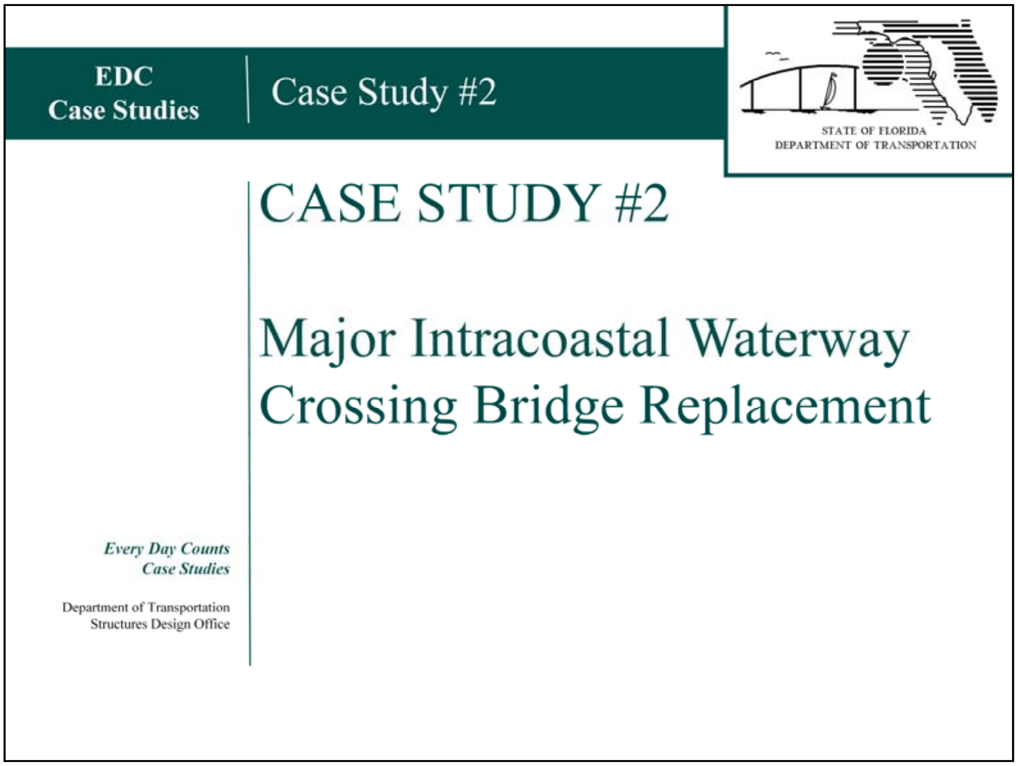
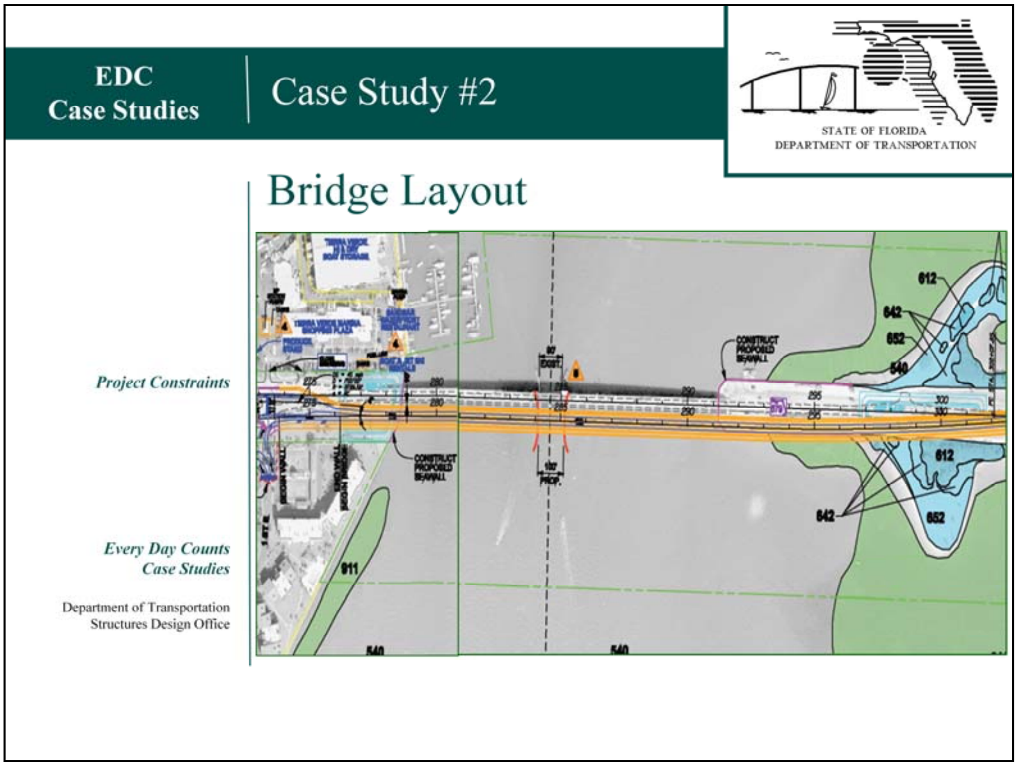


➢ The purpose of this presentation is to demonstrate the sort of factors influencing the decision to employ Prefabricated Bridge Elements and Systems for rapid project delivery. Bridges showcased in these case studies are not real FDOT projects, but the sites have been chosen because of their unique 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.

➢ Case Study #2 is a major intracoastal waterway crossing bridge replacement.

