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| EDC Case Studies | Case Study #1 |  STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION |
| <i>Every Day Counts</i> <i>Case Studies</i> Department of Transportation Structures Design Office | <p>These case studies are not real FDOT projects. The project sites have been selected because of their unique project constraints and ability, from a training point of view, to show various prefabricated accelerated bridge construction (or ABC) options.</p> <p>In each case, assumed constraints will be stated, from which possible design options involving prefabricated ABC approaches can be discussed.</p> <p>The main emphasis here is to demonstrate the sort of factors influencing which bridge components may be prefabricated. Also discussed will be the overall prefabrication ABC strategies and implications.</p> | |

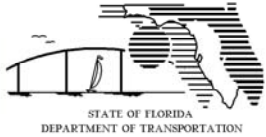
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| <h1>CASE STUDY #1</h1> <h2>Bridge Replacement in Close Proximity to a Major Interstate-to-Interstate Interchange</h2> <p><i>Every Day Counts</i> <i>Case Studies</i></p> <p>Department of Transportation Structures Design Office</p> | | |

- Case Study #1 is a bridge replacement close to a major interstate-to-interstate interchange.
- This project poses unique challenges specifically related to the nearby interchange ramp access and maintenance of traffic.

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Bridge Replacement in Close Proximity to a Major Interstate-to-Interstate Interchange

Project Constraints

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- This view shows the bridge's proximity immediately to the east of a major interstate-to-interstate interchange.
- The primary challenge for this project is the demolition of the existing structure and construction of the new structure while minimizing user impacts to traffic on the ramps, the interstate, and local roads.
- Typical bridge demolition generally takes 2 to 3 days per span.
- Maintenance of traffic for this type of work is normally accomplished with crossovers. Crossover are used in order to keep traffic from underneath spans on which work is being performed
- However, the proximity of construction and access to the ramps on the east side of the interchange make crossovers very difficult, if not impossible.

