Introduction on Use of Self-Propelled Modular Transporters (SPMTs) to Move Bridges

by

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National Highway Institute (NHI)
“Real Solutions” Webinar
June 26, 2008
2004 FHWA / AASHTO / NCHRP
Prefabricated Bridge Elements & Systems Scan

1. Japan
2. Netherlands
3. Belgium
4. Germany
5. France
SPMT Movement Capability

- diagonal crab steering
- 90-degree crab steering
- circular steering
- carousel steering about a point
Munster, Germany
- 1700 M Ton
SPMTs Install Multiple-Span Curved Concrete Highway Superstructure

A4/A5 Hwy Bridge
Badhoevedorp
Netherlands

2-span, 390 ft long, 3600 tons moved in 2 Hours with 1 weekend road closure
RR Bridge 1309, Nohant le Pin, Normandy

SPMTs Install Complete
Multiple-Span Railroad Bridge

2,200 tons moved using SPMTs
Use of SPMTs to Remove & Replace Bridges

# 1 Implementation Recommendation of 2004 FHWA/AASHTO/NCHRP Prefabricated Bridge Elements & Systems International Scan
WSDOT SR 433 over Columbia River Deck Replacement – 2003

103 full-width full-depth precast concrete panels

Replaced 3900 ft deck length with no impact to peak-hour traffic

Lewis & Clark Bridge
WSDOT SR 433 over Columbia River Deck Replacement – 2003

• **Costs:**
  • $18M low bid compared to engineer’s estimate of $28M (38% savings)

• **Benefits:**
  • Closure of 124 nights plus 3 weekends (vs. 4 years)
  • No impact to peak-hour traffic
  • Delay-related user cost savings – $$$$$
FDOT Graves Avenue over I-4
Bridge Replacement - 2006

Half-hour rolling roadblocks on I-4 to remove 71-ft long, 30-ft wide, 250-ton spans

143-ft long, 59-ft wide
1,300-ton replacement spans built in adjacent staging area
FDOT Graves Avenue over I-4 Bridge Replacement - 2006

Each new span installed in few hours overnight

I-4 closed two partial nights for installations
FDOT Graves Avenue over I-4 Bridge Replacement - 2006

- Costs:
  - Supplemental Agreement for Change Order to existing contract – $570,000

- Benefits:
  - Graves Avenue detour from 12 to 8 months, for start of school
  - I-4 lane closures from 32 nights to 4 nights
  - Delay-related user cost savings of $2.2M
LaDOTD I-10 over LA 35
Bridge Span Replacements - 2006

I-10 East over LA 35
Span Installation

I-10 East over LA 35
Span Removal

Half hour to move in SPMTs for removal to final setting of new identical 60-ft span
LaDOTD I-10 over LA 35 Bridge Span Replacements - 2006

I-10 West over LA 35 Span Installation

I-10 West over LA 35 Span Removal

Same process two nights later for I-10 West removal & installation
LaDOTD I-10 over LA 35 Bridge Span Replacements - 2006

- Costs:
  - Emergency contract for $1M for 2 spans
  - Included $130,000 for SPMT subcontractor

- Benefits:
  - I-10 detour less than 10 hours for removal & replacement
  - Delay-related user cost savings – $$$$$
RIDOT I-195 over Providence River Bridge Replacement - 2006

Barged to site on SPMTs

400-ft long, 160-ft wide network arch assembled in staging area
RIDOT I-195 over Providence River Bridge Replacement - 2006

• Costs:
  • After award, Contractor-proposed float-in
  • No additional cost to RIDOT

• Benefits:
  • Float-in avoided site constraints
  • Concurrent onsite / offsite construction saved 9-12 months
  • Delay-related user cost savings – $$$$
UDOT 4500 South over I-215E Bridge Replacement - 2007

4-lane, 173-ft long, 1,750 ton span installed over weekend with no impact to rush-hour traffic
UDOT 4500 South over I-215E Bridge Replacement - 2007

• **Costs:**
  • Additional $800,000 for use of SPMTs

• **Benefits:**
  • I-215E closed 53 hours over a weekend (versus 6-month conventional construction)
  • 4500 South Bridge closed 10 days
  • Delay-related user cost savings of $4M
SPMT Equipment & Services Availability

- Mammoet – 2004 Prefab Scan Host
  - 2,200 axle lines of SPMTs
- Sarens – 2004 Prefab Scan Host
  - 500 axle lines of SPMTs
- Barnhart Crane & Rigging
  - 108 new axle lines of SPMTs
- Bigge Crane & Rigging Co.
- Fagioli USA, Inc.
- S.G. Marino Crane Service Corporation
Oregon DOT Sauvie River Span Replacement - 2007

Sarens

365-ft long
77-ft tall
1,600 tons

Sauvie Island Bridge

Above:
Arch in the air on barge 12/2007

Left:
Arch being turned at the dock 12/19/07
CTA Main Street Viaduct Span Replacement in Chicago - 2007

Demolished old span, new abutment work, new span installed on weekend

In just 54 hours
Barnhart SPMTs
2008 International Bridge Conference, Pittsburgh Exhibitor
SPMT Demonstration

2008 International Bridge Conference, Pittsburgh

One-person electronic steering operation
Manual is available in print & electronic versions.

