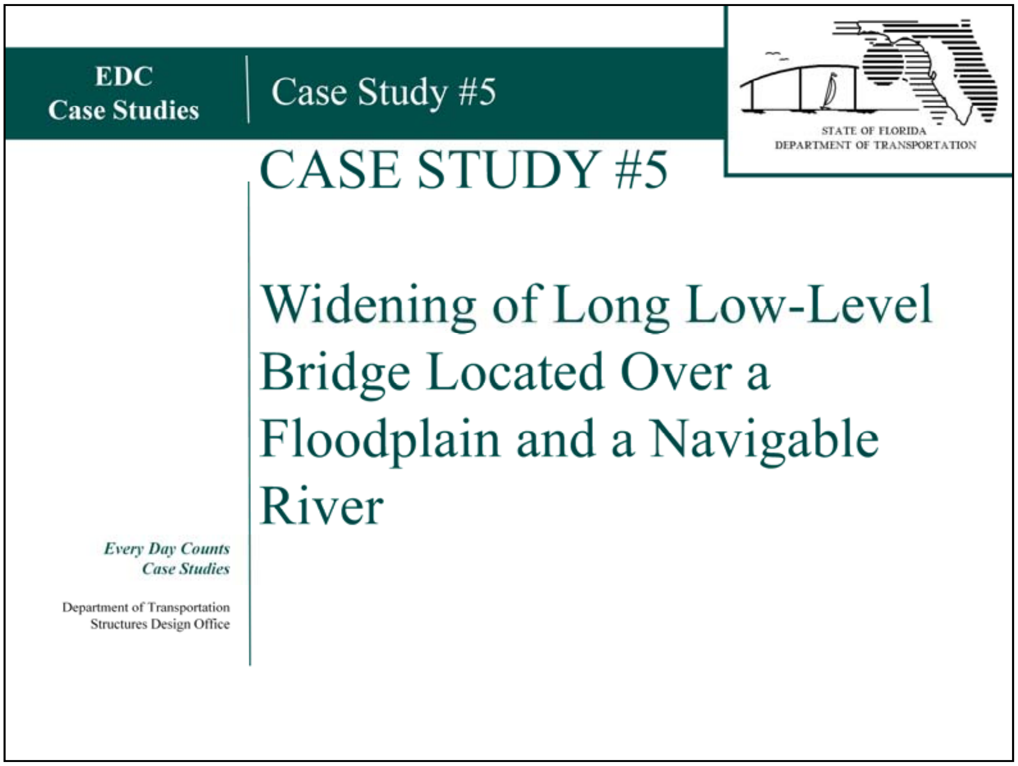
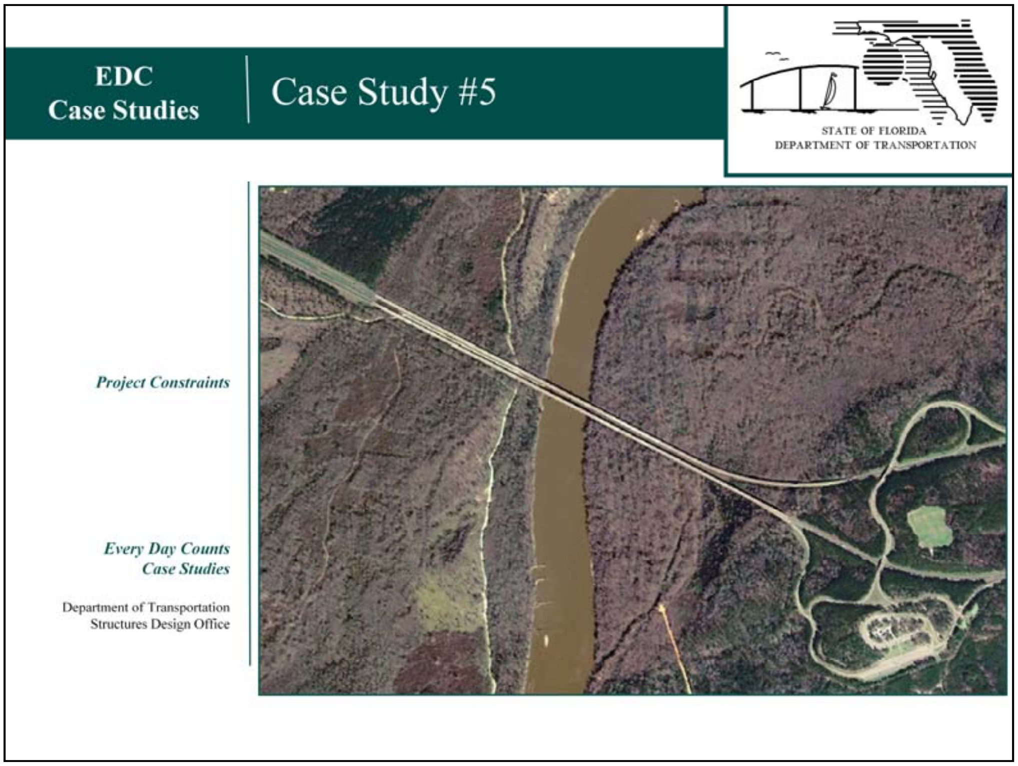
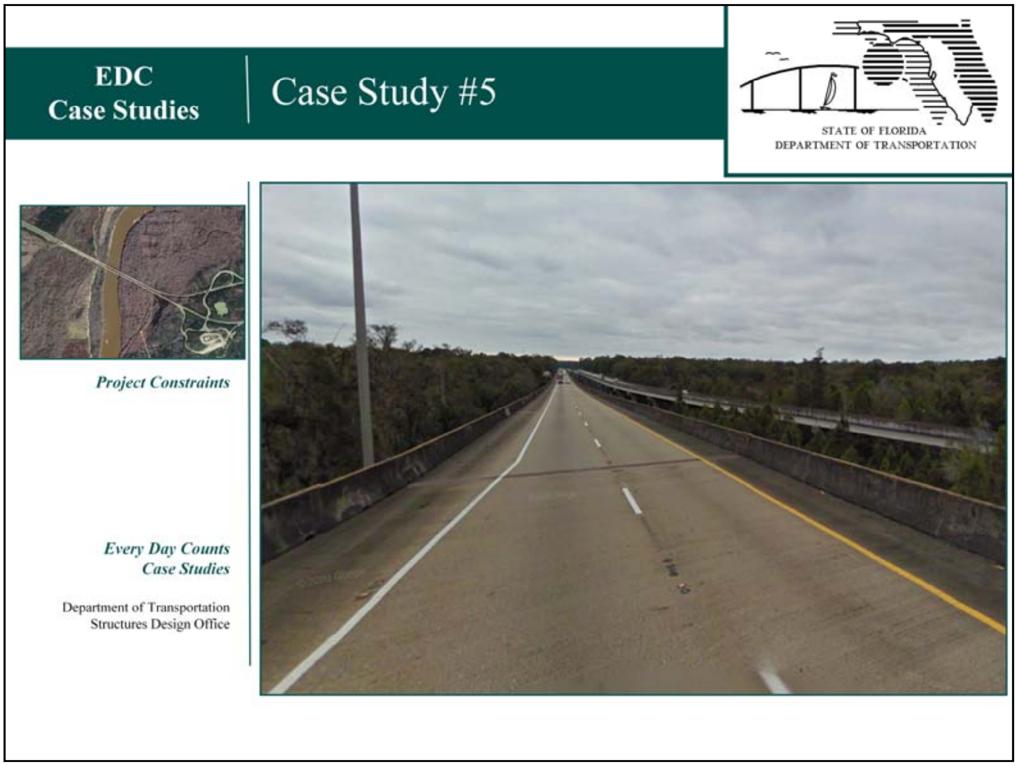


