

<p>Design Conference 08</p>	<p>Prefabricated Bridges</p>	
 <p><i>Prefabricated Bridges</i></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p>Prefabricated Bridges - Strategies, Challenges & Opportunities</p> <p>Roadmap: Will discuss state-of-the-art technologies related to prefabricated rapid bridge construction for both steel and concrete bridges.</p>	

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<p><i>Prefabricated Bridges</i></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	 <p>Where have we been?</p> <p>Where are we headed?</p>	

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Assist. State Structures
Design Engineer



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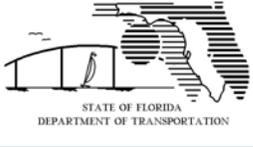
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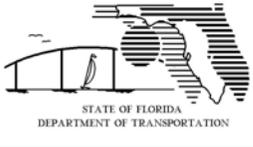
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Why Prefabricate Bridges?



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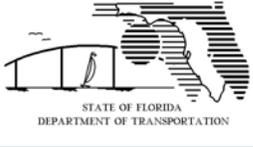
- Faster
- Can be cheaper
- Improve quality
- Minimizes traffic impacts
- Can be easier to construct
- Improves construction zone safety
- Minimizes environmental impacts
- Can allow for more aesthetic opportunities

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 <p><i>Prefabricated Bridges</i></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p>FHWA Framework for Prefabricated Bridge Elements and Systems (PBES) Decision-Making</p> <p>http://www.fhwa.dot.gov/bridge/prefab/framework.cfm</p>	

<p>Design Conference 08</p>	<p>Prefabricated Bridges</p>	
<p>FHWA Framework for Prefabricated Bridge Elements and Systems (PBES) Decision- Making</p>  <p><i>Prefabricated Bridges</i></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p>Project Selection</p> <ul style="list-style-type: none"> <input type="checkbox"/> High ADT <input type="checkbox"/> Emergency replacement/ repair <input type="checkbox"/> Where conventional construction requires long detours <input type="checkbox"/> Where bridge location creates problems w/ ready-mix concrete delivery <input type="checkbox"/> Where time spent on the water affects labor/ insurance costs <input type="checkbox"/> Does site access allow for prefabricated components and heavy lifting equipment? <input type="checkbox"/> Is casting yard available? 	

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Project Selection (cont.)

FHWA Framework for Prefabricated Bridge Elements and Systems (PBES) Decision-Making



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Design Engineer

- Does variability within project allow for formwork reuse?
- Will long construction times create adverse economic impacts?
 - Ramps to international airport
 - Bridge into major port
 - Major hurricane evacuation route
 - Construction finish time may affect tolling revenues
- Is the bridge construction on the critical path for the project?

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The Devil is in the Details

Considerations:

- Fit-up
- Durability of connections



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Deck Replacements:

Precast Deck Panel Replacements Using Near-Surface Mounted Reinforcement as a Splicing Method

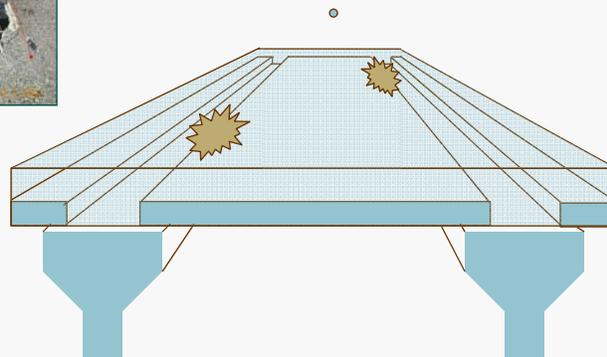
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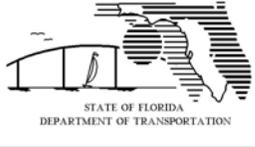


