

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

by

Mary Lou Ralls, P.E.
Ralls Newman, LLC

National Highway Institute (NHI)
“Real Solutions” Webinar
June 26, 2008

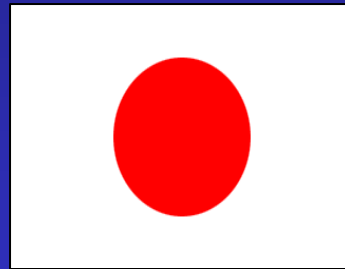
2004 FHWA / AASHTO / NCHRP Prefabricated Bridge Elements & Systems Scan



Mammoet

Sarens

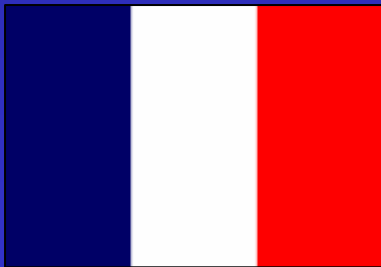
2. Netherlands



1. Japan



3. Belgium



5. France



4. Germany



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

SPMTs Install Complete Multiple-Span Railroad Bridge

RR Bridge 1309, Nohant le Pin, Normandy



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



Lewis & Clark Bridge

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

103 full-width full-depth precast concrete panels



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

143-ft long, 59-ft wide
1,300-ton replacement
spans built in adjacent
staging area



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



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



400-ft long, 160-ft wide network arch assembled in staging area

Barged to site on SPMTs



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

removal



4-lane, 173-ft long,
1,750 ton span
installed over
weekend

installation



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 12/20/07

Left:
Arch being turned at the dock 12/19/07



CTA Main Street Viaduct Span Replacement in Chicago - 2007

Barnhart Crane & Rigging



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

In just 54 hours



SPMT Demonstrations



Barnhart SPMTs
2008 International Bridge
Conference, Pittsburgh
Exhibitor

SPMT Demonstration

2008 International Bridge
Conference, Pittsburgh



Barnhart Crane & Rigging

One-person
electronic
steering
operation

SPMT Demonstration

2008 International Bridge
Conference, Pittsburgh



Mammoet

One-person
electronic
steering
operation





U.S. Department
of Transportation
Federal Highway
Administration

Manual on Use of Self-Propelled Modular Transporters to Remove and Replace Bridges

June 2007



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](http://www.fhwa.dot.gov/bridge/prefab)

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National Cooperative Highway Research Program
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Thank You