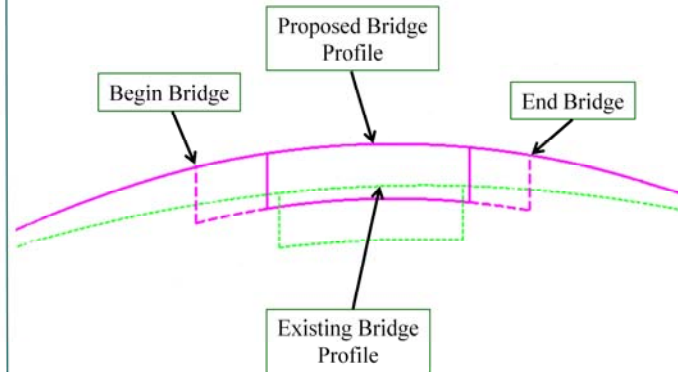


Project Constraints

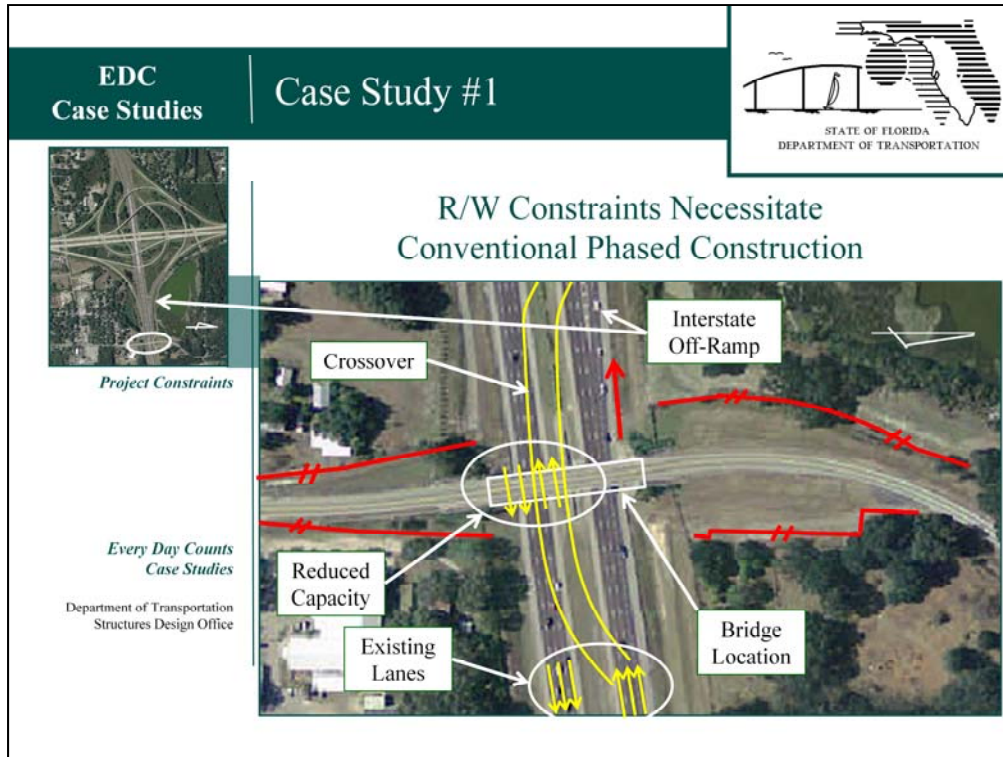
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New Bridge is Higher than Existing



- The new bridge is on the same alignment as the existing but is at a higher elevation and has a deeper superstructure.
- This geometry, in fact, allows for consideration of an innovative design approach which allows for accelerated construction to be covered on later slides.

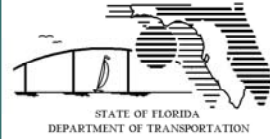


- The limitations of the project include:
 - A crossover reduces capacity on the east-west interstate from 3 lanes in each direction to 2 lanes in each direction. Each span that has to be replaced is only long enough for 4 total lanes underneath, 2 lanes in each direction, as shown in the crossover diagram.
 - As mentioned previously, the ability of the crossover to accommodate the ramps on the east side of the interchange will be difficult if not impossible (see key map in upper left corner for interchange layout and ramp proximity to bridge replacement).
 - Some of the traffic may have to be directed to the next interchange to the west and then use a U-turn to accommodate the north-south movements; however, this may not be practical due to traffic volume, especially during peak hours.
 - Available right-of-way would likely allow for phased bridge construction but is somewhat limited on the south end.
 - Finally, phased construction lengthens construction time which extends the length of time users are impacted.

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|  <p><i>Project Constraints</i></p> <p><i>Every Day Counts Case Studies</i></p> <p>Department of Transportation Structures Design Office</p> | <p><i>Conventional Construction Approach:</i></p> <ul style="list-style-type: none"> • Demolition – generally requires 2-3 days per span • M.O.T. – crossovers typically used; however, most-likely not possible here due to proximity to major interchange and required direction-change movements • Lanes – horizontal clearance beneath spans only allows for 2 lanes (interstate) in each direction • Overhead Work – limited; traffic MUST be moved to set beams, placement of deck forms, pour deck, etc. – carefully coordinated MOT required, with likely long detour for certain direction-change movements (e.g., northbound or southbound exiting to head eastbound) | |

For the conventional construction approach there are several considerations...

- Demolition - Demolition usually requires 2 to 3 days per span.
- Crossovers - As mentioned previously, crossovers would typically be required but would impede ramp access.
- Horizontal Clearance - Available clear roadway width beneath each span reduces capacity on the east-west interstate under the bridge from 3 lanes to 2 lanes in each direction.
- Overhead Work – Beam placement at night could be done using “pacing” or “rolling road blocks”, but would affect use of interchange ramps, as well.
- During pacing, major connection ramps would need to be closed, traffic re-routed to the west, then U-turned back to this interchange from the other direction to use the unaffected ramps.