➢ The following are general rules of thumb for large water crossing bridge projects:

- Major considerations affecting the project and potentially ***reducing*** direct costs include the economy of scale and adequate water access for barging large precast elements.
- Working from a barge tends to ***increase*** direct costs because of labor and insurance rates; therefore, shortening time over water ***reduces*** direct costs.



➢ Here is a long water crossing showing a typical bridge replacement scenario.

➢ The new high level bridge can be constructed along side the existing bridge, traffic shifted to the new bridge, then the old bridge demolished.

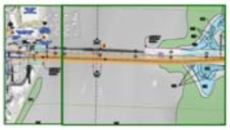
➢ Again, when evaluating construction approaches, consideration must be given to the direct costs resulting from total length of construction time over water, which in this case drives the total cost of the project.

EDC
Case Studies

Case Study #2

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

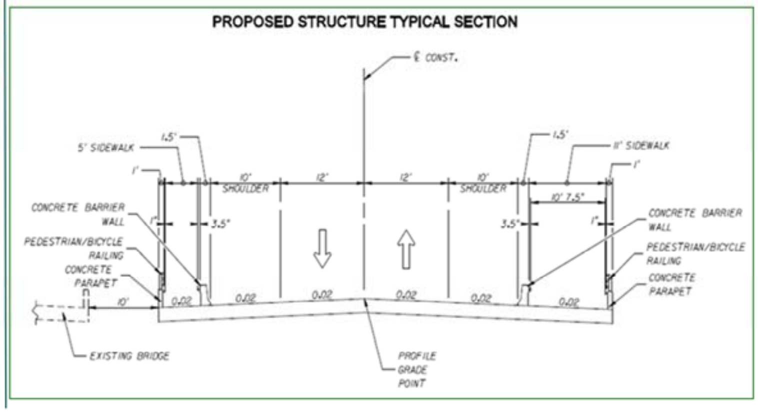
Bridge Cross Section



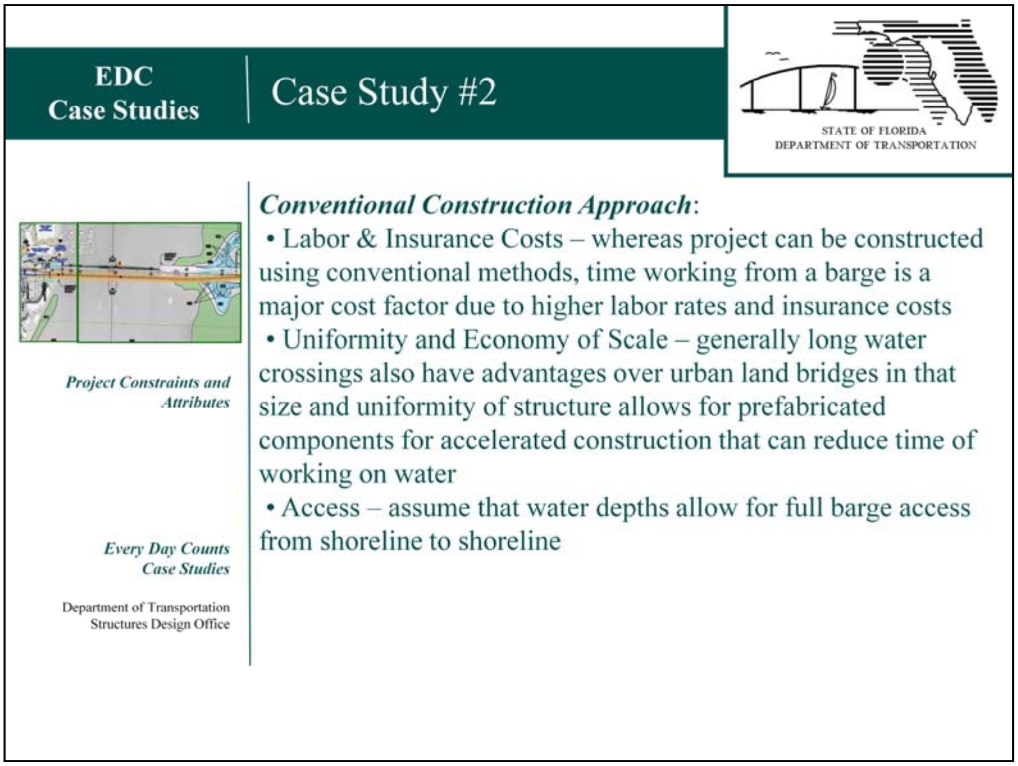
Project Constraints

Every Day Counts
Case Studies

Department of Transportation
Structures Design Office



➢The typical section of the bridge consists of 2 ~ 12' lanes, 2 ~ 10' shoulders, with sidewalks and barriers on both sides.