SPMTs

Self Propelled Modular Transporter





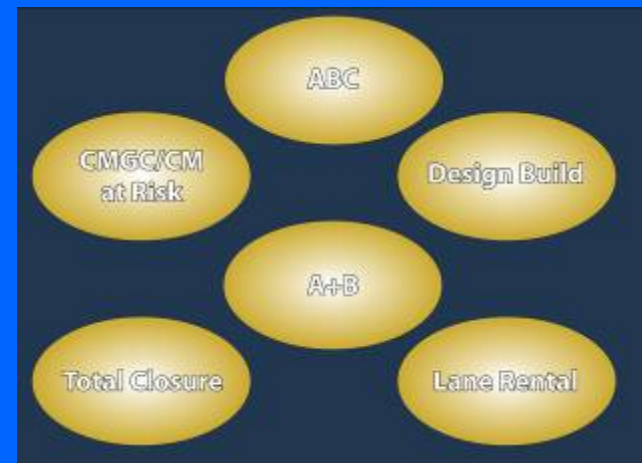
Introduction

- 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

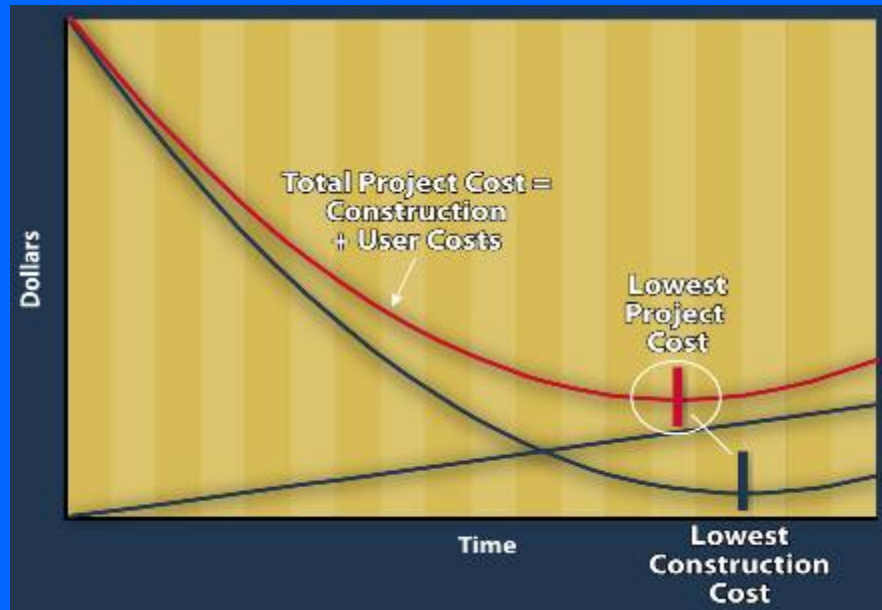


Family of APC (Accelerated Project Construction)