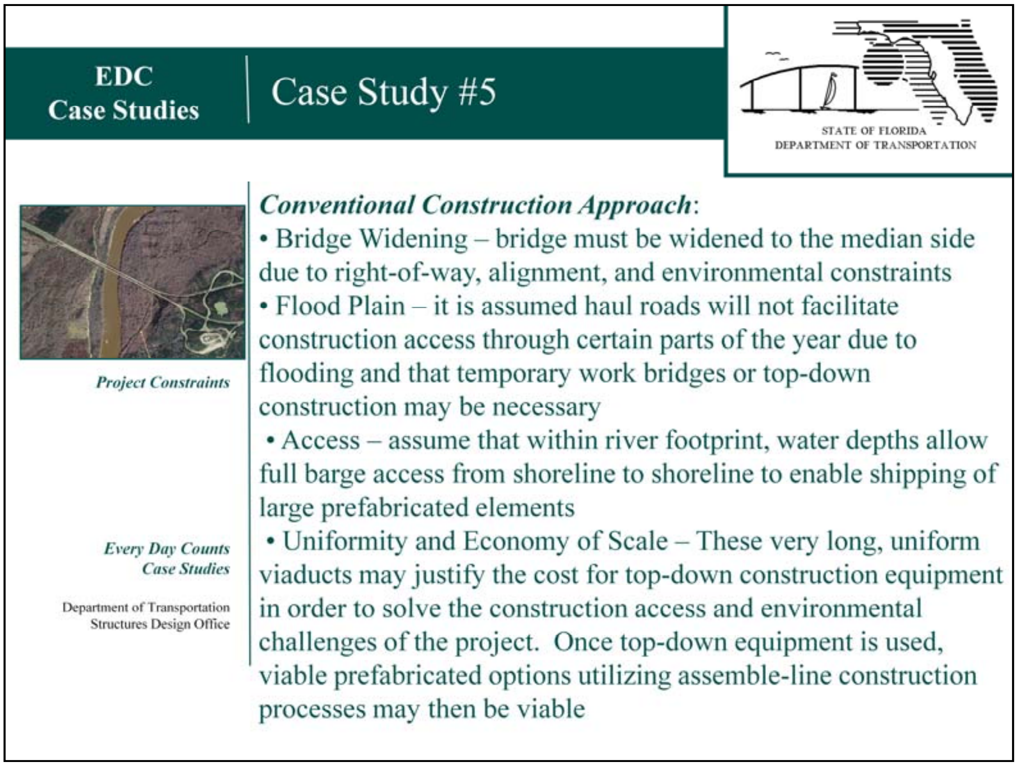
- The purpose of this presentation is to demonstrate the sort of factors influencing the decision to employ Prefabricated Bridge Elements and Systems for rapid project delivery. Bridges showcased in these case studies are not real FDOT projects, but the sites have been chosen because of their unique design constraints and ability to illustrate various accelerated bridge construction considerations. For each case, particular constraints will be assumed and then possible prefabricated ABC approaches will be explored.
- This case study involves the widening of a long low-level bridge “viaduct” located over a floodplain and a navigable river.
- This project involves the following challenges:
  - How to accommodate construction access
  - How to minimize environmental impacts