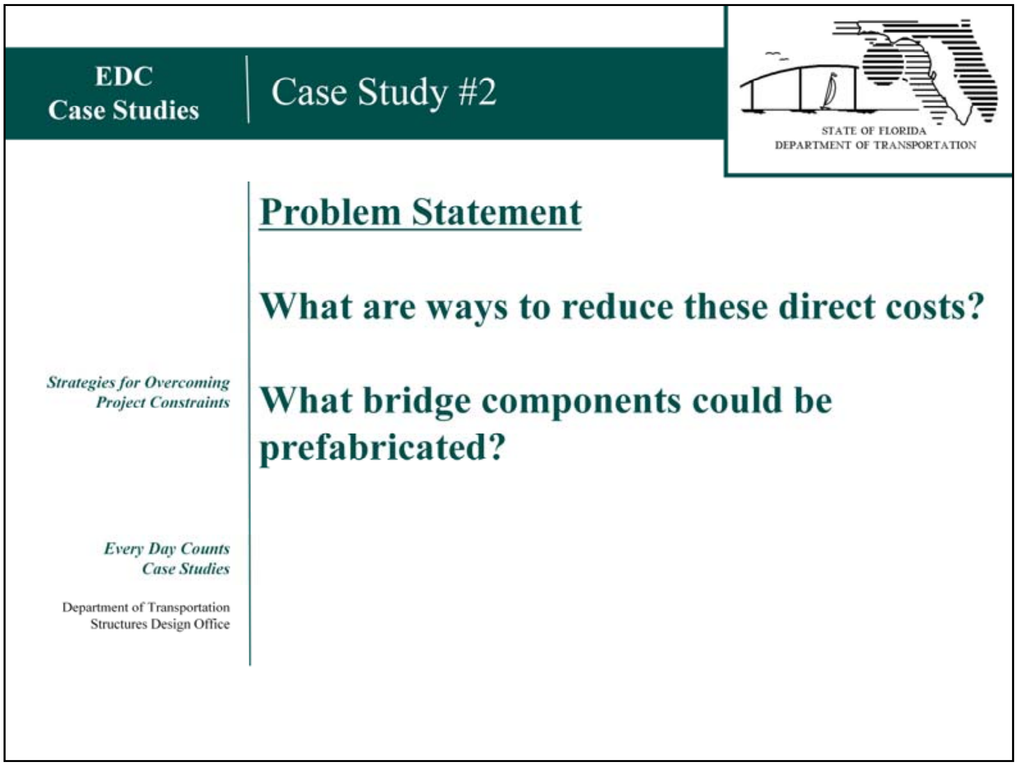
Some considerations for the conventional construction approach include:

➢Labor & Insurance Rates - even though the project can be constructed using conventional construction techniques, time working from a barge typically results in high labor rates and insurance costs.

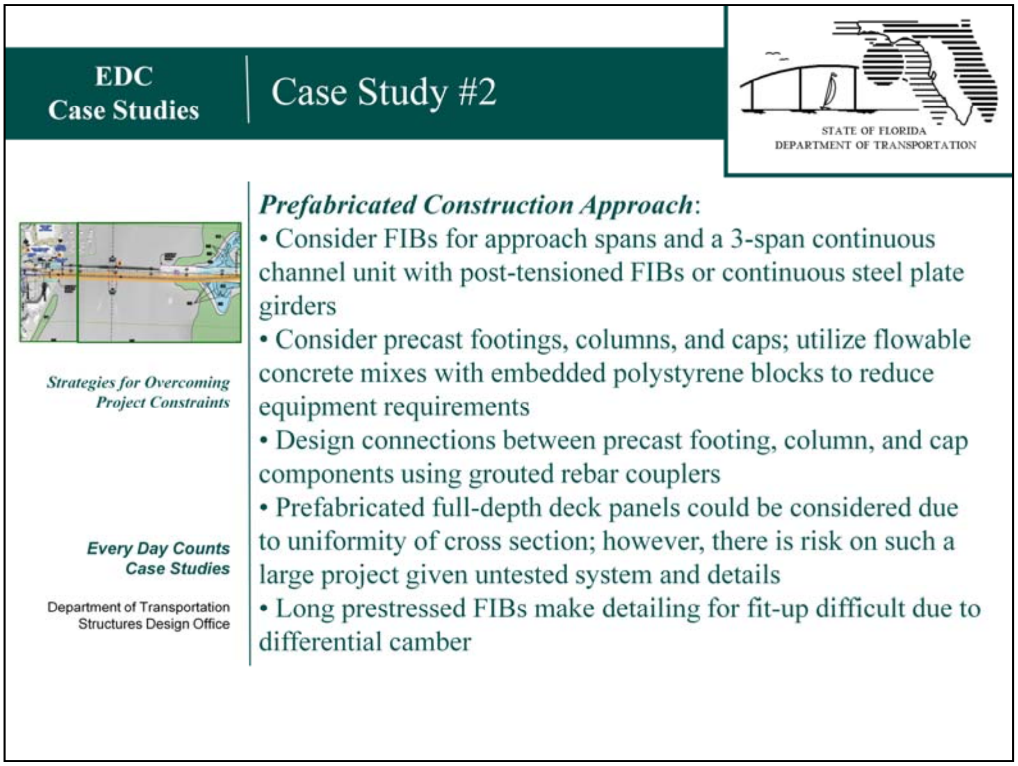
➢ Uniformity - generally long water crossings also have advantages over urban land bridges in that size and uniformity of the structure lends to repetition afforded by prefabricated components and also accelerates construction reducing time working on the water.

➢Economy of Scale – prefabricated options involve a learning curve; so with large bridges, there’s time for the contractor to learn the process whereas shorter bridges are completed by the time construction production rates have been optimized.

➢ Access – lets assume that water depths allow for full barge access from shoreline to shoreline.



- What are some ways to mitigate these direct cost implications?
- And which components could be prefabricated?



Some prefabricated construction considerations include:

➢ First off, we may consider using Florida I-Beams (FIBs) for approach spans and perhaps spliced 3-span continuous FIB units for the channel spans – especially since vessel collision would likely be a major consideration.

