PRESENTATION HANDOUTS:

COURSE 1 SIBC OVERVIEW FOR DESIGNERS
Introduction

U.S. bridges

In need of rehabilitation, repair, or replacement
Deployment of underutilized innovations to:
- Shorten delivery of highway projects
- Enhance roadway safety
- Reduce congestion
- Improve environmental sustainability

**Background**

**EDC-2 Initiative**

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

- PBES
- GRS-IBS
- SIBC
- Accelerated Bridge Construction

Course 1: SIBC Overview for Designers
Course 1: SIBC Overview for Designers

EDC-2 Initiative

- PBES
- Accelerated Bridge Construction
- GRS-IBS
- SIBC

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

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**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.
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
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

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
Unattached temporary works results in an overturning moment at temporary bent.
Attached temporary works ensures no overturning moment induced in temporary bent.

Connection transfers friction forces between the structures.
Knowledge Check

Which is a better method for constructing temporary works?

![Diagram](image)

Project Highlight

**Massena – Iowa**
- Semi-integral abutment acts as jacking location
- Temporary works attached to permanent substructure
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

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
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

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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
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

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

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<tr>
<th>Slide Mechanism</th>
<th>Estimated Lateral Force Required*</th>
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<tr>
<td>PTFE coated neoprene bearing pads</td>
<td>10% of vertical load</td>
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<tr>
<td>Heavy duty rollers</td>
<td>5% of vertical load**</td>
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* Recommended 5% minimum design load in any case  
** Possibility of roller binding occurring increasing lateral force required

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

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

SIBC 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

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**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?

- 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

Delivery Method and Cost
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

Diagram showing details of semi-integral abutment design.
Engineer’s sliding concept
Contractor elected to use commercially available rollers
Critical Closure Schedule

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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
PRESENTATION HANDOUTS:

COURSE 2 SIBC OVERVIEW FOR CONTRACTORS
Introduction

U.S. bridges

In need of rehabilitation, repair, or replacement

Course 2: SIBC Overview for Contractors
Deploy underutilized innovations to
- Shorten delivery of highway projects
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EDC-2 Initiative

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PBES

Accelerated Bridge Construction

GRS-IBS

SIBC
Course 2: SIBC Overview for Contractors

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Elk Creek – Oregon

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Factors of Interest

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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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**Knowledge Check**

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

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- All of the above

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

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

- 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
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

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
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.

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
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

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
• 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

• 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
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

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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
Unattached temporary works results in an overturning moment at temporary bent.
Attached temporary works ensures no overturning moment induced in temporary bent

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

<table>
<thead>
<tr>
<th>Slide Mechanism</th>
<th>Estimated Lateral Force Required*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTFE coated neoprene bearing pads</td>
<td>10% of vertical load</td>
</tr>
<tr>
<td>Heavy duty rollers</td>
<td>5% of vertical load**</td>
</tr>
</tbody>
</table>

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

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

- 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

Course 2: SIBC Overview for Contractors
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
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

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/
Thank you!
PRESENTATION HANDOUTS:

COURSE 3 SIBC OVERVIEW FOR OWNERS
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 Diagram:
- PBES
- Accelerated Bridge Construction
- GRS-IBS
- SIBC
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
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**