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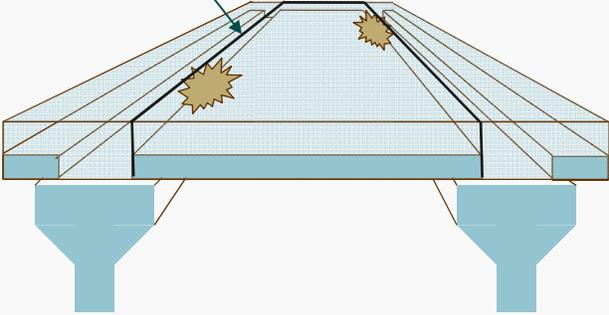


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Night One Lane Closure

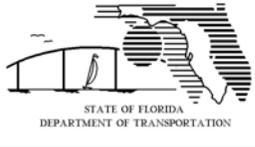
Saw Cut Existing Deck



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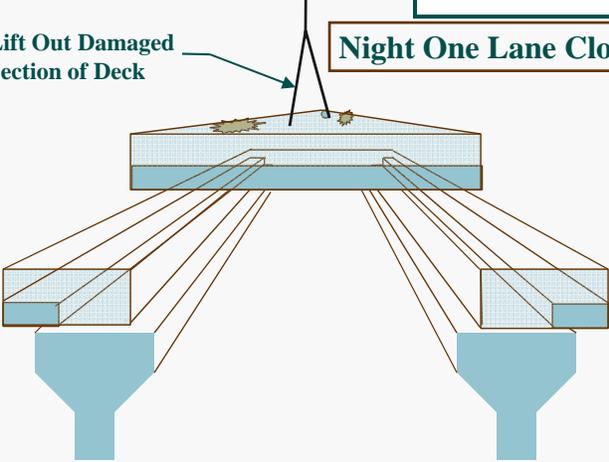
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Night One Lane Closure

Lift Out Damaged Section of Deck



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Lift-In Full Depth Precast Panel w/ Strong Backs

Night One Lane Closure

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The diagram shows a cross-section of a bridge deck with two piers. A large, light-colored rectangular precast panel is being lifted into place between the piers. The panel is supported by a network of cables or strong backs that are anchored to the piers. A dark horizontal bar is positioned above the panel, indicating the location of the lane closure. The text 'Lift-In Full Depth Precast Panel w/ Strong Backs' has an arrow pointing to the panel. The text 'Night One Lane Closure' is enclosed in a box. The Florida Department of Transportation logo is in the top right corner.

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Epoxy Grout Between Existing Deck and New Precast Panels

Night One Lane Closure

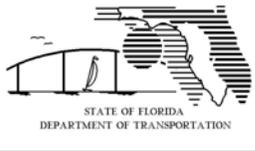
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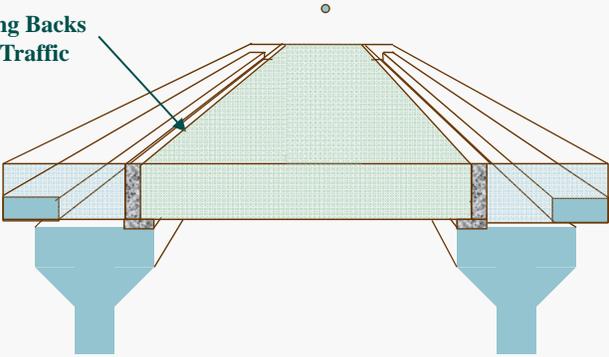
The diagram shows a cross-section of a bridge deck with two piers. A new precast panel is being added to an existing deck. The new panel is supported by cables or strong backs. The text 'Epoxy Grout Between Existing Deck and New Precast Panels' has an arrow pointing to the joint between the new panel and the existing deck. The text 'Night One Lane Closure' is enclosed in a box. The Florida Department of Transportation logo is in the top right corner.