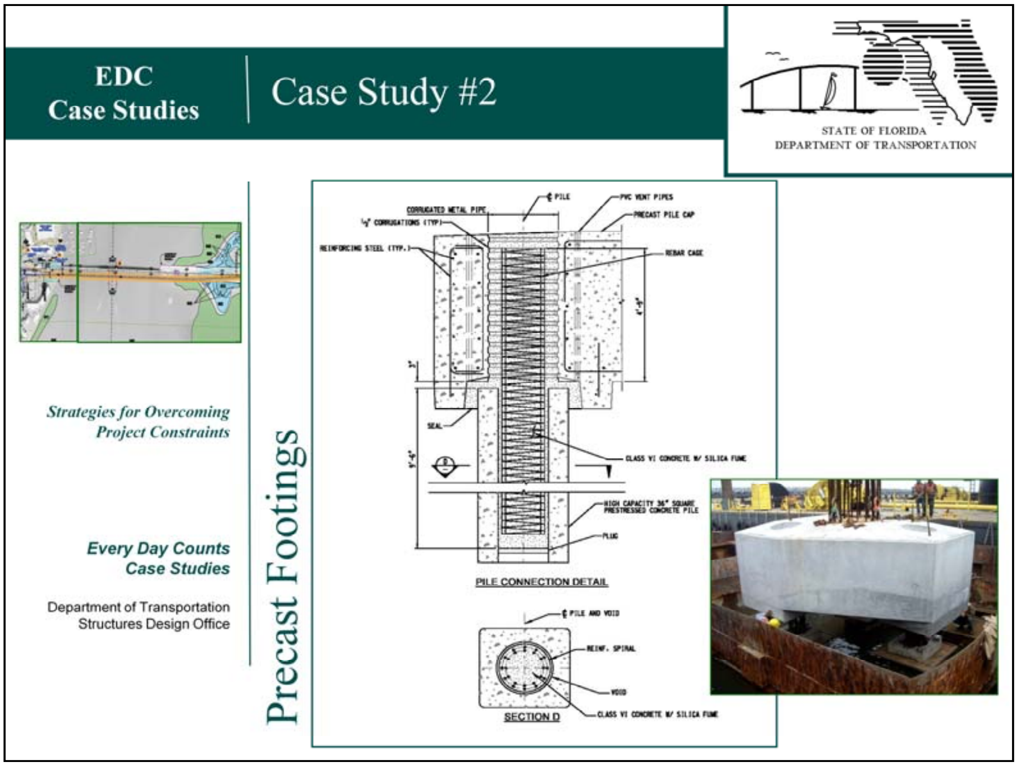
➢ Continuous steel plate girders may also be a consideration for the main channel unit.

➢ We could consider precast footings, columns, and pier caps, along with the precast FIBs, for uniformity and speed of construction to minimize time on the water.

➢ For the waterline footings located in major ship impact zones, size and weight of pile cap/footing may be a consideration.

➢ Stay-in-Place precast concrete bathtub forms that are considered non-structural and mechanically isolated for in-situ structural concrete in-fill may be a consideration to reduce weight.

➢ A consideration could also potentially include full-depth precast deck panels; however, the construction details and differential camber of long span precast beams are untested in Florida and may be discouraged until adequate testing and experience has been gained.



➢ Here are some sample details for a precast footing from a previously constructed Florida project.

➢ It should be noted here that a major consideration for prefabricated components is the attention given to the connection details – that the interface between prefabricated components achieves the design strength and behavior to adequately transmit forces between elements.

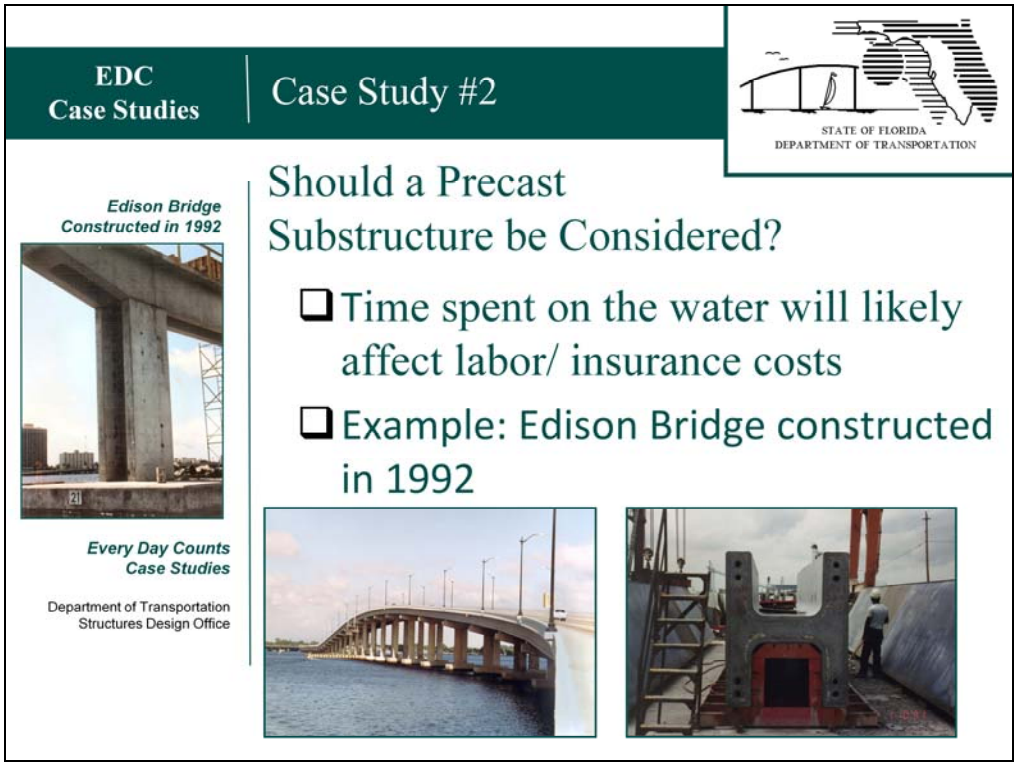
➢ In this example showing multi-column pier footings, the footings were small enough not to pose a lifting weight problem.