For print version, contact Vasant Mistry, FHWA.

For electronic version, go to www.fhwa.dot.gov/bridge/prefab

Thank You
SPMTs
Self Propelled Modular Transporter
Introduction

• Reasons for Using SPMT
  – Minimize Traffic Disruptions
  – Safety of the Workers/Public
  – Fastest replacement method possible

• For UDOT
  – One of a number of ABC methods, Accelerated Bridge Construction
Family of APC  
(Accelerated Project Construction)

- Innovations to Reduce Project Delivery Time
- Contracting Methods
  - CMGC, DB
- MOT
  - Total Closure
- Incentives
  - A+B, Lane Rental
User Cost vs. Construction Cost

- New Paradigm
- Lowest Construction Cost to Lowest Project Costs
- Societal Cost Minimized
- Political Capital
- Public Praise
Innovation

- This Graph has Killed More Good Ideas …
- First time implementation usually costs more
- Potential for new methods to cost less
- Promise of time savings
Who Says ABC Costs More?

- Deck Panel Unit Cost
- 5 projects over last 15 months
- Cast in place - $53/ft²
- Precast showing bids as low as $38
- Parleys Design Build SPMT alternate beats CIP by $1M
Summary of SPMT Projects

- I-215 @ 4500 So- complete
- I-80, State to 1300 East- in progress next 6 weeks
- I-80 Mt Dell and Lambs Canyon – moving in August
- I-215 @ 3300 So- moving in August
I-215 @ 4500 South

- Severe deterioration of beam ends and bent columns
- Temp. shoring installed
- Sufficiency rating = 40
I-215 @ 4500 South

- Benefits of CMGC combined with SPMTs
  - Allowed contractor to develop concept with owner/engineer
  - Allows all parties to help minimize risk
  - Allows accelerated schedule
I-215 @ 4500 South
Design Challenges

5-Foot elevation difference between I-215 NB and SB roadways

- I-215 on 4% grade with 2% cross slope
- 4500 South on 12% grade with varying cross slope
- North American record 173 feet, 3.5 million pounds
- Completed removal and replacement in 53 hours
After project lesson learned

Owner Assurance of SPMT

- Instrumentation
  - Stress/Strain, Laser, Inclinometer
  - Real Time
  - Confirm design assumptions
  - Development of future specifications
  - Locations, deck, diaframes

- QC/QA - getting industry involved
  - Contract w/ independent engineer
    - Provide a second set of eyes
    - Verification of process
    - Verification of...
I-80, State to 1300 East

- 14 Structures
- Existing Conditions
  - Deterioration of bents and columns
  - Delamination of bridge decks
  - Blow through of two decks
  - To facilitate paving schedule use SPMTs on 7 structures
I-80, State to 1300 East

- Design - CMGC
  - Close coordination between EOR contractor and heavy lifter
  - Design of structure to accommodate heavy lifter’s means and methods
I-80, State to 1300 East

• Design
  – Design of one BSA (Bridge Staging Area)
I-80, State to 1300 East

- Construction
  - Economy of scale
  - Workers very pleased with safe working conditions
  - Complex TP (travel path) from BSA (bridge staging area) to new location.
  - Complex transfer from SPMTs to skid jacks to climbing jacks.
I-80, State to 1300 East

• Construction Challenges
  – Protecting existing utilities
  – Construction of false-work
  – Providing traffic and spectator control during the move
I-80 @ Mt Dell & Lambs Canyon

- Design Challenges-
  - 4 structures
    - Geometry
      - I-80, 6% Grade with Super Elevation
      - Cross Road, 4% Grade
    - Verify final accuracy
      - Use two Different Survey Companies
I-80 @ Mt Dell & Lambs Canyon

- Design Challenges
  - Structure set on “Garage”
  - Pick Pts and Construction Bearings the same.
I-80 @ Mt Dell & Lambs Canyon

- Construction Challenges
  - Building next to final position allows geometry to be seen.
  - 22 Hours Closure to set both WB Structures
  - Following Weekend 22 Hour Closure to set both EB Structures
I-215 @ 3300 East

- Design
  - ¾ Mile travel path
  - Less SPMT units required with - light wt aggregate deck
  - 3 lanes of traffic at all times
  - 48 hour window
I-215 @ 3300 East

- Construction
  - Construction of new abutment in front of old
  - Finding a suitable bridge staging area
Public Perceptions

Stakeholders' OVERALL Satisfaction With Project Results
(1=not satisfied, 7=very satisfied)

- 7, 76.10%
- 1, 0.00%
- 2, 0.00%
- 3, 1.40%
- 4, 1.40%
- 5, 2.80%
- 6, 18.30%
Questions
Keep America Moving
During Bridge Construction

Jugesh Kapur, P.E., S.E.
State Bridge & Structures Engineer
Washington State Department of Transportation

NHI Webinar
June 26, 2008
“Get in, do it right, get out, and stay out.”
SPMT technology = ultimate flexibility and speed

Keep America Moving
During Bridge Construction

Jugesh Kapur, P.E.
State Bridge Engineer
Washington State DOT

NHI Webinar
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What is an SPMT?