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Night One Lane Closure

Remove Strong Backs And Open to Traffic



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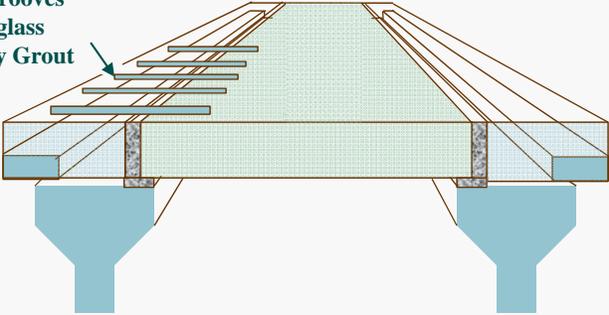


Night Two Lane Closure



Typical Transverse Groove Cross Section

Cut-in Transverse Grooves
Install FRP or Fiberglass Reinforcing & Epoxy Grout



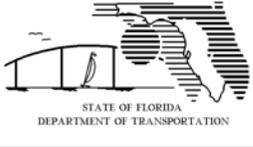
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Near-Surface Mounted Reinforcement Splice

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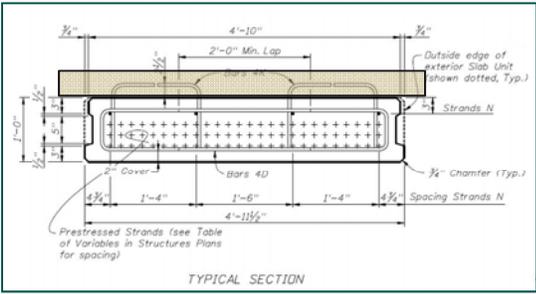
- Unit thickness of 1'-0" and 1'-3"
- Spans up to 50'
- No Transverse Post-tensioning
- Pre-wetting of units prior to placing topping

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Short Span Prefabricated Bridges Standard Index 20350 - Prestressed Slab Units w/ 6" Topping

New Standard to be Published in Jan -09



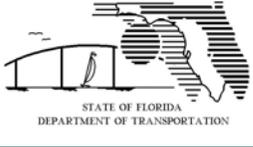
TYPICAL SECTION



← Steel Fibers Placed in Topping to Reduce Differential Shrinkage Cracking

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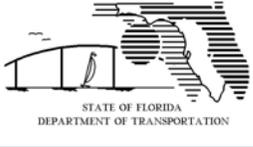
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PRECAST SUBSTRUCTURE STANDARD FOR SMALL OVERPASS BRIDGES

- Need Management Aesthetic Buy-in
- Choices Limited Due to Need to Standardize Formwork
- Lifting Weights May Require Multiple Pier Caps Across Bridge Width

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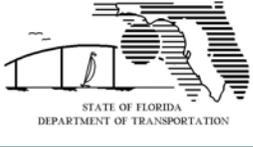


**Column and Cap
Elements can be
Precast**

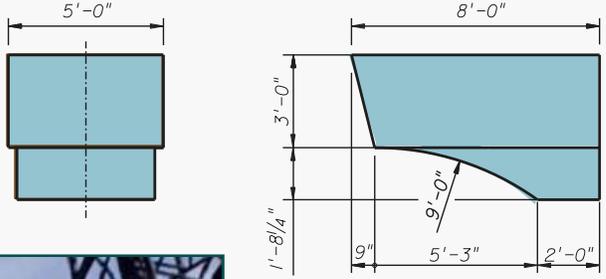
**Whereas Large
Projects can Justify
Using Project
Specific Precast
Shapes,
Small Overpass
Projects Require
Standardization
Because of Forming
Costs**

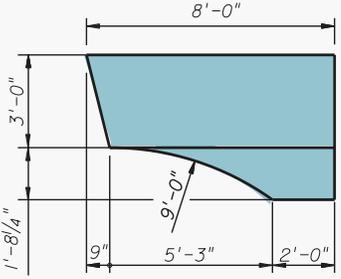
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**Standardize
Shape of Pier
Cap to Allow
Reuse of
Formwork**