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

**Matrix Method**

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>Maybe</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the bridge have high average daily traffic (HADT) or average daily truck traffic (ADTT)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is this project an emergency bridge replacement?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Is the bridge on an emergency evacuation route or one that is not reconstructible?</td>
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<td></td>
</tr>
<tr>
<td>Will the bridge construction impact traffic in terms of roadway time misses or distance?</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Will the bridge construction impact the duration of the total project?</td>
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<tr>
<td>Can the bridge be cleared during off-peak traffic periods, e.g., nights and weekends?</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Is it expected that unusual phenomena or input derivation of some decision scenario is necessary for this bridge?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the bridge locations subject to construction time restrictions due to adverse economic impact?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the local weather limit the time of year when in-place construction is practical?</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Do nearby safety concerns at the site or surrounding areas, e.g., adjacent power lines, exist?</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Is the site an environmentally sensitive area requiring mitigation such as wetlands, wetland, or wetland?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there potential or endangered species at the bridge sites that necessitate unconventional construction time windows or suspension of work for a significant time period, e.g., bats, salamander, peregrine falcon, nesting?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will the bridge or wildlife for the habitat and riparian of historic, unusual, or archaeological necessity for replaced or rehabilitation per the Department of Archaeology?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can the bridge be integrated with multiple similar spans?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the location of the bridge site create problems for delivery of ready-mix concrete?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will the traffic control plan change significantly through the course of the project due to development, local expansion, or other projects in the area?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are delays related due to costs to the agency?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can environmental concerns be mitigated or accelerated construction be initiated in the contract documents?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the site area possess the necessary staging to effectively accommodate the project?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can the bridge be designed with seismic effects for economy of scale?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will the bridge be used on a broader scale in a geographic area?</td>
<td></td>
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</tr>
</tbody>
</table>

* 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

Decision has been made to use ABC

Is there room adjacent to the bridge for construction of the new superstructure?

Yes

No

Is there available BOC?

Yes

No
Sites Suitable for SIBC

- Yes
- No

- Is the bridge over a river or stream?
  - Yes
  - Can permits be obtained for temporary structures?
  - Yes
  - SIBC is Appropriate
  - No
  - Is it a short-term, flexible solution?
    - Yes
    - SIBC is Appropriate
    - No
    - Can permits be obtained for temporary structures?
      - Yes
      - SIBC is Appropriate
      - No
      - Is there a traffic impact on the facility under the bridge?
        - Yes
        - Can permits be obtained for temporary structures?
          - Yes
          - SIBC is Appropriate
          - No
          - Is the bridge over a river or stream?
            - Yes
            - Can permits be obtained for temporary structures?
              - Yes
              - SIBC is Appropriate
              - No
              - Is there a traffic impact on the facility under the bridge?
                - Yes
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                          - SIBC is Appropriate
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                            - Yes
                            - Can permits be obtained for temporary structures?
                              - Yes
                              - SIBC is Appropriate
                              - No
                              - Is there a traffic impact on the facility under the bridge?
                                - Yes
                                - Can permits be obtained for temporary structures?
                                  - Yes
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                                  - No
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                                                - Can permits be obtained for temporary structures?
                                                  - Yes
                                                  - SIBC is Appropriate
                                                  - No
                                                  - Is the bridge over a river or stream?
                                                    - Yes
                                                    - Can permits be obtained for temporary structures?
                                                      - Yes
                                                      - SIBC is Appropriate
                                                      - No
                                                      - Is there a traffic impact on the facility under the bridge?
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

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

Course 3: SIBC Overview for Bridge Owners
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 crossovers, 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

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
Traffic Control

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

![Route 6/202 Map]

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
- \( f'c = 10 \text{ ksi} \)
- 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

During slide

Final (after reopening)

Precast Approach

Slide Surface

Modular walls

Precast Approach Slabs

Slides on inverted T sleeper slab
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
Cap Beam
Slide Shoe
Abutment & Wingwalls

T-Wall

Cap Beam

Drilled shafts supporting cap beam

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

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

100 Ton Cylinders

Gripper
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
Thank you!
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

- PBES
- Accelerated Bridge Construction
- GRS-IBS
- SIBC
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, shooflies, 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)
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)

**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
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

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

Project Highlight

Massena – Iowa

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

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
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

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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
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.

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.
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

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

<table>
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<tr>
<th>Slide Mechanism</th>
<th>Estimated Lateral Force Required*</th>
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<tr>
<td>PTFE coated neoprene bearing pads</td>
<td>10% of vertical load</td>
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<tr>
<td>Heavy duty rollers</td>
<td>5% of vertical load**</td>
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* Recommended 5% minimum design load in any case
** Possibility of roller binding occurring increasing lateral force required

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

- 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
- 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.