➢ Also in this example, a full scale mock-up test was required prior to installing and making the footing-to-pile connections.

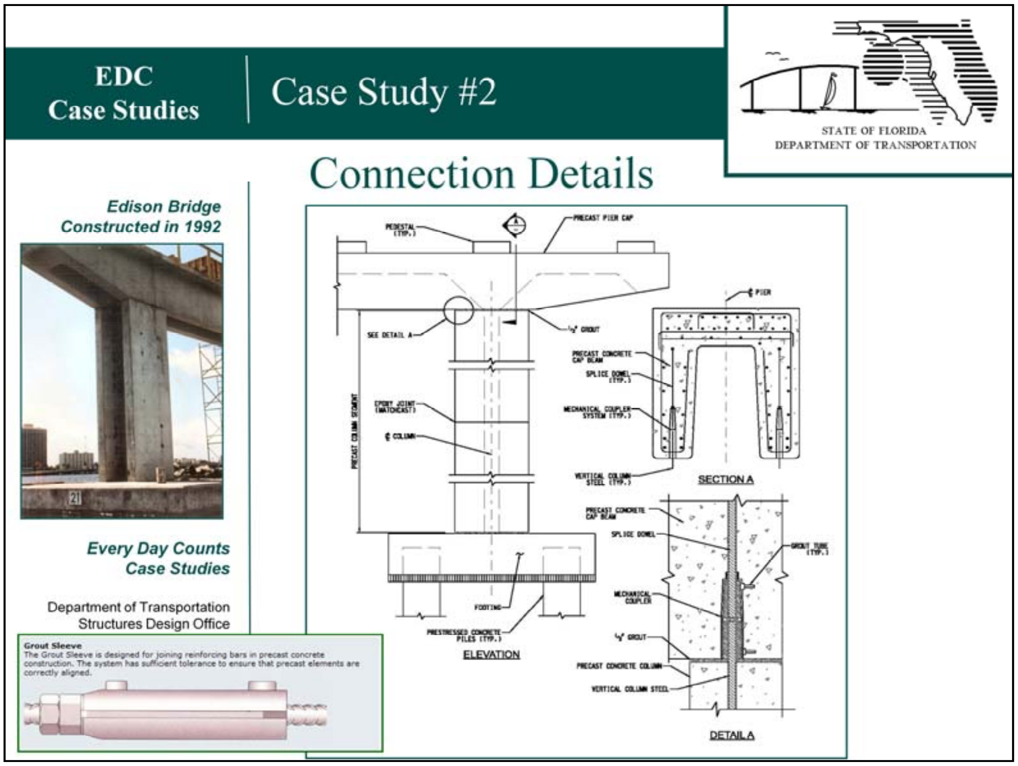
➢ In this case, the pile-to-cap connection depends on the ½” corrugated metal pipe form interface.

➢ Details need to accommodate pile placement tolerances.

➢ As noted previously, an isolated SIP precast bathtub form that could be sealed and pumped dry may be acceptable depending on the details.



- This is the Edison Bridge constructed in 1992.
- All columns and caps were precast.
- The leftmost picture shows the carve-out in the column and cap elements used to reduce its weight in order to reduce required crane capacity.



➢ Here is a view of some precast column and cap connection details that were used for the Edison Bridge.

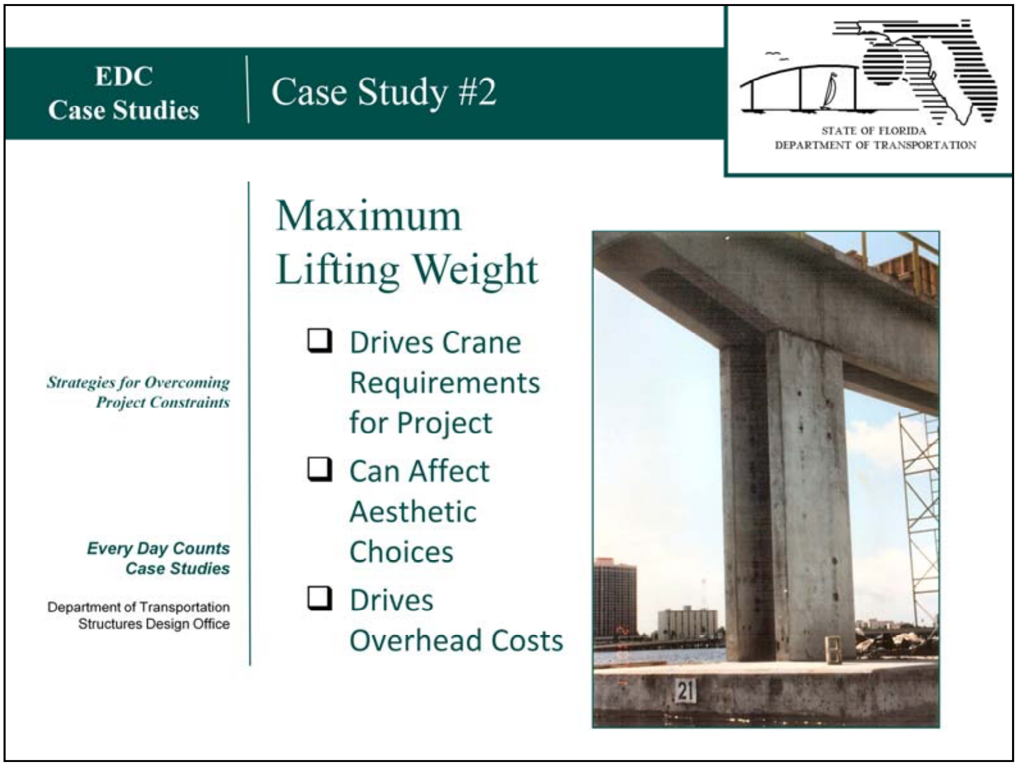
➢ These components were connected using mild reinforcing steel with grouted sleeve couplers without the need for post-tensioning.