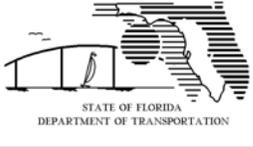






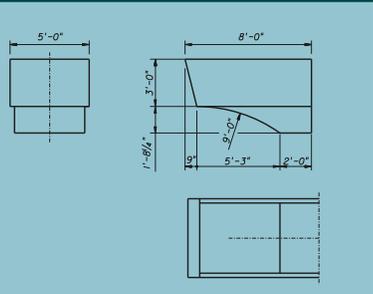
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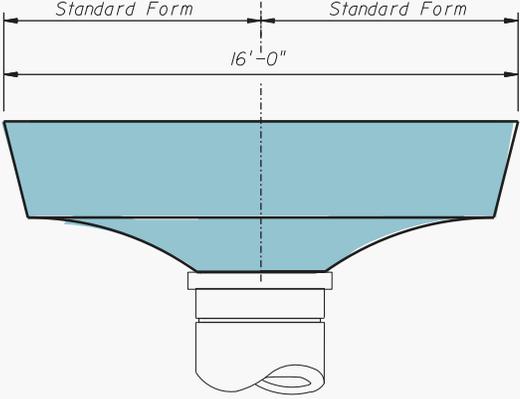
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Single Column Pier





SINGLE COLUMN PIER

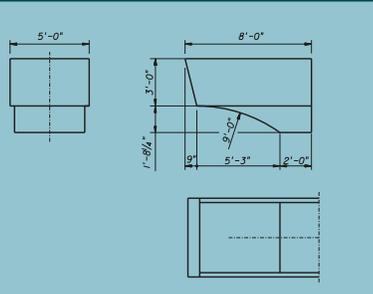
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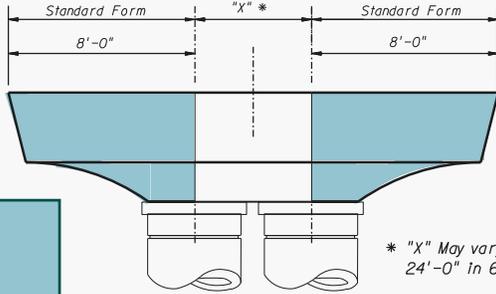
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Two Column Pier



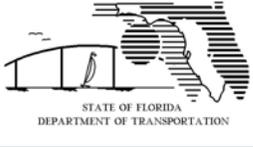


TWO COLUMN PIER ("X" = 5'-0" SHOWN)

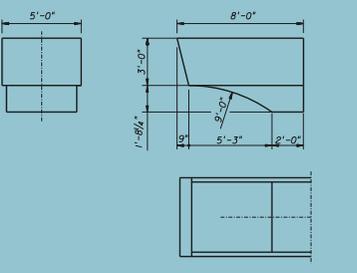
* "X" May vary from 5'-0" to 24'-0" in 6" steps

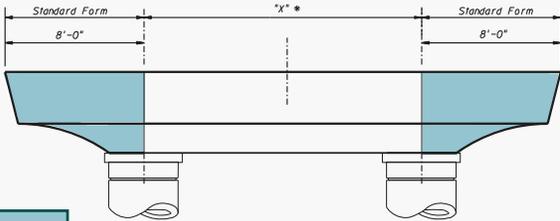
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Two Column Pier





TWO COLUMN PIER ("X" = 16'-0" SHOWN)

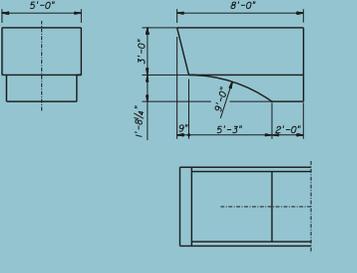
"X" may vary from 5'-0" to 24'-0" in 6" steps

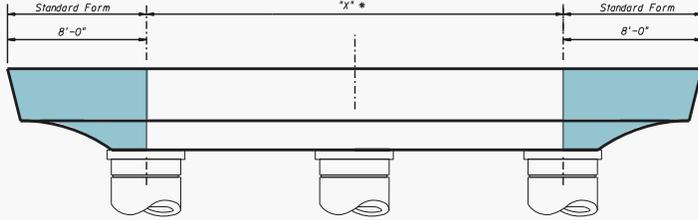
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Three Column Pier





