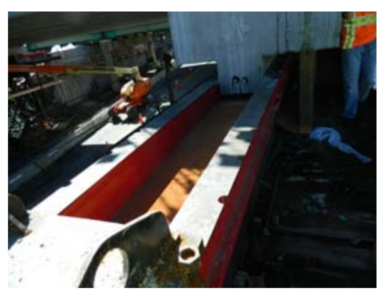
- Temporary bents on H piles
- Slide system

- Contractor designed
- Always connect temporary bents to the abutment

End Diaphragms & Slide Shoes



Slide Shoe



Slide Shoe

New Bridges

Abutment Slide Surface

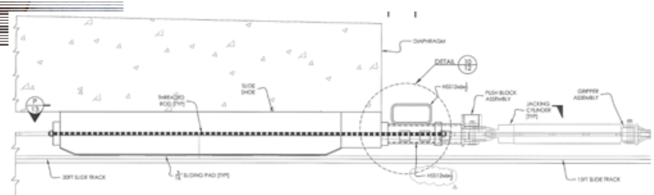
Stainless steel on 16 gage PTFE bonded to elastomeric bearing pad

Approach Slab Slide Surface

Stainless steel on PTFE pads

Inverted T Sleeper Slabs

Push/Pull Jacks at Abutments



Rapid Demolition – 4 Hours

- Chop and drop
- Local road below closed

Lateral Slide – Oct 21, 2013

Raising of Approach Roadways

- Done within slide period
- Slow compared to demo and slide

Both bridge slides completed 10 months after NTP!

View from Dingle Ridge Road

Lessons Learned

- Focus on roadway approaches as much as structure slide-in
- Need for displacement control during slide
- Importance of camber control in P/S beams
- With full depth precast P/S sections its recommended to use asphalt overlay

ABC Benefits

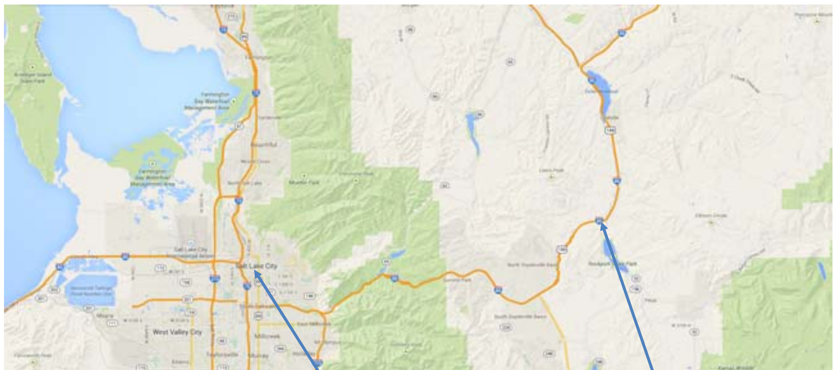
- Cost savings
- Minimizes road closure (2 weekend nights)
- Improved work zone safety
- Reduced impact to NYC watershed

Time Lapse Video

Case Study: Wanship

Utah Department of Transportation

Project Location



Why ABC and SIBC?

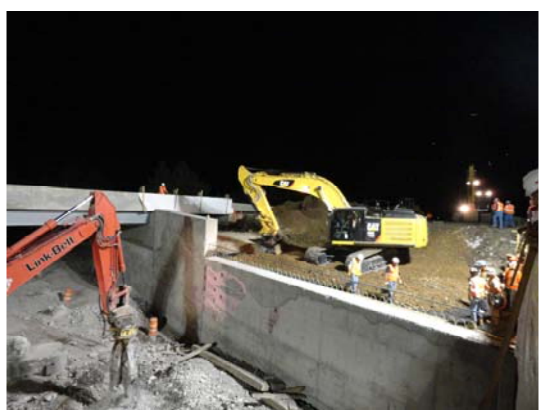
- Traffic limitations
  - Mainline interstate
  - High truck traffic
  - Recreation traffic
- Available staging areas
- CRAVE study recommended