➢ A reinforcing steel location transfer template was used in the field in order to properly locate the column dowel reinforcing which was cast into the cast-in-place footing concrete.

➢ In this case, the column-to-column joints were required to be matchcast and epoxied.

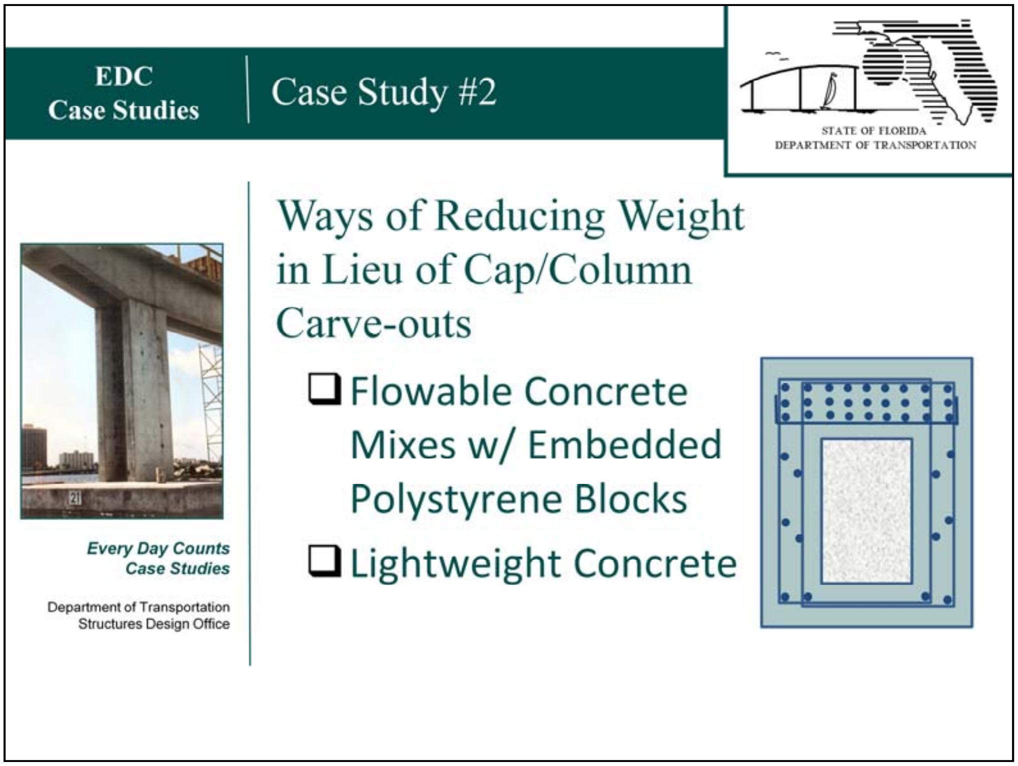
➢ The column-to-footing and column-to-cap connection required a ½" grouted joint.

➢ All connections were made with grouted mechanical rebar couplers.



Some potential limitations of precasting large elements include:

- Restricting aesthetic choices when trying to limit lifting weights.
- Larger cranes are a consideration and can drive overhead costs.
- A crane on a barge is limited to about an 80 ton “pick,” depending on factors such as boom reach, lean, barge size, etc.



What are ways to reduce lifting weights while still achieving project aesthetics?

➢ You could use flowable concrete with embedded polystyrene blocks to lighten precast elements along with designing grouted rebar couplers for connections.