• large multi-axle platform
• computer-operated
• pivots 360 degrees
• lifts, carries, sets large/heavy loads
• moves at walking speed
Keep America Moving During Bridge Construction

Jugesh Kapur, P.E.
State Bridge Engineer
Washington State DOT

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Why SPMT? Why Now?

- Significantly Reduce Traffic Disruption
Why SPMT? Why Now?

• Significantly Reduce Traffic Disruption
• Open Highways To Traffic In Hours
Why SPMT? Why Now?

• Significantly Reduce Traffic Disruption
• Open Highways To Traffic In Hours
• Improve Work Zone Safety

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Why SPMT? Why Now?

- Significantly Reduce Traffic Disruption
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- Improve Work Zone Safety
- Improve Quality and Constructability
Why SPMT? Why Now?

- Significantly Reduce Traffic Disruption
- Open Highways To Traffic In Hours
- Improve Work Zone Safety
- Improve Quality and Constructability
- Increase Contractor and Owner Options
Examples of Project and User Cost Savings

- less maintenance-of-traffic
- possibility of less night work
- reduced construction time
- reduced onsite time for engineering and inspection requirements
Examples of Project and User Cost Savings

• reduction in construction-related user costs
• lower contractor insurance premiums
• reduced labor costs (water projects)
# Traffic Impact Comparison

## CONVENTIONAL BRIDGE CONSTRUCTION

<table>
<thead>
<tr>
<th>Work Operation</th>
<th>Duration</th>
<th>Traffic Control Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge Demolition</td>
<td>2-3 days per span</td>
<td>Detour</td>
</tr>
<tr>
<td>Beam Placement</td>
<td>25-90 minutes per beam</td>
<td>Rolling roadblocks or detour</td>
</tr>
<tr>
<td>Form Placement</td>
<td>Varies</td>
<td>Lane shifts/ closure</td>
</tr>
<tr>
<td>Deck Concrete Placement</td>
<td>1-2 days per span</td>
<td>Lane shifts/ closure</td>
</tr>
</tbody>
</table>

## SPMT

<table>
<thead>
<tr>
<th>Complete Span Removal or Placement</th>
<th>Duration</th>
<th>Traffic Control Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25 minutes to a few hours</td>
<td>Detour or Single Rolling roadblock</td>
</tr>
</tbody>
</table>
New Bridge Construction

Lewis Street
Vertical Lift Bridge
New Iberia, LA

SPMT’s to float-in whole prefabricated spans.

Exhibit A

Keep America Moving
During Bridge Construction
Jugesh Kapur, P.E.
Bridge State Engineer
Washington State DOT

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SPMT

SELF-PROPELLED MODULAR TRANSPORTERS

- SPMT.FLOAT.flv
SPMT
SELF-PROPELLED MODULAR TRANSPORTERS

Bridge Reuse Concept

Exhibit B

SPMT's used to relocate existing bridge units.

We Recycle Bridges

During Bridge Construction

Jugesh Kapur, P.E.
Bridge Design Engineer
Washington State DOT

Construct New Foundations

Existing Superstructure (Relocated)

Widening
• SPMT Ramp.flv
Bridge Replacement

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Washington State DOT

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Straddle Existing Foundations. Use Integral Frame
Straddle Piers and End Bents.
• SPMT Straddle.flv
Consider When:

- There are a significant amount of long-distance travelers.
- R/W Costs are high.
Possible Managed-Lane Policy Initiative for Interstate Corridor Expansion Using SPMT’s

The Bridge Viaduct To Increase Capacity and Reduce R/W Costs
Possible Managed-Lane Policy Initiative for Interstate Corridor Expansion Using SPMT’s

- Separate Long Distance Travelers From Local Commuters.
- Do Not Connect Everybody to Everything.
- Constructing Interchanges (making connections) is Costly.

The Bridge Viaduct To Increase Capacity and Reduce R/W Costs
Temporary Works

SPMT’s used as a span delivery system for top-down construction.

Deck Replacement Project
SR 433 Over Columbia River between Washington & Oregon

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State Bridge Engineer
Washington State DOT

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• SPMT.flv
How do I learn more?

TIG’s Lead States Team:

• DOT and industry representatives
  • Technical assistance
  • Insight
  • Expertise
  • Advice
How do I learn more?

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Also:
http://www.fhwa.dot.gov/bridge/prefab/