Problem Statement

What are ways to mitigate these user impacts?



*Strategies for Overcoming
Project Constraints*

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What are ways to mitigate these user impacts?

➤ One approach is to consider ways to accelerate bridge demolition, as well as, beam placement in order to accommodate traffic and reduce user impacts.

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|  <p><i>Strategies for Overcoming Project Constraints</i></p> <p><i>Every Day Counts Case Studies</i></p> <p>Department of Transportation Structures Design Office</p> | <p><i>Prefabricated Construction Approach:</i></p> <ul style="list-style-type: none"> • Near Site Casting – sufficient space apparent within R.O.W. outside of Interstate footprint for precasting/demolition • Access – reasonable SPMT access appears available between near site casting area and bridge location • SPMT Costs – remobilization costs for SPMTs are very high, so preferable to develop concept that makes full use of SPMT without having to remove from site, then return to make the additional bridge moves • Precast – may consider shored construction and composite dead loads for increased structural efficiency • May consider 2 simple span FIBs or 2-span continuous steel plate girder unit, as well as, precast pier caps to be cast with superstructure | |

To accomplish the goals of reduced user impacts:

- Use full-span prefabricated construction with the use of Self-Propelled Modular Transporters (or SPMTs).
- Use Near-Site Casting. In order to use SPMTs, designers must determine if there is sufficient area within the right-of-way for near-site casting and relatively-level access from the casting site to the bridge location.
- Consider SPMT Costs. The mobilization costs of the SPMT are high. Therefore, the time the SPMT is on site must be limited and the use of SPMT's must be maximized by using it for both the removal of the existing bridge and the placement of the new bridge.
- Consider near site precasting of the superstructure. Full-span near-site casting offers the advantage of utilizing the composite section to increase structural efficiency of the superstructure using shoring of the span during deck placement.
- For this example, consider using 2 simple-span bridges with Florida I-Beams (FIBs) or a 2-span continuous steel plate girder unit.

Existing R/W Allows for Near-Site Span Fabrication and Demolition w/ SPMT's

Bridge Replacement Option



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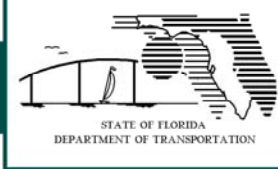
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- As seen on this slide, there appears to be sufficient level space with the right-of-way for near-site casting.
- This space should also be adequate for temporary storage and demolition of existing spans.

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Near-Site Areas For Span Fabrication and Demolition w/ SPMT's


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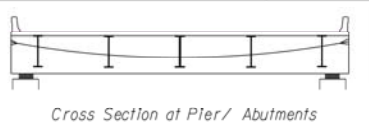
- Relatively-level terrain is evident in these two pictures. This is required for the delivery of the spans using SPMT's
- The overhead utilities seen the lower right photo may require temporarily relocation or otherwise avoided.

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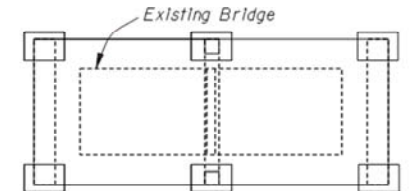
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Cross Section at Pier/ Abutments



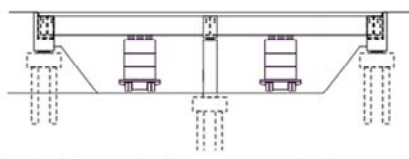
Existing Bridge



Bridge Replacement Option

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Straddle Existing Foundations (mono-shafts or pile groups). Use Integral Frame Straddle Piers and End Bents.