- This plan view shows the interstate with a wide median between two parallel bridges.
- These bridges are long low-level viaducts spanning a river and flood plain.
- The river is a navigable waterway, which has implications for consideration related to ship impact and the requirement for continuous spans in the Structures Design Guidelines.



- This is a view of the eastbound bridge looking west.
- Note the uniform cross section and uniform separation between the two structures in the median.
- Also note the fact that both bridges have a fairly flat grade and have the same vertical profiles.
- It is assumed that the regions on both sides of the bridge pair are environmentally-sensitive and the entire corridor is over a large floodplain adjacent to a navigable river.
- This poses major construction access and environmental impact challenges.



Some considerations for the conventional construction approach include:

➢ The bridges will require widening to the median to reduce environmental impacts.

➢ The floodplain limits or prohibits the use of haul roads due to seasonal flooding.

➢ Temporary work bridges or some sort of top-down construction would be necessary to reduce wetland impacts.

➢ A work trestle footprint would be in the way of actual construction.

➢ Access – assume within river footprint, water depths allow full barge access from shoreline to shoreline to enable shipping of large prefabricated elements.

➢ The use a top-down construction approach is only viable given the economy of scale of the project and the size of the bridges to be widened – the cost of the special equipment is a small cost relative to the project size.

➢ A top-down construction approach may also allow for a "linear" prefabricated approach for columns, pier caps, pile bent caps, beams, and possible precast full-depth deck panels such that all prefabricated bridge components can be delivered by the overhead straddle cranes.