- 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

- Engineer’s sliding concept
- Contractor elected to use commercially available rollers
**Sliding Shoe**

**Critical Closure Schedule**

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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
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  - 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
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- $2 m cost savings from elimination of crossovers, temporary bridge (Source: NYSDOT)
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- 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

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
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
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- 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

During Slide

Final (after reopening)

Precast Approach

Slide Surface

Modular walls

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
- Cap Beam
Abutment & Wingwalls

T-Wall

Cap Beam

Drilled shafts supporting cap beam

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

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

100 Ton Cylinders

Gripper

Course 4: SIBC Overview for All Audiences
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!
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 it’s recommended to use asphalt overlay

Lessons Learned
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
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

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/
Thank you!
PRESENTATION HANDOUTS:

COURSE 5 SIBC CASE STUDIES
In need of rehabilitation, repair, or replacement

U.S. bridges
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

PBES
Accelerated Bridge Construction
GRS-IBS
SIBC
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?

- 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

![Plan Design and Details](image)

![Semi-Integral Abutment](image)
Engineer’s sliding concept
Contractor elected to use commercially available rollers
### Critical Closure Schedule

<table>
<thead>
<tr>
<th>Activity</th>
<th>Day</th>
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<tbody>
<tr>
<td>Start Critical Closure</td>
<td>9/27/2013</td>
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<tr>
<td>Bridge Removal and Grading</td>
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<tr>
<td>Pile Driving</td>
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<tr>
<td>Revetment</td>
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<tr>
<td>Abutment Footing</td>
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<tr>
<td>Bridge slide</td>
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<tr>
<td>Precast wings</td>
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<td>Bridge Barrier Rail</td>
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<td>Approach paving</td>
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<td>Barrier End Sections</td>
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<td>Steel Guardrail</td>
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<tr>
<td>Longitudinal Grooving</td>
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<tr>
<td>Pavement Marking</td>
<td></td>
</tr>
<tr>
<td>Finish Critical Closure</td>
<td>10/6/2013</td>
</tr>
</tbody>
</table>

### 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

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  - Detailer – 338 hours
  - Check engineer – 168 hours
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Time Lapse Video
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- 1 mile from CT border
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Bridge Slide
Slide-In Construction

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Pre Slide

New Abutment
Slide Operation

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- 6” width
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Deck Waterproofing

- Spray-applied waterproofing membrane placed before the slide
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Elevation

- Slide Surface
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- Modular walls

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Final (after reopening)
**Precast Approach Slabs**

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- 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 it's recommended to use asphalt overlay

**ABC Benefits**

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

Salt Lake City

Wanship

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
Alignment Control

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

- Design Build, Best Value Selection
- Winning team proposed 2 slide-ins to eliminate expensive detours and flagging
- Winning bid: approximately $50,000,000
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- 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
**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

- Approach Span
- Wide Flange w/ Small Pads
- Main Span
- New Abutment Wall
- Guide
- Bearing Pads
**Bridge Slide Process**

Steel wide flange beam with pads

**Bridge Slide Process**

Hydraulic jacks - one on each abutment
Bridge Slide Process

Operating jacks

Fill and pave the approaches
Aerials of Bridge Progress

December 16, 2011

Aerials of Bridge Progress

January 10, 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
Case Study: Jamaica Ave

New York Department of Transportation

Location

Project Location
Location

- 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

Why ABC and SIBC?
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/

Thank you!
PRESENTATION HANDOUTS:

COURSE 6 SIBC EXTENDED (HALF-DAY)

OVERVIEW FOR ALL AUDIENCES
In need of rehabilitation, repair, or replacement
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

PBES

Accelerated Bridge Construction

GRS-IBS

SIBC
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

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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
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.
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
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)
Weighted Scoring Method

Matrix Method

* 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**

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**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
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
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

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
Advantages
- Contractor’s schedule must minimize construction time and delays

Disadvantages
- Contract changes are magnified
- More resources may be required for contract administration

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
Details are dependent on the slide system used

- Detailing of slide shoes and bearings required
- Jacking locations needed for bearing change-out.