Keep maximum lifting weight < 65 tons

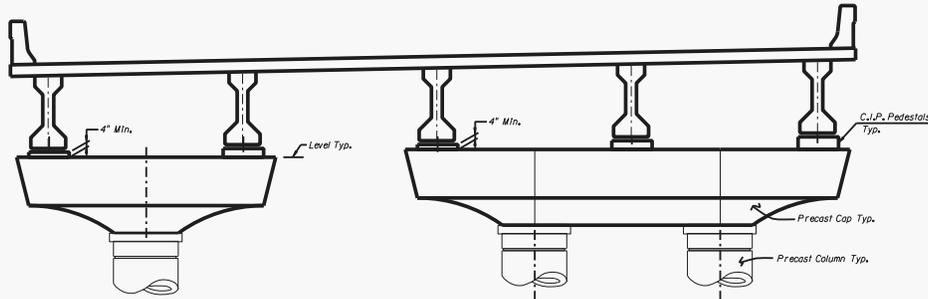
"X" may vary from 5'-0" to 24'-0" in 6" steps

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Variable Bridge Width



BRIDGE WIDTH MADE OF COMBINATIONS OF SINGLE, TWO, OR THREE COLUMN PIERS (12'-0" BEAM SPACING 0.02 CROSS SLOPE SHOWN)

Keep maximum lifting weight < 65 tons
Lifting Weights Require Multiple Pier Caps Across Bridge Width

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Maximum Lifting Weight

- Drives Crane Requirements for Project
- Drives Overhead Costs



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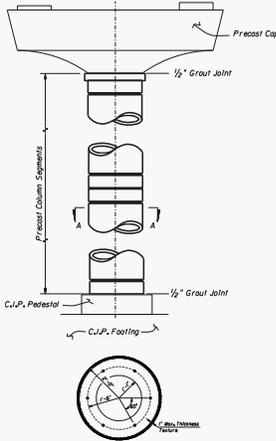
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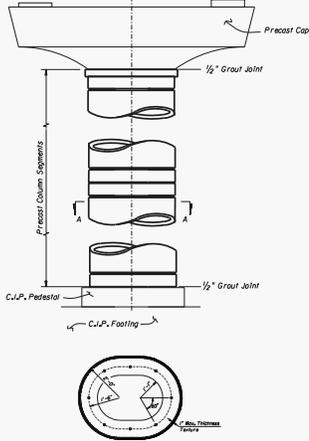
Standardize Shape of Pier Column to Allow Reuse of Formwork



Rebar Coupler



Circular Column



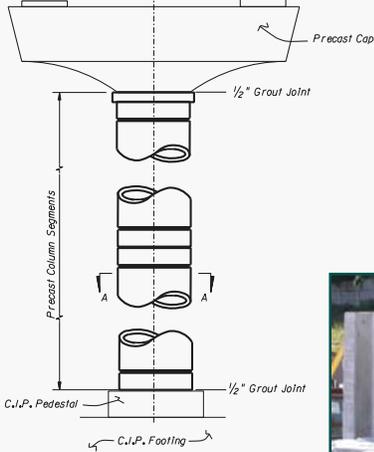
Oval Column

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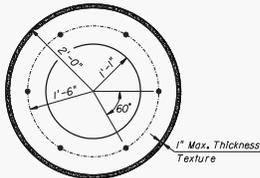
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Allow Texture & Rustication Choices Of Column Element



SECTION A-A
Ties not shown for clarity



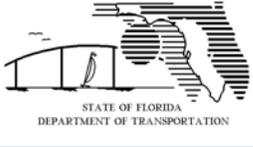


<p>Design Conference 08</p>	<p>Prefabricated Bridges</p>	
<p style="text-align: center;">How Much to Precast?</p> <p style="text-align: center;">Can Entire Bridge be Prefabricated and Rolled or Skidded into Place?</p> <p style="text-align: center;">FHWA Manual on Use of Self-Propelled Modular Transporters to Remove and Replace Bridges</p> <p style="text-align: center;">http://www.fhwa.dot.gov/bridge/pubs/07022/</p> <div style="display: flex; justify-content: space-between;"> <div> <p><i>Prefabricated Bridges</i></p> </div> <div> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p> </div> </div>		