EDC Case Studies | Case Study #5

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

Problem Statement

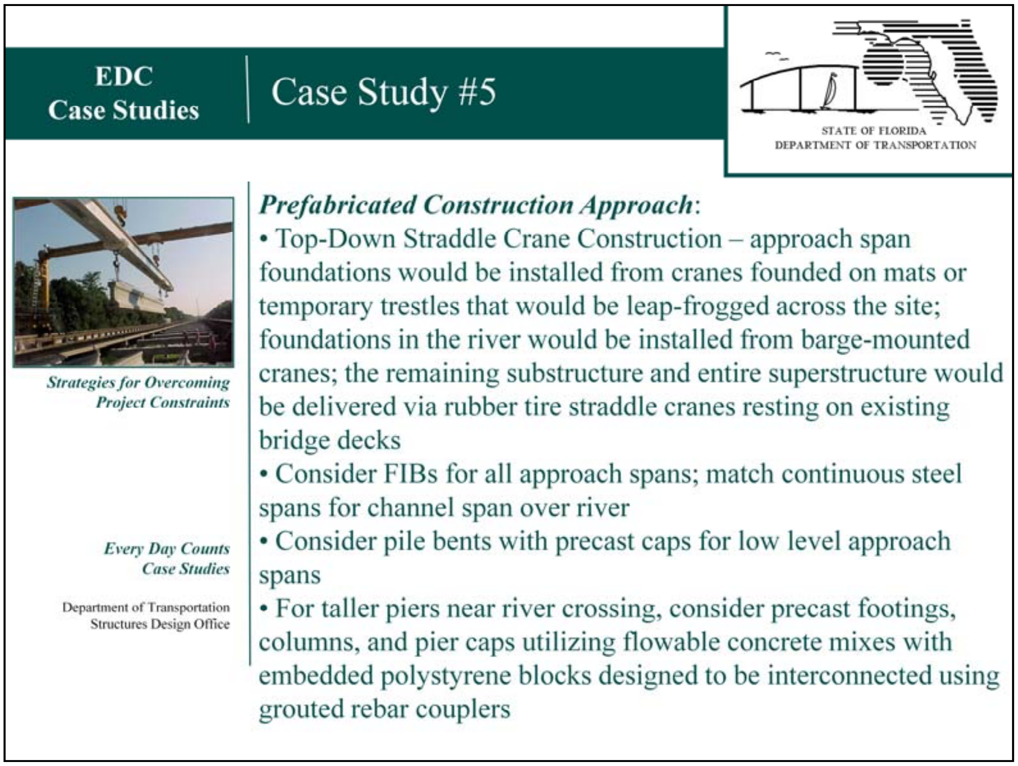
What are ways to minimize environmental impacts, provide construction access, reduce construction time as well as reduce overall cost?

Strategies for Overcoming Project Constraints

Every Day Counts Case Studies

Department of Transportation
Structures Design Office

What are ways to minimize environmental impacts, provide construction access, reduce construction time as well as reduce cost?



Some considerations for a prefabricated construction approach include:

➢ Top-down straddle crane construction could use similar steps as follows:

- install piles from cranes founded on mats or temporary trestles that would be leap-frogged across the site,
- piles in the water would be installed from barge-mounted cranes,
- remaining substructure and entire superstructure would be delivered via rubber-tire straddle cranes resting on the existing bridge decks

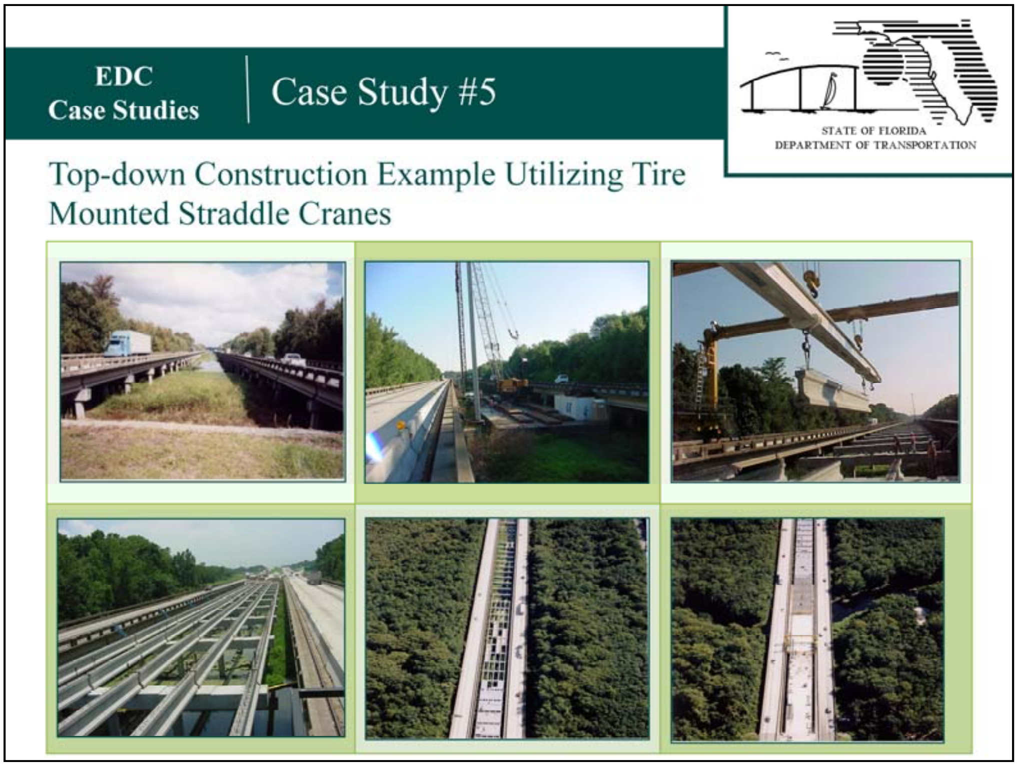
➢ Straddle cranes could be utilized for the delivery of all materials and bridge components after installation of the piling.