- 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

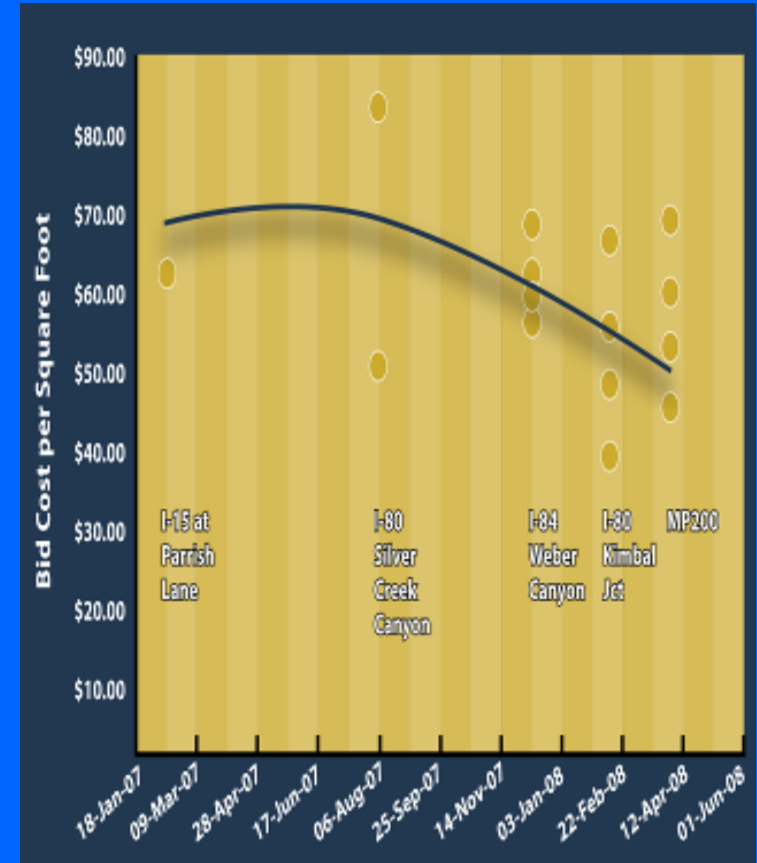
Innovation

- 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

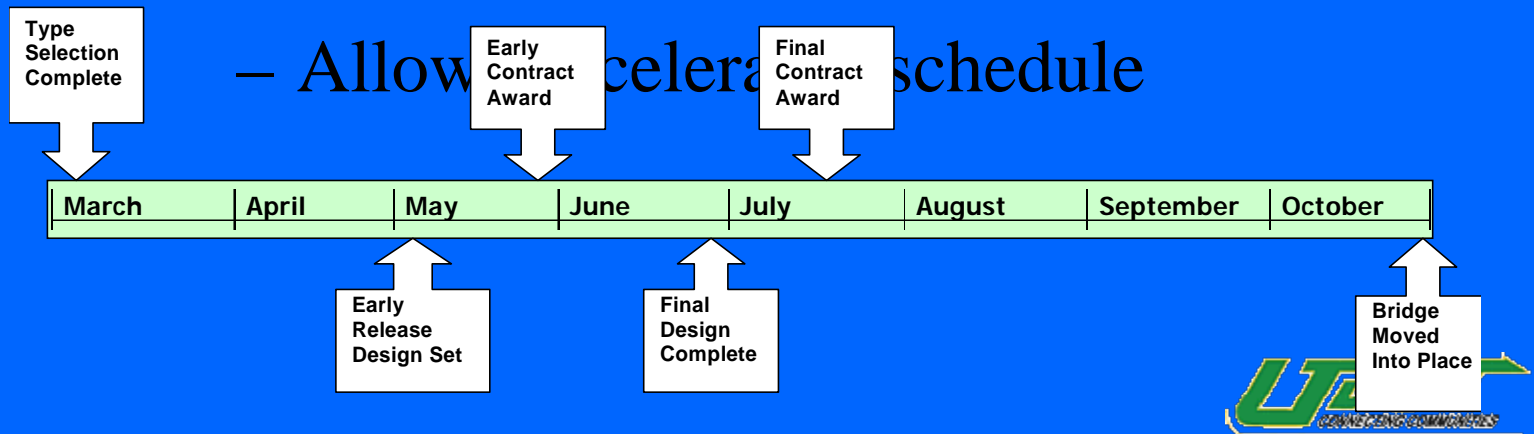
I-215 @ 4500 South

- Severe deterioration of beam ends and bent columns
- Temp. shoring installed
- Sufficiency rating = 40



I-215 @ 4500 South

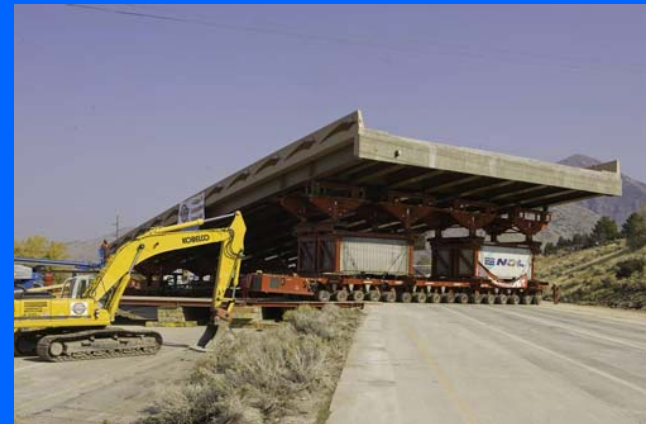
- Benefits of CMGC combined with SPMTs
 - Allowed contractor to develop concept with owner/engineer
 - Allows all parties to help minimize risk
 - Allow accelerated schedule