<p>Design Conference 08</p>	<p>Prefabricated Bridges</p>	
<p style="text-align: center;">Self Propelled Modular Transporters (SPMT's) Allows for Whole Spans to be Rolled-in or Out</p> <div style="display: flex;"> <div style="flex: 1;"> <p>Graves Avenue / I-4 Project</p> <p>22 Minutes To Move Span Outside Of Travelway</p> </div> <div style="flex: 2;">  </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 20px;"> <div> <p><i>Prefabricated Bridges</i></p> </div> <div> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p> </div> </div>		

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Traffic Impact Comparison

Graves Avenue / I-4



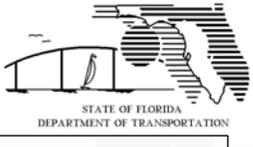
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Design Engineer

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

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New Bridge Construction

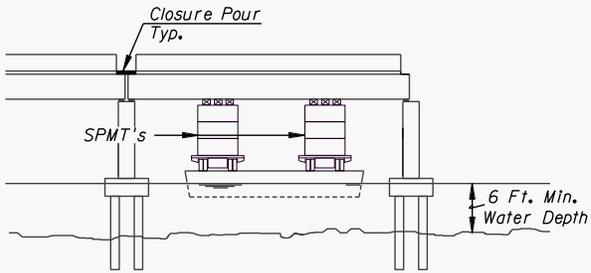
Lewis Street Vertical Lift Bridge
New Iberia, LA



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Exhibit A



SPMT's to float-in whole prefabricated spans.

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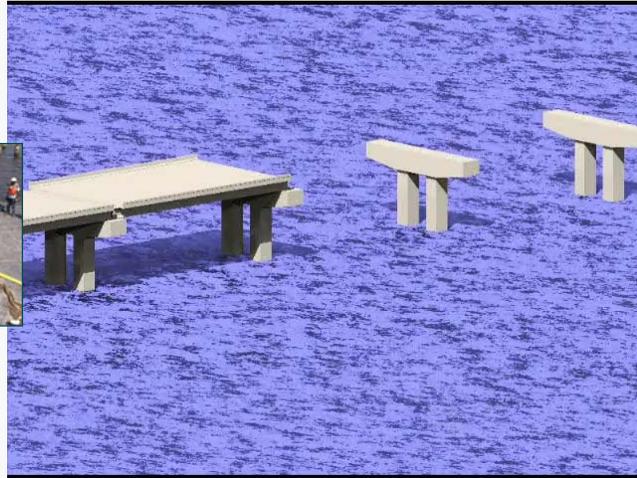


I-10 Escambia



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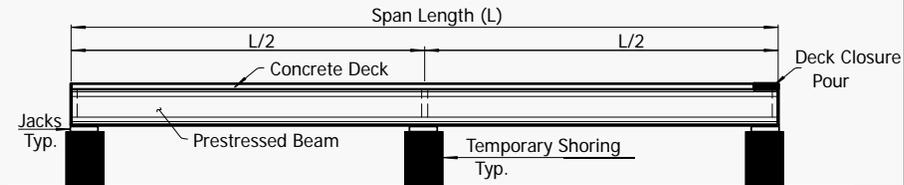
SPMT's used to float-in whole prefabricated spans.

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Shored Construction



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Composite Dead Load of Deck

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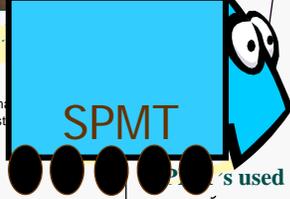
Bridge Reuse Concepts