➢ Lower sections of bridge could consist of pile bents utilizing precast cap components and higher-level portions of the viaducts located near the river could consist of precast piers. The overhead straddle crane could even be used to off-load prefabricated elements from a barge located in the river to the rest of the structure.

➢ Bent cap components could consist of flowable concrete with polystyrene in-fill blocks to reduce weight.

➢ Piers components could consist of flowable concrete, polystyrene utilizing rebar couplers for connections between prefabricated elements. Due to footing lifting weights, precast concrete bathtub forms within the river could be considered. See Case Study #2 for more information.

➢ As previously mentioned, a continuous steel span over the shipping channel is required due to vessel collision design requirements in the Structures Design Guidelines and in order to match the existing superstructure type over the river.



➢ The following is a series of slides showing a similar project using top-down construction.

➢ The cranes between the bridges used to install piling can be seen mounted on mats or temporary work trestles.

➢ These cranes would be leap-frogged as foundation construction progresses.

➢ The straddle cranes are mounted on rubber tires located behind temporary barriers which takes very little space from the existing bridge shoulder width. The existing structures would need to checked for the temporary crane loading.

➢ This top-down straddle crane concept eliminates potential overhead work which could impact traffic.

EDC
Case Studies

Case Study #5

STATE OF FLORIDA
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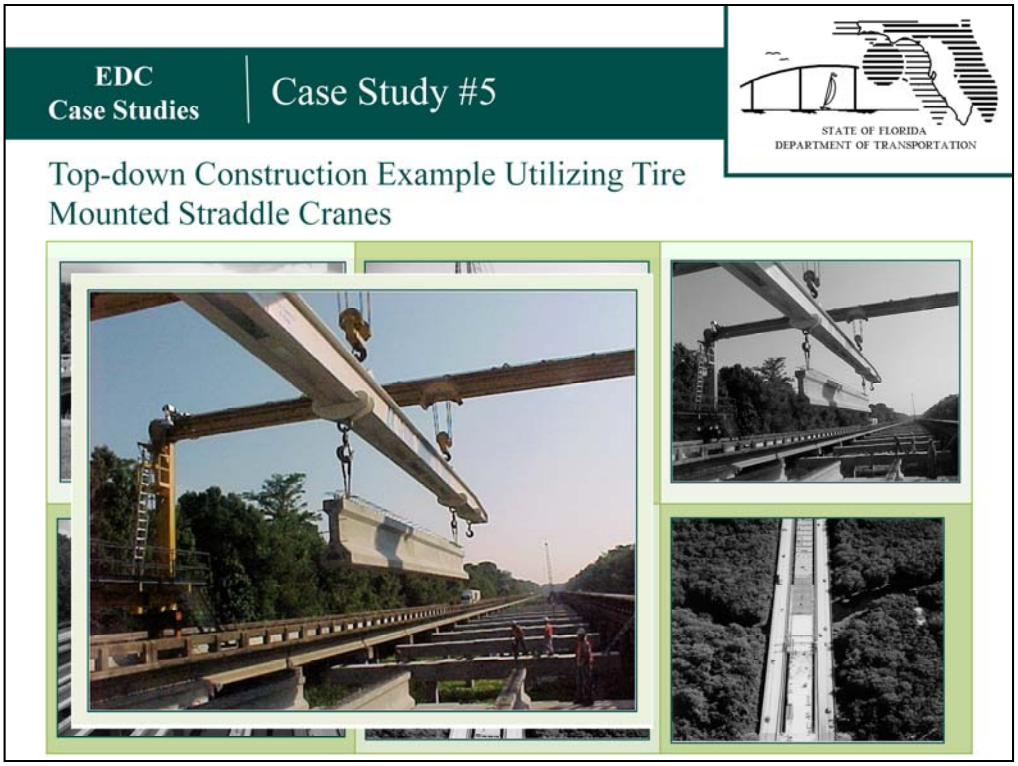
Top-down Construction Example Utilizing Tire Mounted Straddle Cranes

Here, the blown-up picture shows the ground crane used on mats which are leap-frogged across the site as foundation construction progresses.