Project Overview

- Replacement of EB & WB I-80 at Wanship
- Replaced 3 span with single span structure
- Full retaining abutment in center with full height wingwalls
  - Constructed while existing bridge in service
- Built superstructures to the side of existing and slid to final location

Project Overview

- All thread jacking/sliding system
- Ramps used as detour
- Spread footings



Design Aspects

- Vertical clearance
  - Raise I-80 or lower SR-32

Design Aspects

- Reinforcing
  - Stainless steel

Design Aspects

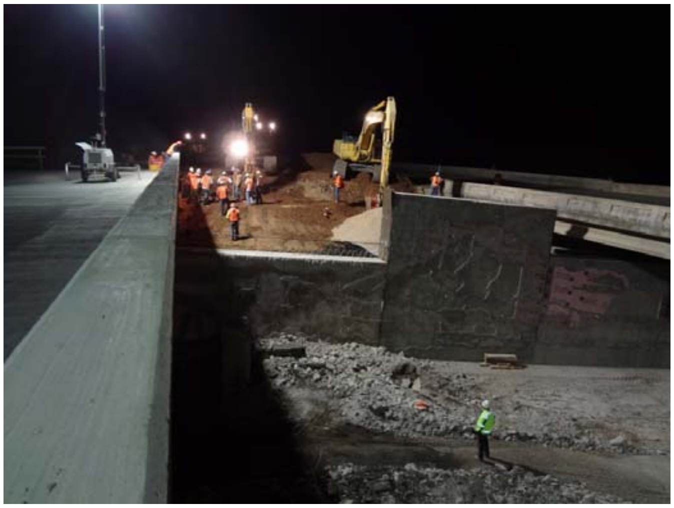
- Relationship to existing structure
  - Sleeper slab location
  - Earth work
  - Approach slab

Submittals

- Contractor submittals
- Designed with specific slide system in mind
- Tracks not required with contractors proposed system
- Modified design required changes to end diaphragms and center retaining wall
- All changes subject to review and approval

Jacking System

Jacking System



Jacking System

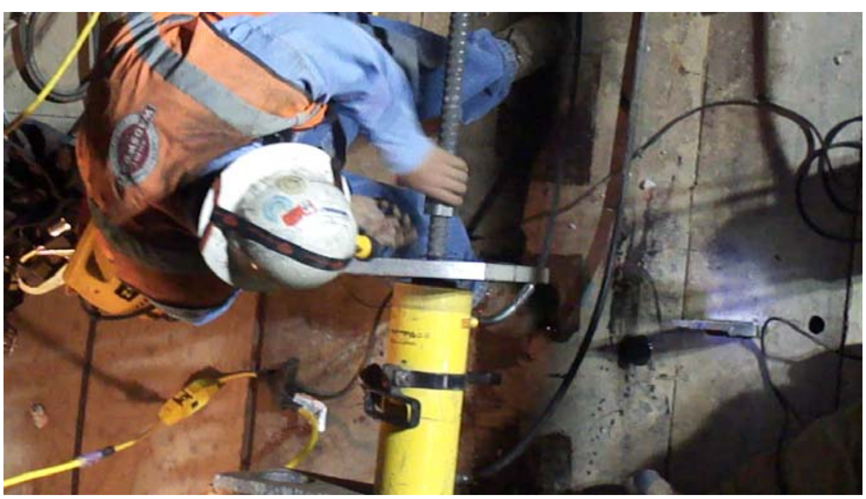
Jacking System

Jacking System

Jacking System

Jacking System

Jacking Video



Alignment Control

- Tracked alignment along the abutment
- Measured gap between the sleeper and the approach slab

Alignment Control

Closure Times

- Closed 16 hours for westbound
- Partial slide the day before the closure
  - One lane remained open on I-80

Closure Times

- Closed 18 hours for eastbound
- Completed move in one night
- Limited to one night due to the condition of the existing structure