Exhibit B

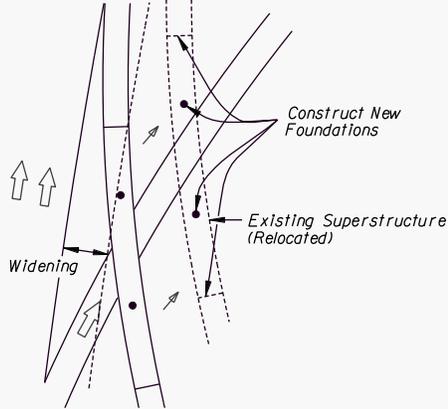


We Recycle Bridges

Thomas
Assist

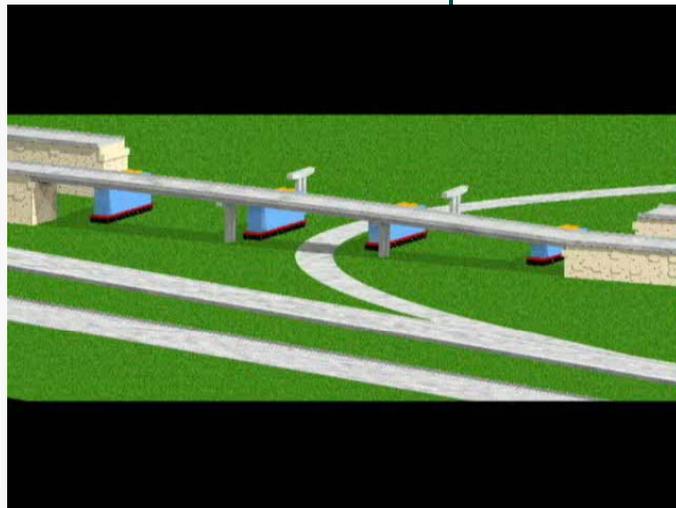


s used to relocate existing bridge units.



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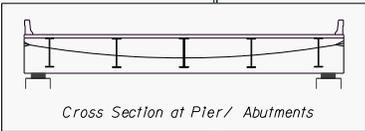
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Cross Section at Pier/ Abutments



Existing Bridge

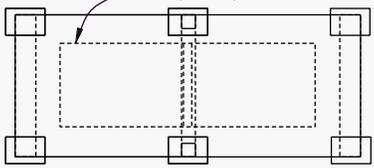
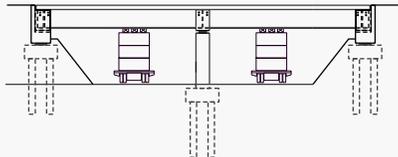


Exhibit C

Bridge Replacement

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Design Engineer



Straddle Existing Foundations. Use Integral Frame Straddle Piers and End Bents.

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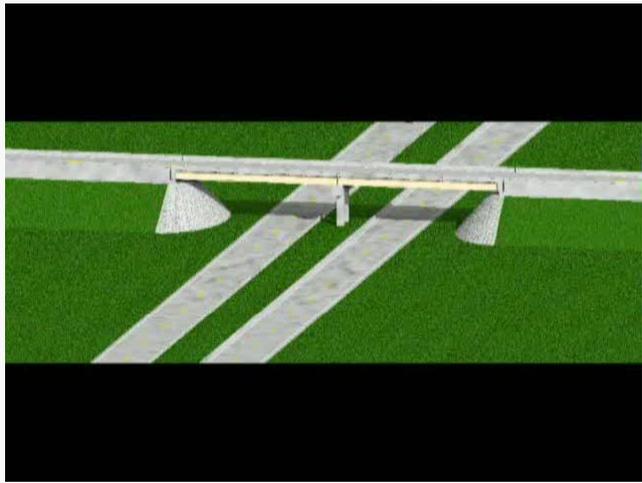
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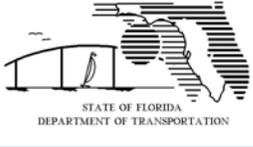
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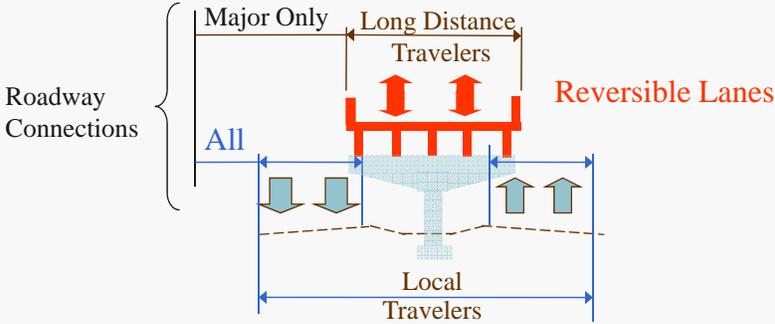
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<p>Possible Managed-Lane Policy Initiative for Interstate Corridor Expansion Using SPMT's</p>	
<p>The Bridge Viaduct To Increase Capacity and Reduce R/W Costs</p>	