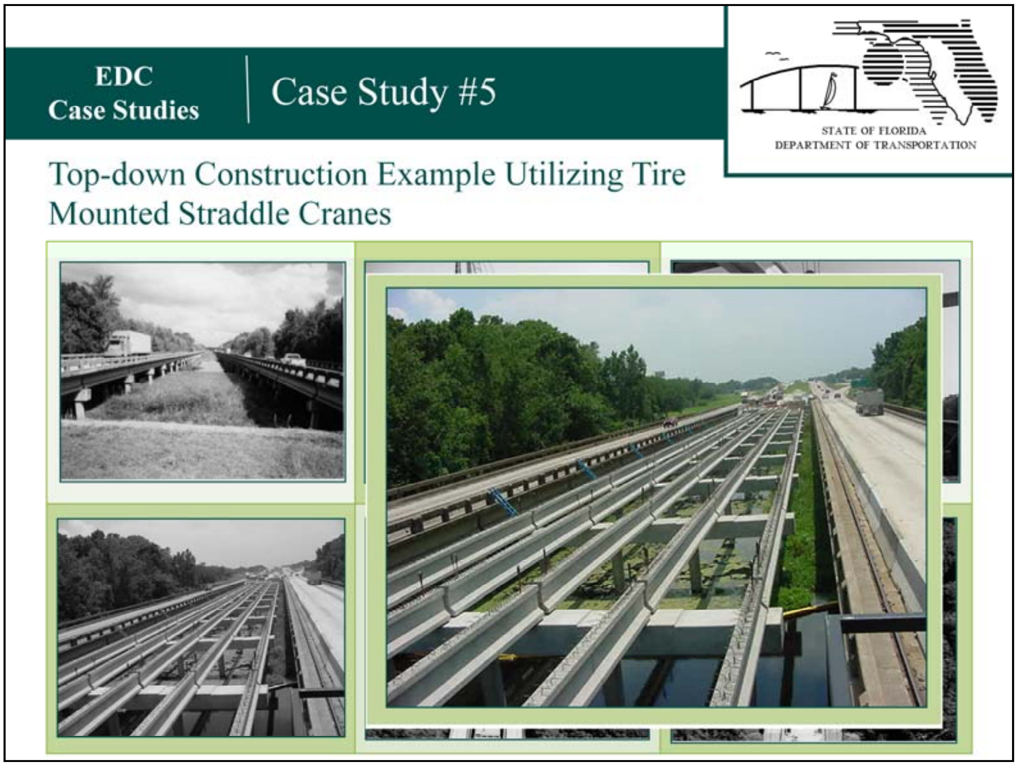


➢ Here rubber tire straddle cranes are setting girders.