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



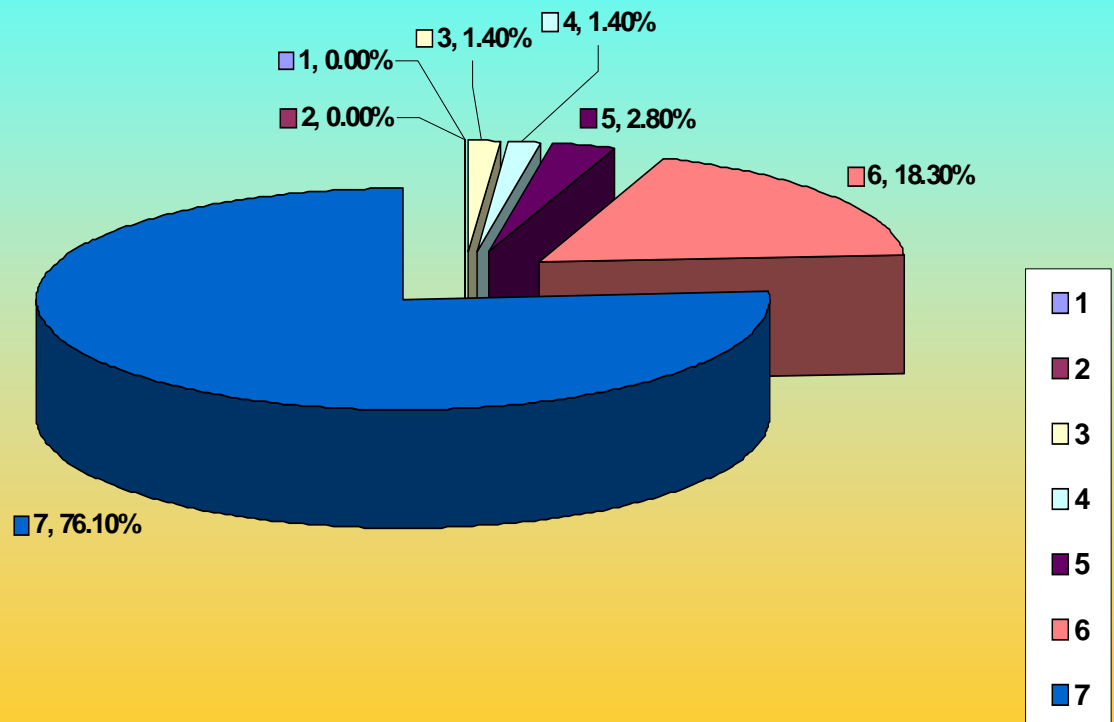
I-215 @ 3300 East

- 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)



Questions



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Jugesh Kapur, P.E., S.E.

State Bridge & Structures Engineer

Washington State Department of Transportation

NHI Webinar

June 26, 2008



SPMT

SELF-PROPELLED MODULAR TRANSPORTERS

*“Get in, do it right,
get out, and stay out.”*



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State Bridge Engineer
Washington State DOT

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SPMT technology = ultimate flexibility and speed



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State Bridge Engineer
Washington State DOT

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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



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Why SPMT? Why Now?

- **Significantly Reduce Traffic Disruption**



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Washington State DOT

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Why SPMT? Why Now?

- **Significantly Reduce Traffic Disruption**
- **Open Highways To Traffic In Hours**



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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
- Open Highways To Traffic In Hours
- Improve Work Zone Safety
- **Improve Quality and Constructability**



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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**



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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



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Examples of Project and User Cost Savings

- reduction in construction-related user costs
- lower contractor insurance premiums
- reduced labor costs (water projects)



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Traffic Impact Comparison

CONVENTIONAL BRIDGE CONSTRUCTION

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

SPMT

Complete Span Removal or Placement	25 minutes to a few hours	Detour or Single Rolling roadblock
------------------------------------	---------------------------	------------------------------------

Graves Avenue / I-4



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New Bridge Construction

Exhibit A

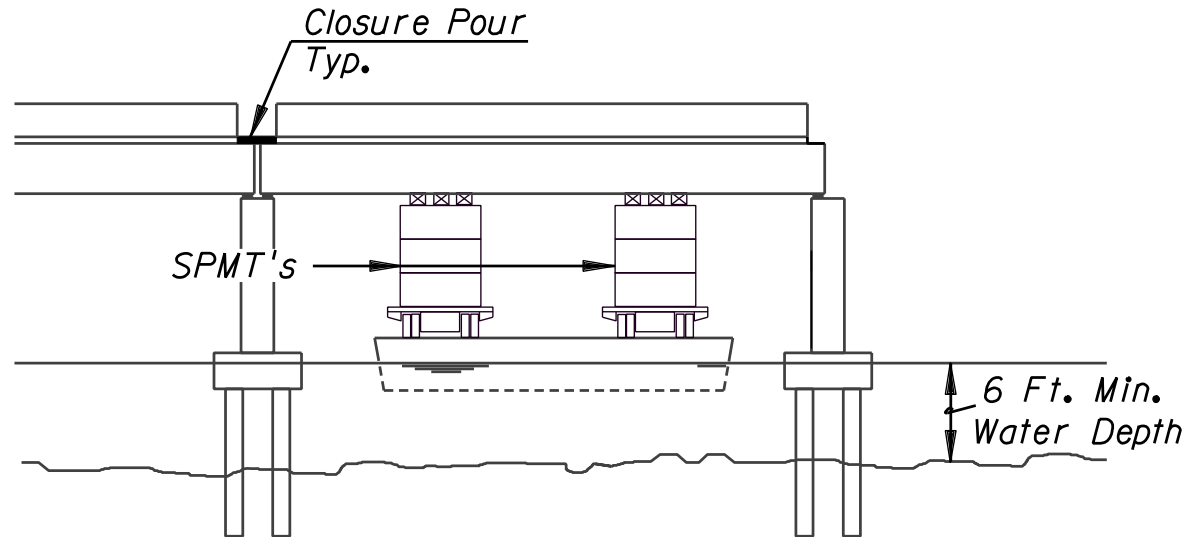
**Lewis Street
Vertical Lift Bridge**
New Iberia, LA