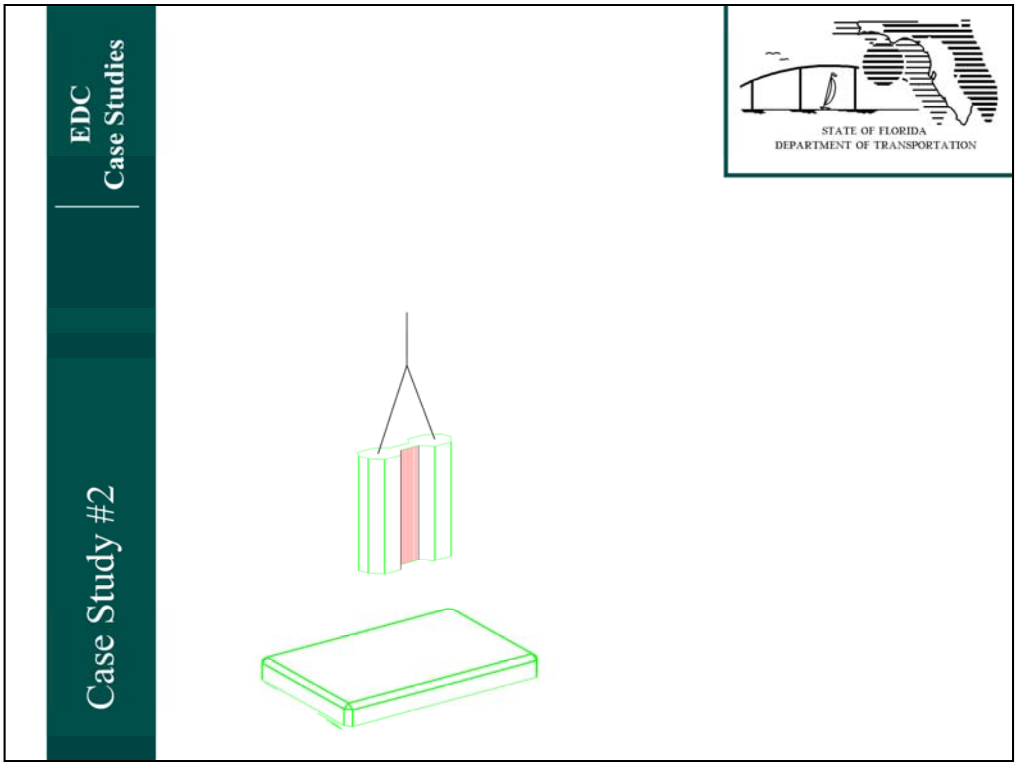
➢ A specification is needed for use of polystyrene.

➢ Important consideration for a possible polystyrene spec includes addressing securing block during concreting to ensure that all concrete covers are being maintained and controlling the size and shape of the blocks so that the weight of the element is ensured.

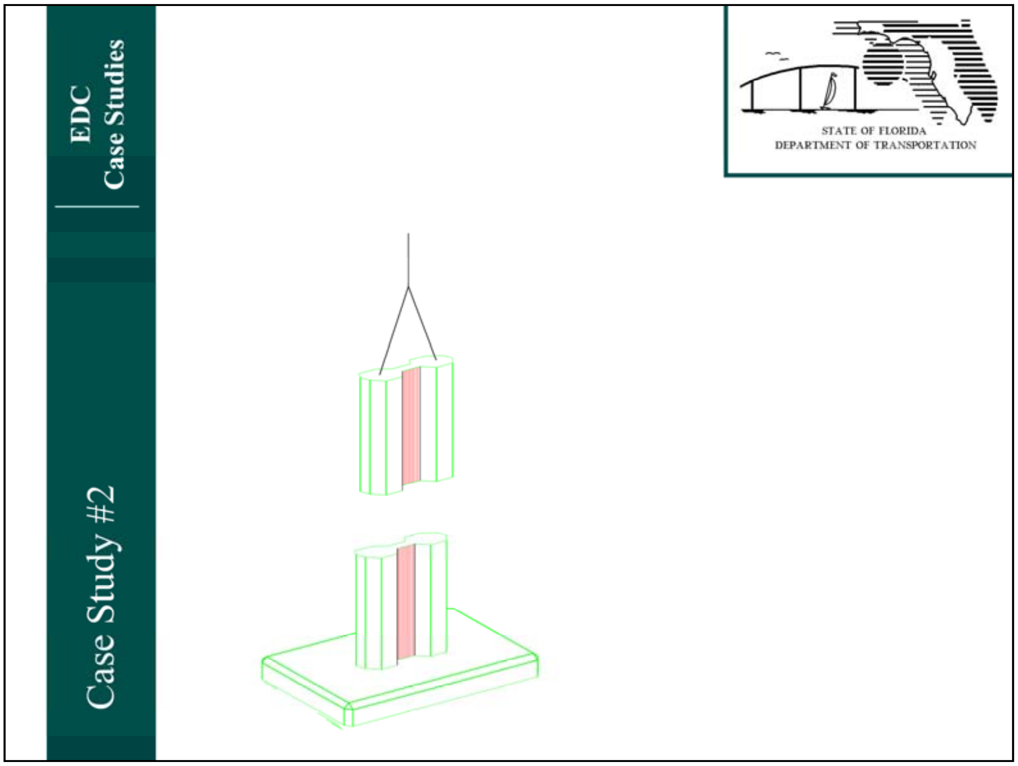
➢ Reducing weight by up to 30% or more may be achieved by using polystyrene and lightweight concrete.

➢ An added benefit of these lighter pier components is the resulting smaller foundation requirements.

➢ Note that for ship impact piers, columns within 15’ of mean high water would need to be solid. In these cases, a bottom hollow segment with concrete in-fill may suffice.