Lessons Learned

- Sleeper slab placement
- Full longer closure is preferred to two partial closures
- Wider shorter shoe can be used if track system is not used
- Embed plate in top of abutment
- Choose form liners that are easy to match up in closure pour areas
- Very detailed and tight schedules
- Engineers and contractors closely teamed with same project goals
- Focus on roadway approaches as much as structure move-in
- Proactive detour planning with the DOT
- Phased first move if overnight full closure

Case Study: Elk Creek

Oregon Department of Transportation

Location

Project Overview

- Design Build, Best Value Selection
- Winning team proposed 2 slide-ins to eliminate expensive detours and flagging
- Winning bid: approximately $50,000,000
- Engineers estimate: approximately $53,000,000
- Actual project duration: 32 months
- Estimated project duration: 54 months

Why SIBC?

Crossing No. 3

- 2-lane detour very expensive and high risk
  - Long detour bridge with high bents or shorter detour with potentially unstable rock cut presenting high risk of unknown resultant solution
  - High risk due to temporary bents within narrow stream channel
  - Very little working room left on East end
- Rapid replacement would score higher and guaranteed full incentive

- Reduced risk of unknowns by avoiding cut slopes and potential geologic instabilities

Why SIBC?

Crossing No. 4

- Single-lane detour problematic
  - A two-lane detour was impossible
  - Staging at tunnel portal would have required temporary signal or constant flagging
  - Analysis demonstrated temporary traffic signal would back traffic up across Crossing No. 3 – negative in proposal
  - 180 calendar days to complete new bridge

- Rapid replacement, which was not envisioned in the procurement documents for these sites, would score higher and guaranteed full incentive

Crossing 3

- Three-span continuous steel plate girder
- Translation accomplished by support at two interior points with end spans cantilevered

Crossing 4

- Two-span prestressed concrete deck girder bridge
- Translation supported at four points

Crossing 4

Keys to success

- Reduction in construction time offsetting additional SIBC costs
- Reduction In MOT time resulting in schedule savings and good public relations
- Elimination of flagging, 180 days one way traffic and traffic shifts – cost savings
- Elimination of a significant temporary bridge carrying public traffic – risk reduction
- Coordination and cooperation with the owner and local communities

Keys to success

- Performance based procurement specifications allowing for innovation and an engineered solution
- Maintained traffic on alignment throughout, greatly enhancing traveler safety and reducing risk

Community Outreach

- Instrumental in providing information to traveling public
- Initiative with local schools
- Student pylon designs
  - $500 scholarship
- Time capsule

Picture Courtesy of Structural Engineer Magazine

Contractor Obstacles on DBB

- Contract issues
  - Design modifications to complete the slide (Will the owner accept the changes?)
  - Contract documents may preclude a complete closure. Will an owner accept a complete overnight closure in place of months of lane restrictions?
  - Are additional environmental clearances or permits required?
- ATC process provides a viable method to bid
- Site concerns
- Reduction in quality
- Design concerns
- Cost concerns
- Increase in risk
- Contract issues

Time Lapse Video

Case Study: Mesquite

Nevada Department of Transportation

Location

I-15 over Falcon Ridge Parkway in Mesquite, NV

Why ABC?

- High traffic volume that justified paying more for faster construction
  - Freight = 25% of vehicles
- Lack of viable alternate routes
- No need for crossovers and detours
- Precast materials could be used
- Cost savings

Why SIBC?