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<p>Lee Roy Selmon Expressway Reversible Lane Viaduct Tampa, Florida</p> 	<ul style="list-style-type: none"> • Separate Long Distance Travelers From Local Commuters. • Do Not Connect Everybody to Everything. • Constructing Interchanges (making connections) is Costly.
<p>Possible Managed-Lane Policy Initiative for Interstate Corridor Expansion Using SPMT's</p>	
<p>The Bridge Viaduct To Increase Capacity and Reduce R/W Costs</p>	

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Consider When:

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

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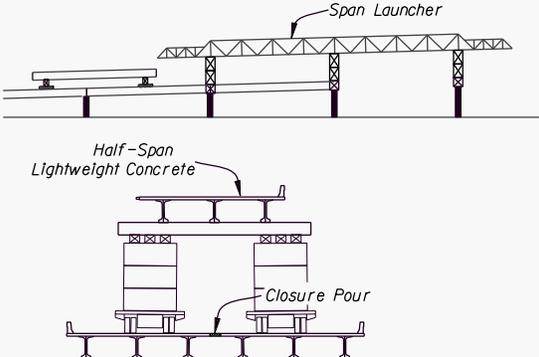
**Deck Replacement Project
SR 433 Over Columbia River
between Washington &
Oregon**



**Prefabricated
Bridges**

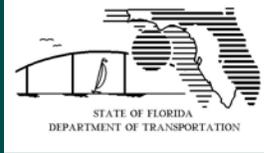
Thomas A. Andres P.E.
Assist. State Structures
Design Engineer

Temporary Works **Exhibit D**



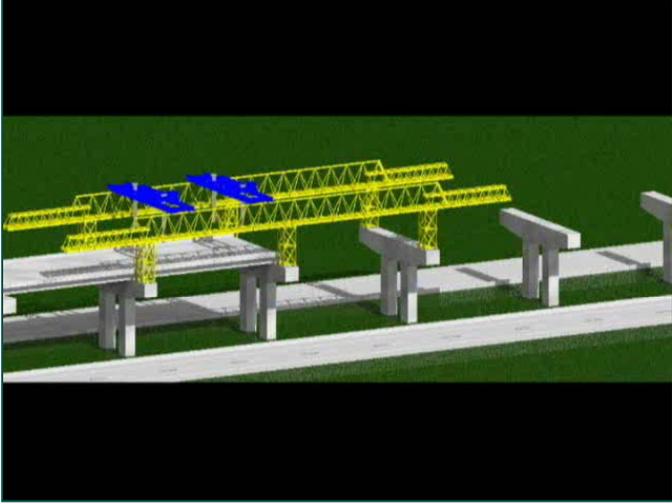
SPMT's used as a span delivery system for top-down construction.

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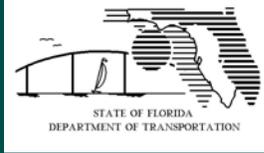


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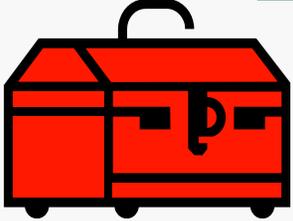
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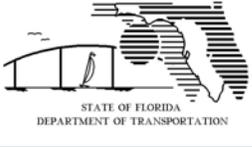


As a General Rule
Prefabricated Bridges Requires
Bigger Tools in the Toolbox



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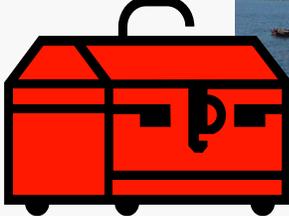


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Building in Environmentally Sensitive Sites

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Questions?

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