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SPMT's to float-in whole prefabricated spans.

SPMT

SELF-PROPELLED MODULAR TRANSPORTERS

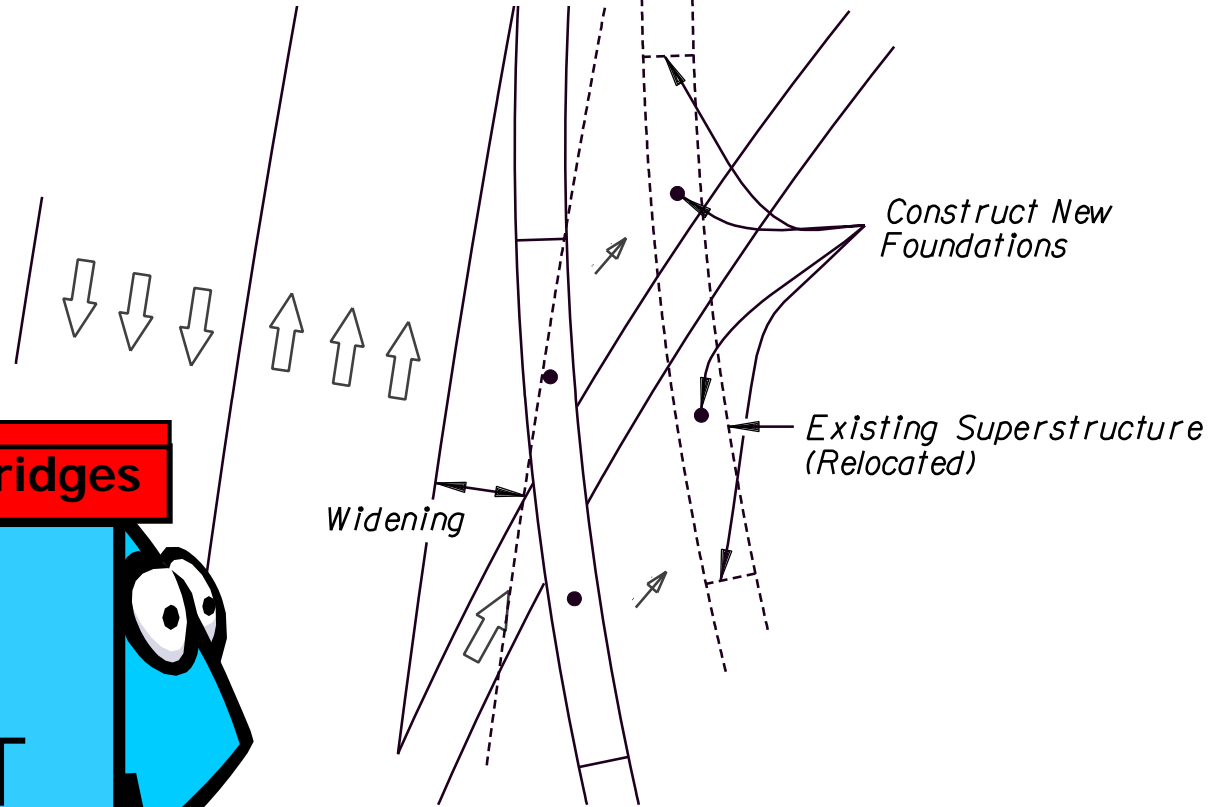
- SPMT.FLOAT.flv

SPMT

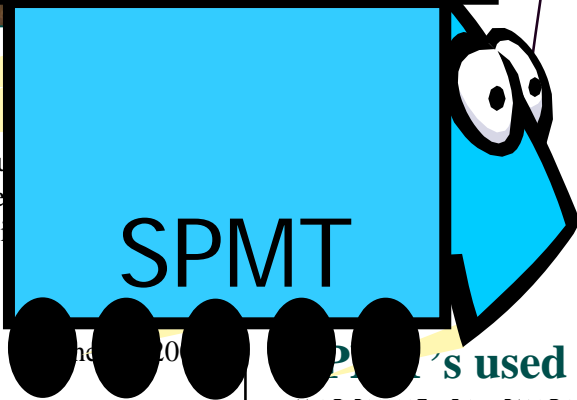
SELF-PROPELLED MODULAR TRANSPORTERS

Bridge Reuse Concept

Exhibit B



We Recycle Bridges



During
Ju
Bridge
Wash

SPMT

...s used to relocate existing bridge units.