- Plentiful existing right-of-way adjacent to final location
- Added safety building the bridge out of live traffic

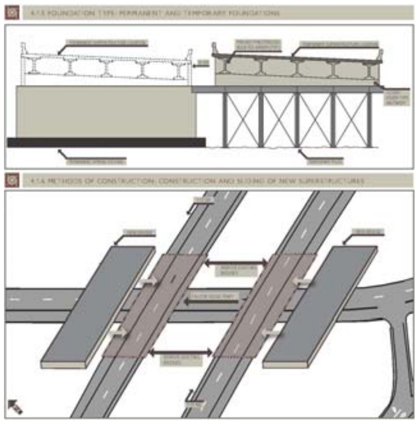
Delivery Method and Cost

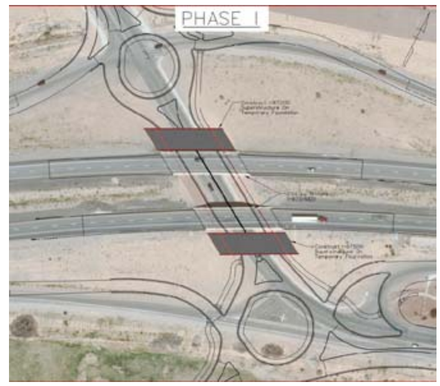
- Design-build
  - Contractor: W.W. Clyde
  - Engineer: Horrocks Engineers
  - Owner: Nevada DOT
- Construction began 1 month after NEPA approval
- Completed 6 months ahead of engineer’s estimated schedule
- Total interchange reconstruction = $15 million
  - Original estimate without ABC = $25 million

Project Elements

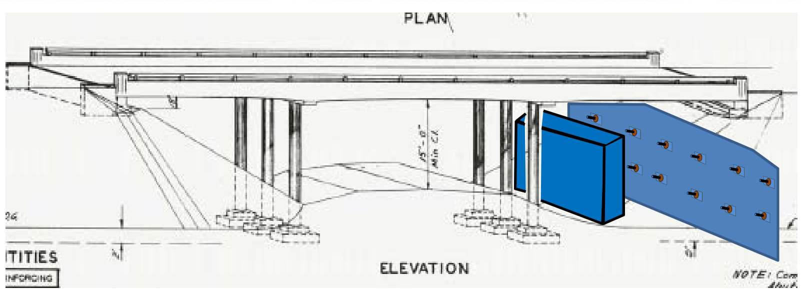
- Falcon Ridge widening and extension to Leavitt
- Lighting, signing, landscaping, and shared use path
- Construct two roundabouts
- Ramp improvements
- Drainage facilities
- Demolish existing bridges
- Construct two new bridges

Slide Schematic



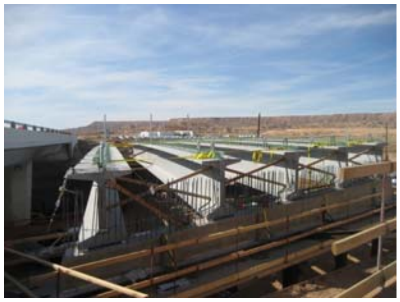


SIBC Procedure



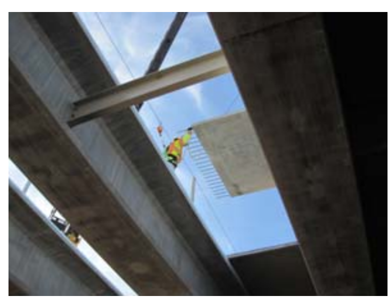
- Construct soil nail wall in front of existing abutment
- Construct new abutments under existing bridge
- Construct superstructure adjacent to existing bridge
- Demolish existing bridge
- Slide new bridge into place

Precast Concrete I-Girders



- Construction and assembly of new structures adjacent to each existing bridge
- UDOT bulb tee
- Fabricated concurrently with other construction activities

Precast Concrete Deck Panels



- Fabricated concurrently with other construction activities
- Eliminated the need for deck forming system