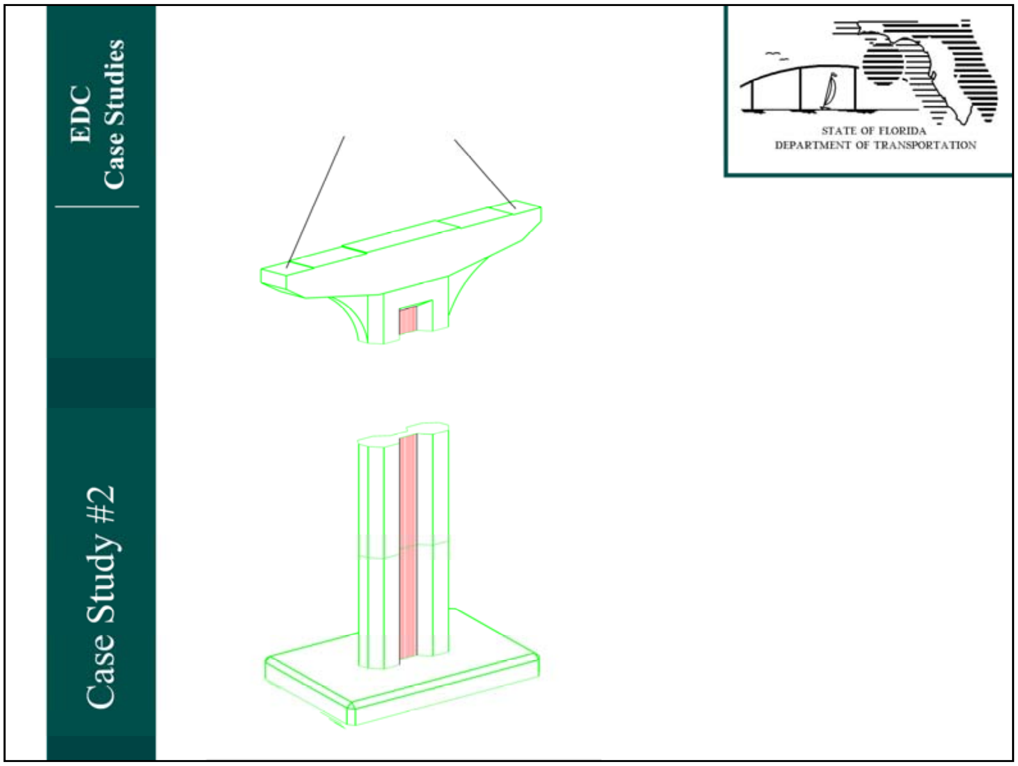


➢ With precast and/or CIP footings in place, precast column segments can be “flown-in” by barge-mounted crane and placed onto a ½” bed of grout and plastic shims relatively quickly with the rebar connections then grouted.



➢ Next, the second precast column segment can be epoxied along with the first and then the reinforcing bars at the column-to-column interface can be grouted.

➢ This assumes match casting of the joint.



➢ Lastly, the precast cap with polystyrene in-fill block to reduce weight can be placed on a ½” bed of grout and plastic shims then rebar coupler grouted into place.

EDC Case Studies

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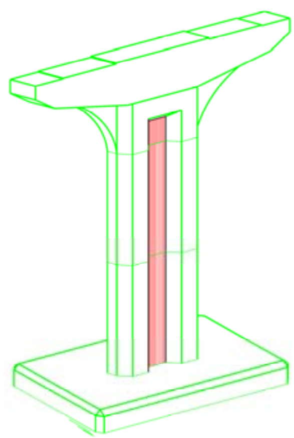
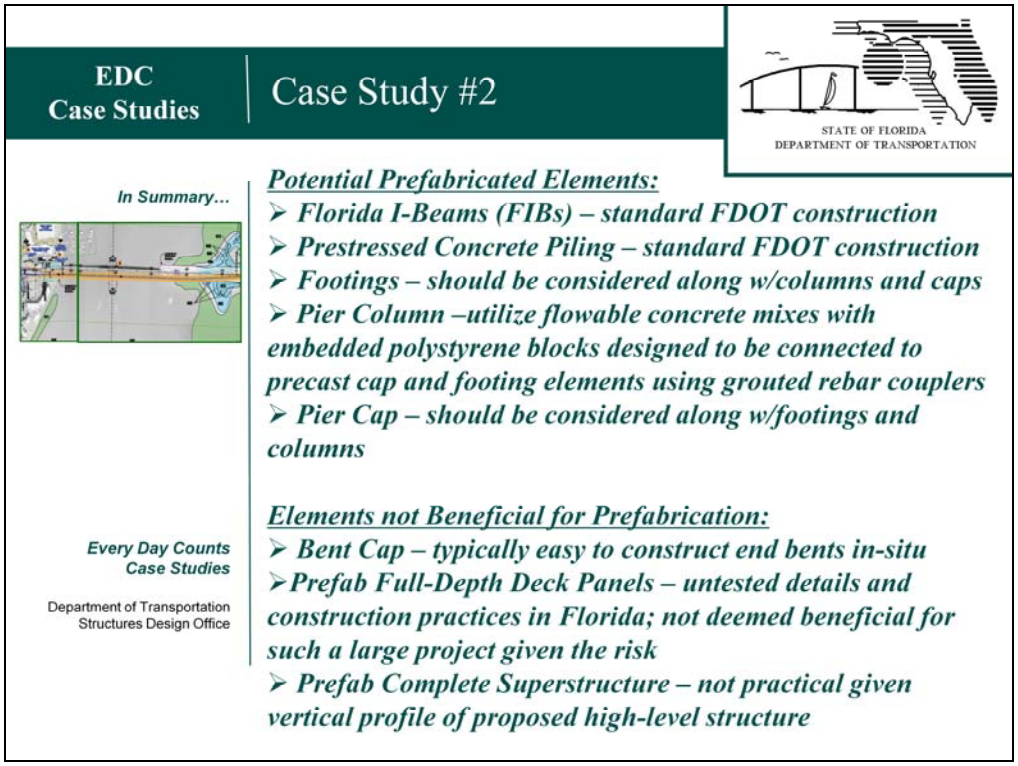
Case Study #2





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

➢ Footings – consider along with precast columns and pier caps

➢ Pier Columns – utilize flowable concrete mixes with embedded polystyrene blocks designed to be connected to precast cap and footing elements using grouted rebar couplers

➢ Pier Cap – consider along with precast columns and footings

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

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

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

➢ Prefab Complete Superstructure – not practical given vertical profile of proposed high-level structure