- As previously discussed, one strategy involves a concept for using SPMT's to remove the existing bridge and place new spans in one weekend to avoid the high cost of remobilizing the SPMT's
- This slide shows a straddle pier bridge replacement SPMT concept. The foundations for the new longer, higher bridge straddle the existing structure. This eliminates the need for phased construction and allows for simultaneous construction.
- In this case, the existing and proposed bridge width allows for the piers and abutments to straddle the existing bridge footprint. A wider bridge would likely require phased construction as well as SPMT re-mobilization
- The construction process would proceed as follows:
 - First, construct new foundations either side of existing pier and at end bents.
 - Simultaneously, precast new superstructure/substructure integral pier/end bent cap at the near-site location.
 - Next, remove the existing spans using SPMTs.
 - Finally, demolish the existing end bents and pier and deliver the new substructure/superstructure spans using SPMTs.
- The main implementation concern is fit-up of the bearings at the six (6) support locations. Preformed anchor bolt holes, specific shimming options, specific survey requirements, etc. need to be clearly stated in the plans to ensure successful fit-up in the field.

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Bridge Replacement Option



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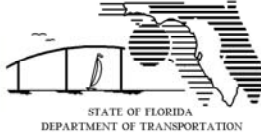


This animation shows the construction sequence

- First, the substructure and ramp approaches are constructed at their new location outside the footprint of the existing bridge and without any disruption to the interstate.
- Then the existing spans are removed using SPMTs, one span at a time, using a short interstate closure.
- Then the new 2-span unit is placed using SPMTs and a short closure time is once again required.
- Lastly, the new bridge approach slabs, expansion joints, end bents, and approach roadway are constructed while traffic on the interstate is flowing as normal.

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In Summary...

Bridge Replacement Option



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Rough Estimated Costs/ Benefits

- ❑ Cost of SPMT's - \$1 million (single mobilization)
- ❑ Reduced Impacts to Interstate: From 30 days to 3-consecutive night closures 2 hours each with traffic detours
 - 1st night - removal of span 1
 - 2nd night - removal of span 2
 - 3rd night – placement of two-span continuous unit
 - **No Daytime ramp movements impacted!!!**
- ❑ Reduced Impacts to local road: From 30 days to 7 days in order to raise bridge approaches and install approach slab and expansion joints.

- The costs and benefits for this concept are estimated as follows:
- Generally, the cost of SPMT mobilization is approximately \$1 million dollars.
- The user impacts on the interstate are reduced from 30 days to 3 days with none of the impacts occurring during the day.
- It may be possible to combine both span removals into a single night further reducing user impacts.
- And finally, local road user impacts are reduced from 30 days to 7 days.

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| <p><i>In Summary...</i></p>  <p><i>Every Day Counts</i> Case Studies</p> <p>Department of Transportation Structures Design Office</p> | <p><u>Potential Prefabricated Elements:</u></p> <ul style="list-style-type: none"> ➤ <i>2-span Continuous Steel – standard FDOT construction</i> ➤ <i>Prestressed Concrete Piling – standard FDOT construction</i> ➤ <i>End Bent/Pier Cap – accelerates construction for rapid superstructure placement</i> ➤ <i>Prefab Complete Superstructure – most-rapid construction option</i> <p><u>Elements not Beneficial for Prefabrication:</u></p> <ul style="list-style-type: none"> ➤ <i>Footings – built outside roadway and not time critical</i> ➤ <i>Pier Column –built outside roadway and not time critical (substructure and superstructure constructed simultaneously)</i> ➤ <i>Precast Full-Depth Deck Panels – not beneficial if complete superstructure is cast nearby in conjunction with SPMTs</i> | |

In Summary, the ...

Potential elements for prefabrication include:

- Using 2-span Continuous Steel which is already standard practice in Florida
- Also Prestressed Concrete Piling which is also standard practice in Florida
- End Bent/Pier Cap. The construction of these components accelerates the superstructure placement.
- and Prefab Complete Superstructure. This is the most-rapid construction option

The elements not considered beneficial for prefabrication include:

- Footings which are constructed outside roadway and not on critical path
- Pier Columns which are constructed outside roadway and not on critical path (substructure and superstructure can be constructed simultaneously)
- and Precast Full-Depth Deck Panels which are not beneficial if the complete superstructure is cast nearby in conjunction with SPMTs