Bridge Demolition

Bridge Slide Process

Bridge Slide Process

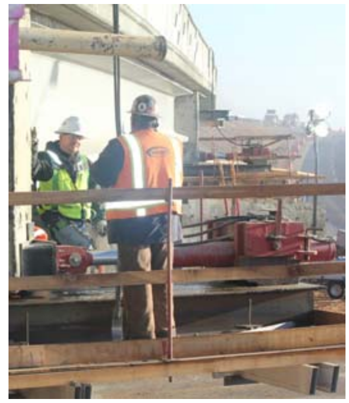
Steel wide flange beam with pads

Bridge Slide Process

Hydraulic jacks - one on each abutment

Bridge Slide Process

Operating jacks



Bridge Slide Process

Fill and pave the approaches

Aerials of Bridge Progress

December 16, 2011

Aerials of Bridge Progress

January 10, 2012

Aerial of Bridge Progress

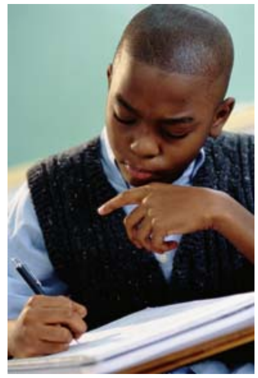
January 11, 2012

Aerials of Bridge Progress

January 24, 2012

Lessons Learned

- Design-build offered a solution that was not otherwise considered
- ABC provided a means for saving considerable time and money
- Building off-line increased the safety for workers and the traveling public
- Contingency measures pay off



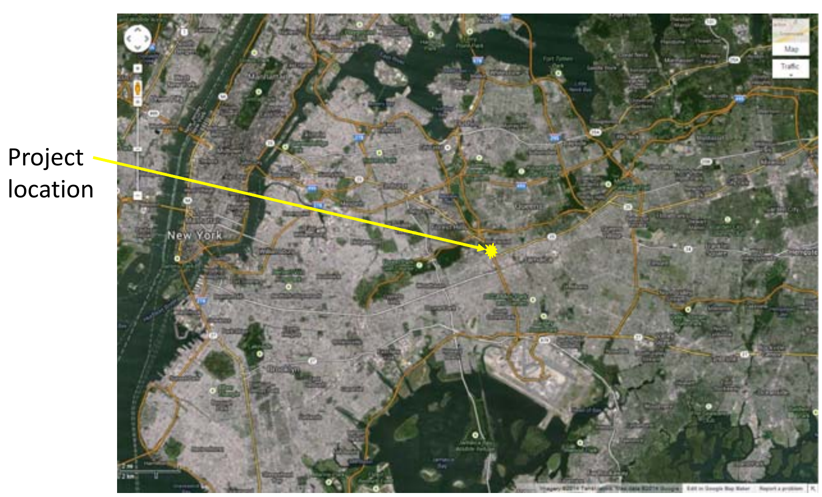
Project Video

NEVADA DOT

Case Study: Jamaica Ave

New York Department of Transportation

Location



Location

Why ABC and SIBC?

- High local volumes – more than 1,100 VPH (peak)
- High expressway volumes (160,000 on VWE)
- Difficult to detour over extended period
- Problematic to stage due to highly congested area
- Must maintain access to Jamaica Hospital

Existing Structure

- Two span
- 110 feet long

Proposed Replacement

- Remove and relocate abutments
- Remove and replace center pier stem
- Slide old bridge out of the way
- Slide new two-span continuous bridge (138 feet long) into place

Lateral Slide Benefits

- Potential to reduce overall construction time
- Substructure and superstructure can progress concurrently
- Improved quality of new structure
- Mitigated the impacts on the community and traffic

Design Challenges

- Interagency coordination
- Subway tracks – vibration monitoring, no loads transferred to subway at any time
- Verizon phone lines – could not relocate
- Utility relocation – utility bridge
- Substructure design – spatial constraints
- Camber adjustments due to temporary support locations
- First LRFD superstructure
- Limited window for rolling
- Rolling scheme was fully designed – slid on fixed rollers
- Special specifications

Construction Challenges

- Unconventional for roadway bridges – unknowns
- Demolition while maintaining traffic
- Erection and demo over traffic
- Asbestos abatement
- Utilities
- Proximity to JFK Airport
- Hours of closure – roll-in had to be completed in one weekend