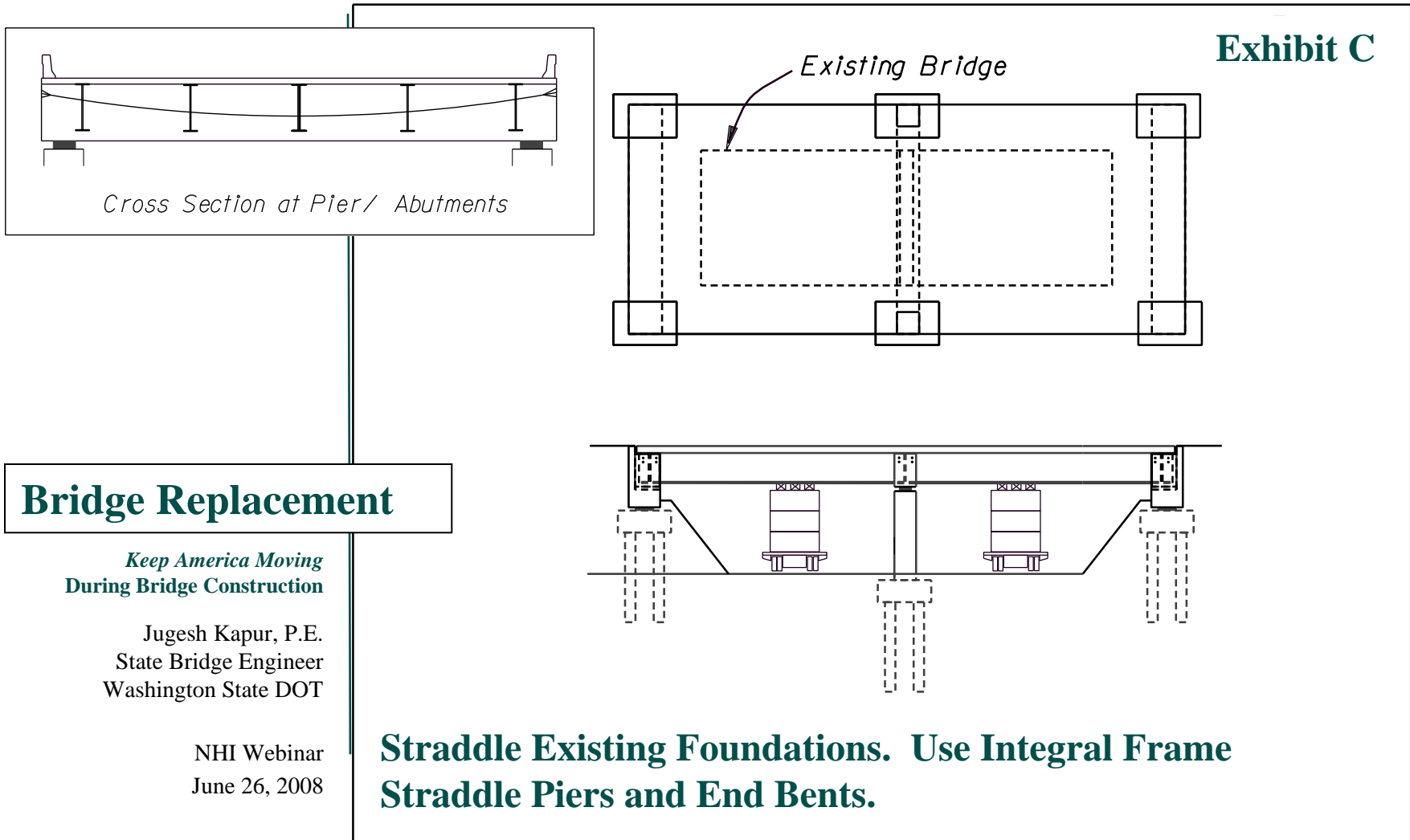
SPMT

SELF-PROPELLED MODULAR TRANSPORTERS

- SPMT Ramp.flv

SPMT

SELF-PROPELLED MODULAR TRANSPORTERS



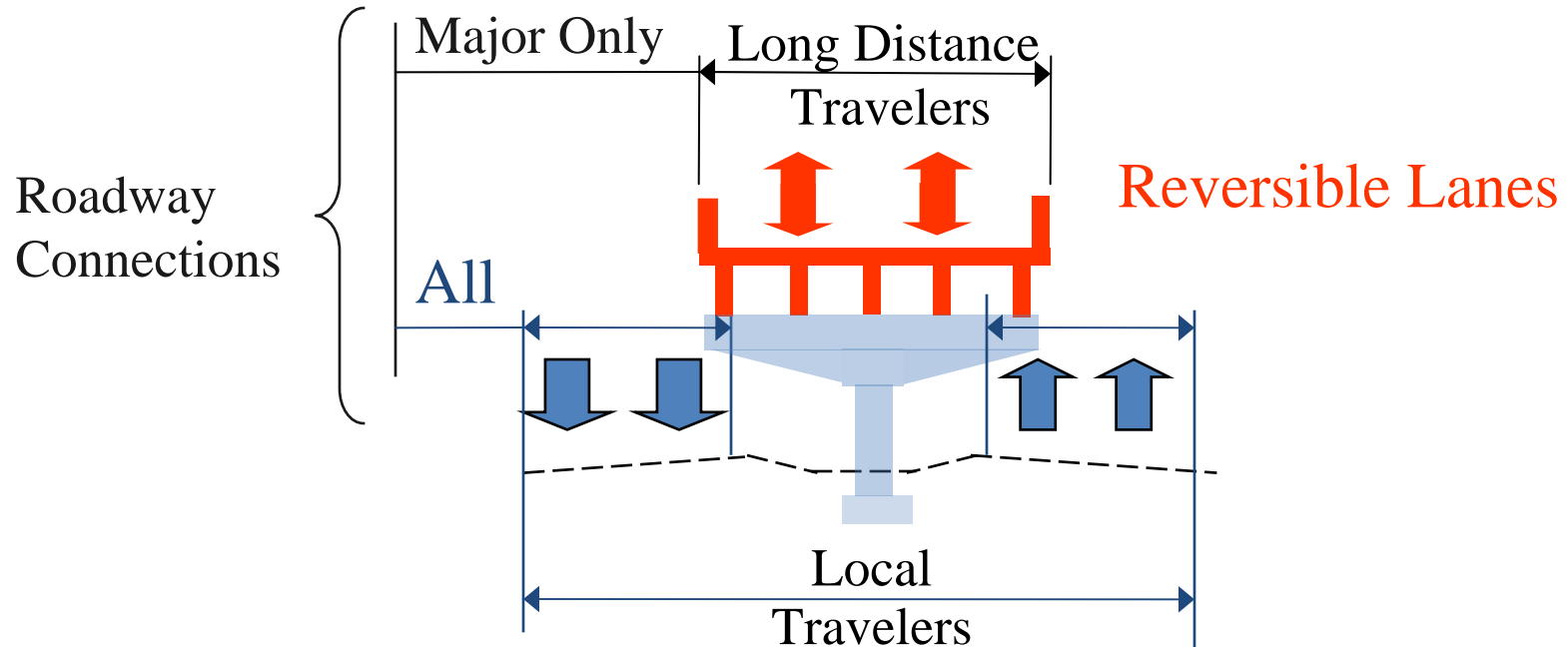
SPMT

SELF-PROPELLED MODULAR TRANSPORTERS

- SPMT Straddle.flv

SPMT

SELF-PROPELLED MODULAR TRANSPORTERS



Consider When:

- There are a significant amount of long-distance travelers.
- R/W Costs are high.

SPMT

SELF-PROPELLED MODULAR TRANSPORTERS



Possible Managed-Lane Policy Initiative for Interstate Corridor Expansion Using SPMT's