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
- Superstructure
- Temporary Works
- Substructure
- Jack
Unattached temporary works results in an overturning moment at temporary bent

Attached temporary works
Force Diagram

Connection transfers friction forces between the structures

Attached temporary works ensures no overturning moment induced in temporary bent

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 include
  - Consider thermal expansion and contraction
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

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.

<table>
<thead>
<tr>
<th>Slide Mechanism</th>
<th>Estimated Lateral Force Required*</th>
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<tbody>
<tr>
<td>PTFE coated neoprene bearing pads</td>
<td>10% of vertical load</td>
</tr>
<tr>
<td>Heavy duty rollers</td>
<td>5% of vertical load**</td>
</tr>
</tbody>
</table>

* 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?

- 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

Delivery Method and Cost
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

$\text{DIAGRAM REINFORCING SECTION B-B}$

$\text{STEEL BEARING}$

<table>
<thead>
<tr>
<th>NAME</th>
<th>MATERIAL</th>
<th>DIA.</th>
<th>LENGTH</th>
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</thead>
<tbody>
<tr>
<td>$C_P$</td>
<td>steel</td>
<td>6&quot;</td>
<td>20 ft</td>
</tr>
<tr>
<td>$A_P$</td>
<td>4&quot; H-pile</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$\text{DIAGRAM SIZE:} 24" \times 44"$
Engineer’s sliding concept

Contractor elected to use commercially available rollers
### Critical Closure Schedule

<table>
<thead>
<tr>
<th>Activity</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Critical Closure</td>
<td>9/27/2013</td>
</tr>
<tr>
<td>Bridge Removal and Grading</td>
<td></td>
</tr>
<tr>
<td>Pile Driving</td>
<td></td>
</tr>
<tr>
<td>Revetment</td>
<td></td>
</tr>
<tr>
<td>Abutment Footing</td>
<td></td>
</tr>
<tr>
<td>Bridge slide</td>
<td></td>
</tr>
<tr>
<td>Precast wings</td>
<td></td>
</tr>
<tr>
<td>Granular Backfill</td>
<td></td>
</tr>
<tr>
<td>Bridge Barrier Rail</td>
<td></td>
</tr>
<tr>
<td>Approach paving</td>
<td></td>
</tr>
<tr>
<td>Barrier End Sections</td>
<td></td>
</tr>
<tr>
<td>Steel Guardrail</td>
<td></td>
</tr>
<tr>
<td>Longitudinal Grooving</td>
<td></td>
</tr>
<tr>
<td>Pavement Marking</td>
<td></td>
</tr>
<tr>
<td>Finish Critical Closure</td>
<td>10/6/2013</td>
</tr>
</tbody>
</table>

### 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
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 crossovers, 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

New Abutment
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
- \( f'c = 10 \text{ ksi} \)
- 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
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
- Cap Beam

Abutment & Wingwalls

- T-Wall
- Cap Beam
- Drilled shafts supporting cap beam
New Foundation

Foundation Construction

Drilled shafts outside existing footprint
Temporary Support

- Contractor designed
- Always connect temporary bents to the abutment
- Temporary bents on H piles
- Slide system

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

100 Ton Cylinders

Gripper

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
Project Location

Salt Lake City  Wanship

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

Image of a construction site at night with workers and equipment.
Jacking System

Jacking System
Jacking System

![Image 1]

Jacking System

![Image 2]
- Tracked alignment along the abutment
- Measured gap between the sleeper and the approach slab
**Closure Times**

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

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**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

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

- 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
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
- 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 Slide Process

Steel wide flange beam with pads

Hydraulic jacks - one on each abutment
Operating jacks

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

- 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

Why ABC and SIBC?
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 tristate 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.

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Construction Photos
Construction Photos

New Bridge with Traffic
“FHWA Slide”

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

Thank you!