Public Outreach

- Substantial public outreach campaign began 3-4 weeks in advance of construction
- Communicated project details via letters, meetings, etc., to
  - Area elected officials
  - Service agencies (PANYNJ, NYPD, FDNY, MTA)
  - Hospitals
  - JFK Airport interests (Taxi and Limousine Commission, airlines, airport employees, private bus companies, trucking companies)
- Broadcast of press release/travel advisory to trisState media outlets and coordination of area-wide VMS signs (NY, NJ, CT)

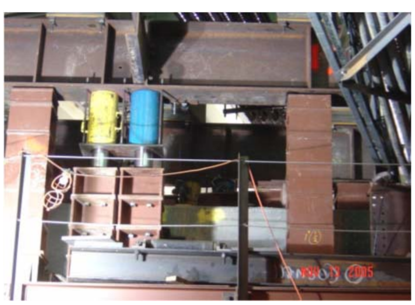
Public Outreach

- Posted construction details on State and City websites
- Notifications to area residents, community boards and businesses on Jamaica Avenue
- Produced extensive radio advertisements
- Special efforts:
  - Established 24/7 “Command Center” at Jamaica Hospital staffed by NYSDOT, NYCDOT, NYPD, FDNY, and hospital Emergency Services. The center remained activated for four days to monitor and report on the status of the work and address any critical situations.

Construction Photos

Construction Photos

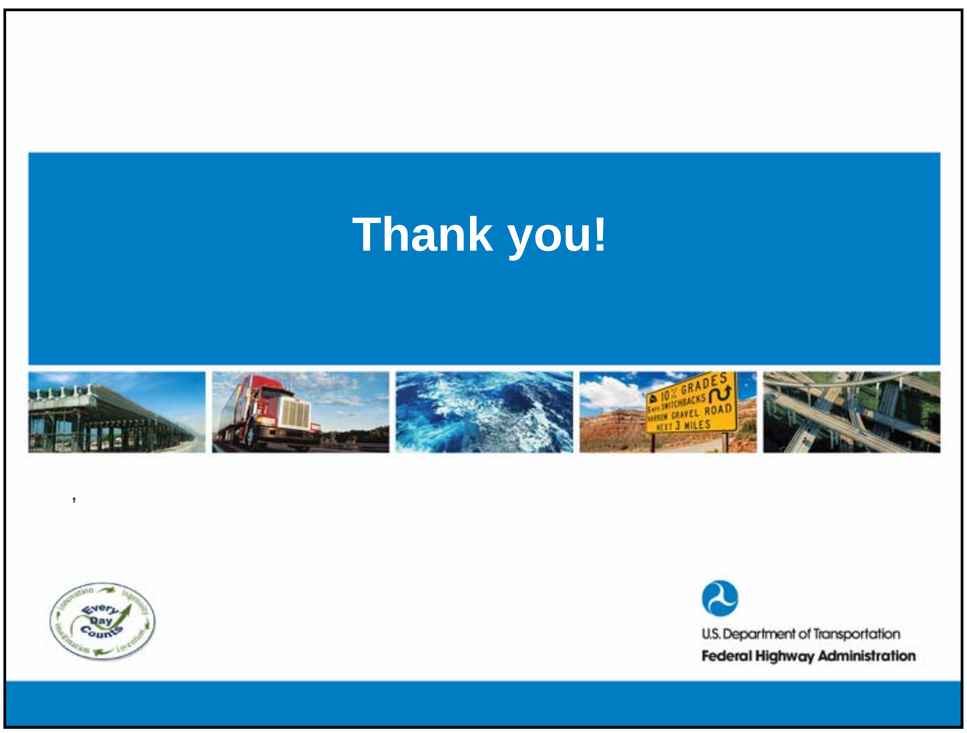
Construction Photos



Construction Photos

New Bridge with Traffic


"FHWA Slide"
www.fhwa.dot.gov/construction/sibc/
U.S. Department of Transportation
Federal Highway Administration


Thank you!
U.S. Department of Transportation
Federal Highway Administration