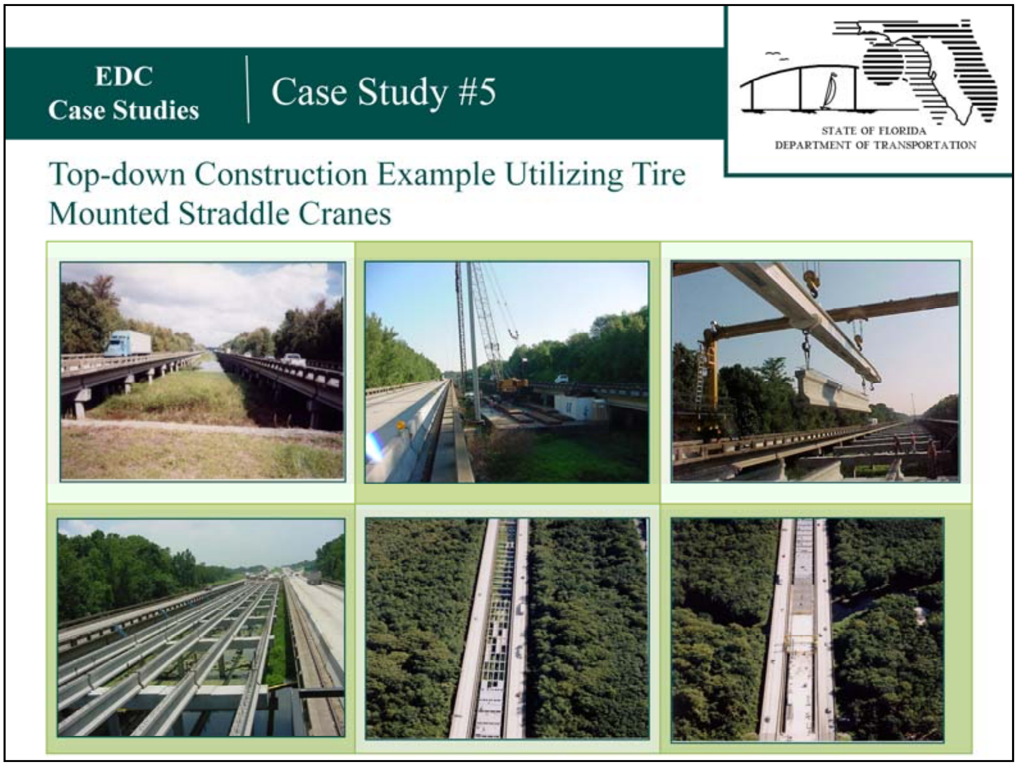
➢ The same straddle cranes can be used to deliver the following bridge components:

- Precast pile bents
- Precast pier bathtub footing forms
- Concrete, formwork and reinforcing steel
- Precast pier columns
- Precast beams
- Precast full-depth deck panels (if deemed viable)

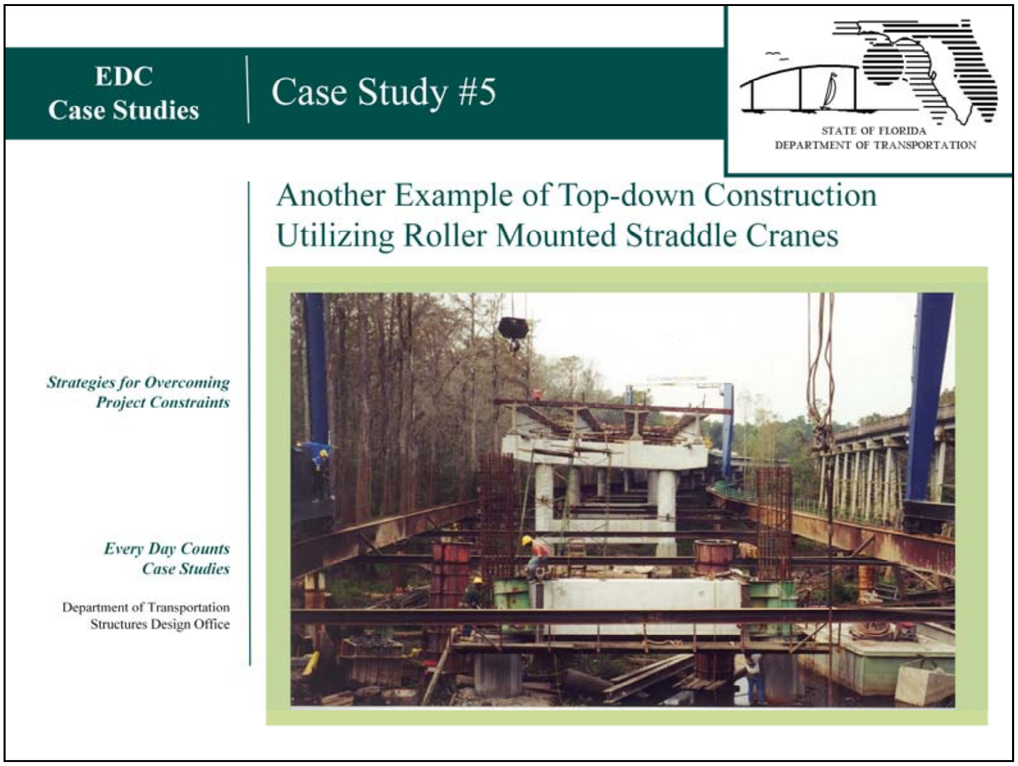
➢ It is easy to see from the photo how two or more straddle cranes could service multiple crews in a linear construction progression utilizing precast components.