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

SPMT

SELF-PROPELLED MODULAR TRANSPORTERS

Lee Roy Selmon
Expressway
Reversible Lane Viaduct
Tampa, Florida



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

Possible Managed-Lane Policy Initiative for Interstate Corridor Expansion Using SPMT's

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

SPMT

SELF-PROPELLED MODULAR TRANSPORTERS

Exhibit D

Temporary Works

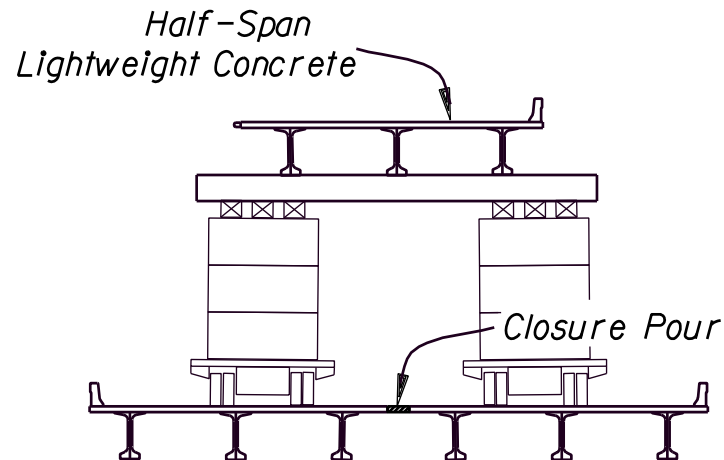
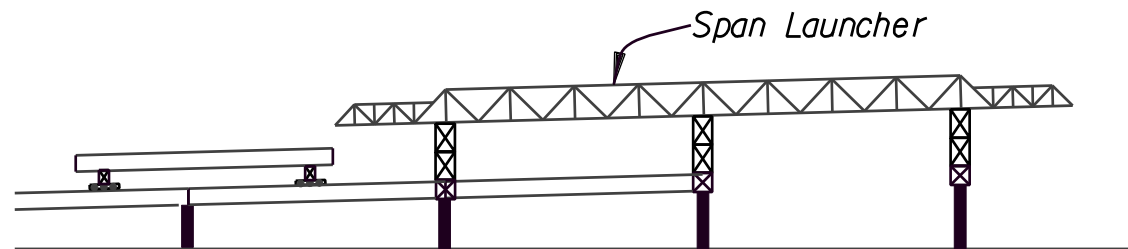
Deck Replacement Project
SR 433 Over Columbia River
between Washington &
Oregon



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

SPMT

SELF-PROPELLED MODULAR TRANSPORTERS

- SPMT.flv

How do I learn more?

TIG's Lead States Team:

- DOT and industry representatives
 - Technical assistance
 - Insight
 - Expertise
 - Advice



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How do I learn more?

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How do I learn more?

www.aashtotig.org



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Also:

<http://www.fhwa.dot.gov/bridge/prefab/>