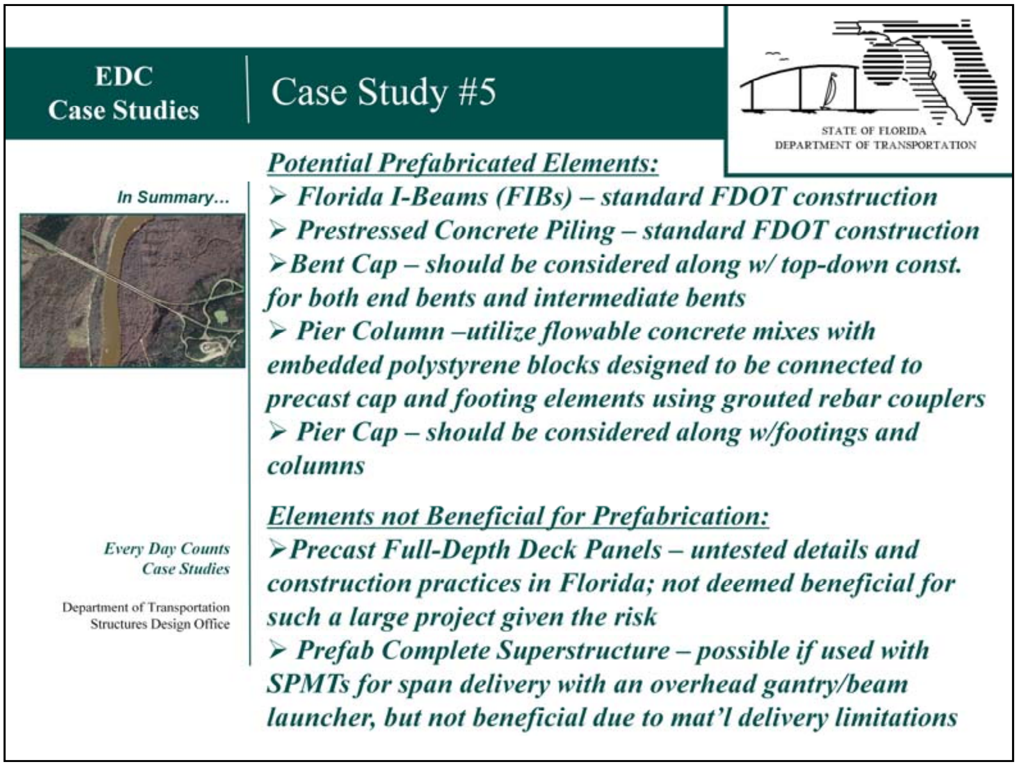
This is a view after beam placement.



- In this particular example, notice in the bottom-center photo taken from the air showing placement of S.I.P. deck forms. Similarly, precast full-depth deck panels could be used.



- This is another project example utilizing top-down construction techniques.
- What is interesting about this project example is that it did not involve a bridge widening in the median so there was no existing deck surface from which the straddle crane could be mounted.
- In this case, roller-mounted straddle cranes were supported on steel beam rails where the pipe piles foundation for the rails were installed along with the drilled shaft bridge foundation as work trestles and cranes were leap-frogged out in front of construction.
- Here you can see the precast pier strut being incorporated into the C.I.P. pier columns. The project also used precast pier caps which were delivered by the straddle cranes.
- It should be noted that what makes this solution feasible is the narrow bridge width which allows the straddle cranes to span the structure transversely.



In Summary…

<u>Potential elements for prefabrication include:</u>

➢ Florida I-Beams – already standard practice in Florida

➢ Prestressed Concrete Piling – already standard practice in Florida

➢ Precast Pile Bent Cap – consider along with top-down straddle crane construction approach

➢ Precast Pier Components – Columns and Caps – utilize flowable concrete mixes with embedded polystyrene blocks designed to be connected to precast cap and footing elements using grouted rebar couplers. See Case Study #2 for more details.

➢ Precast Pier Footings– evaluate considering the weight and demands. Consider precast bath-tub stay-in-place form detailed such that no metallic elements penetrate the structural concrete shell interface.

<u>Elements not considered beneficial for prefabrication include:</u>

➢ Bent Cap – typically easy to construct end bents in-situ

➢ Precast Full-Depth Deck Panels – untested details and construction practices in Florida; may not be deemed beneficial for such a large project given the risk

➢ Prefab Complete Superstructure – may be possible if used with SPMTs for span delivery in conjunction with an overhead gantry/beam launcher, but likely not feasible without existing bridge strengthening.