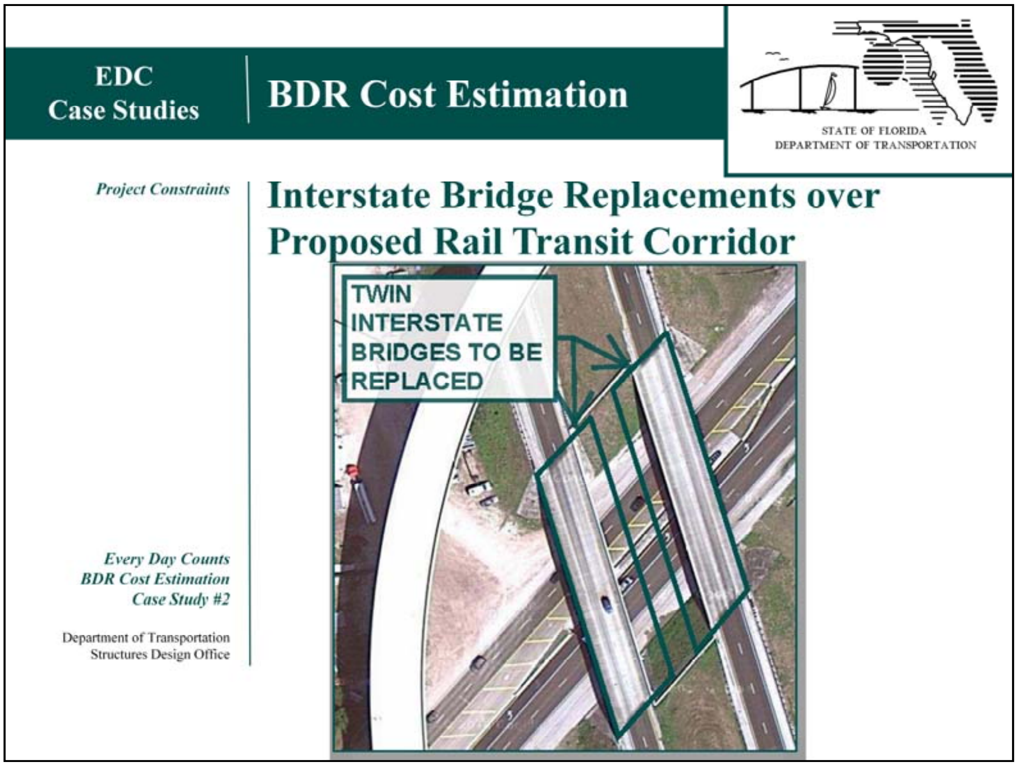
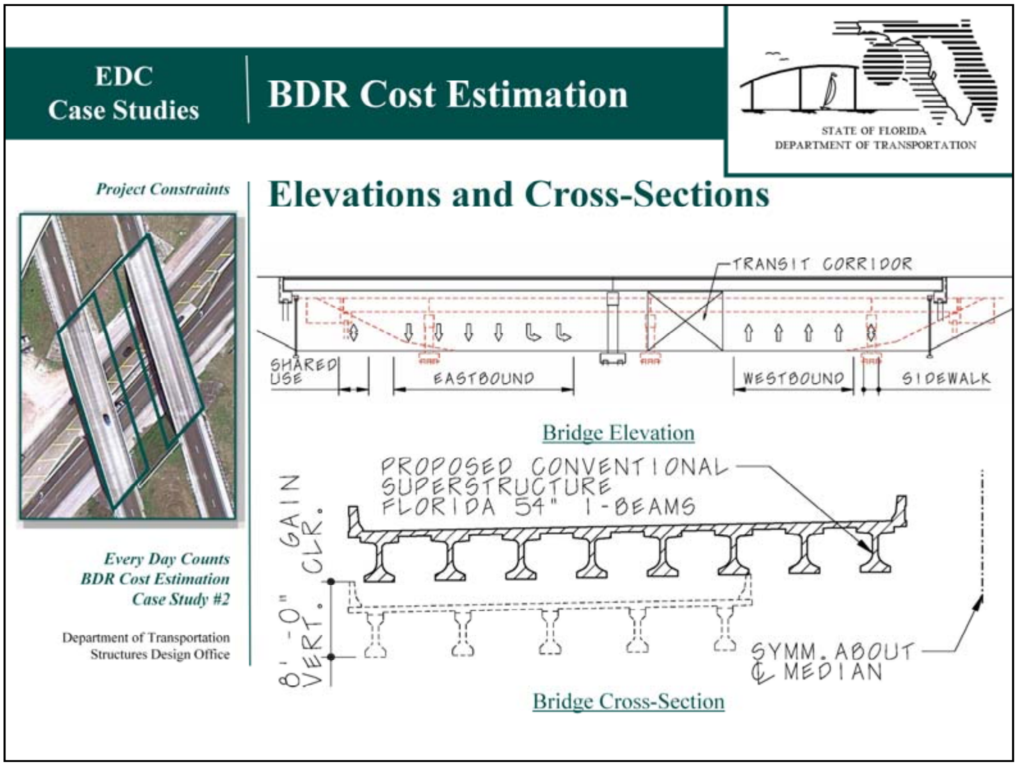
- Case Study #2 represents interstate bridge replacements over a local road which is being upgraded to accommodate a proposed rail transit corridor.
- This case study is the same as Case Study #1, with the exception that there is now the need to raise the vertical profile of the interstate by eight feet to accommodate the required vertical clearance of the proposed rail transit corridor below. Also, this case study assumes that the existing flyover ramp is high enough to facilitate the increase in profile of the interstate underneath.
- This case study will examine how this one modification will impact potential solutions and costs for both the conventional and prefabricated bridge construction alternatives.
- The audience is cautioned to view Case Study #1 prior to this case study, since this presentation will not repeat the material discussed in Case Study #1.



- This aerial view shows existing twin bridges over a local road. Both are identical four-span bridges with fill slope abutments.
- The local road and interstate are undergoing facility expansions identical to Case Study #1. Due to these facility upgrades, the bridges require replacement.
- The major difference between Case Study #1 and Case Study #2 is that the local road below has been identified as a candidate route for a future transit corridor. The corridor has been designated to be 34 feet wide. While the specific mode of transit has yet to be identified, in order to accommodate light rail as a future possibility, the vertical clearance underneath the structure will need to be raised approximately eight feet.



➢ An elevation of the existing bridge along with the existing configuration of the local road below is shown.

➢ Improvements to the local road can be seen if we overlay the proposed configuration on top of the existing.

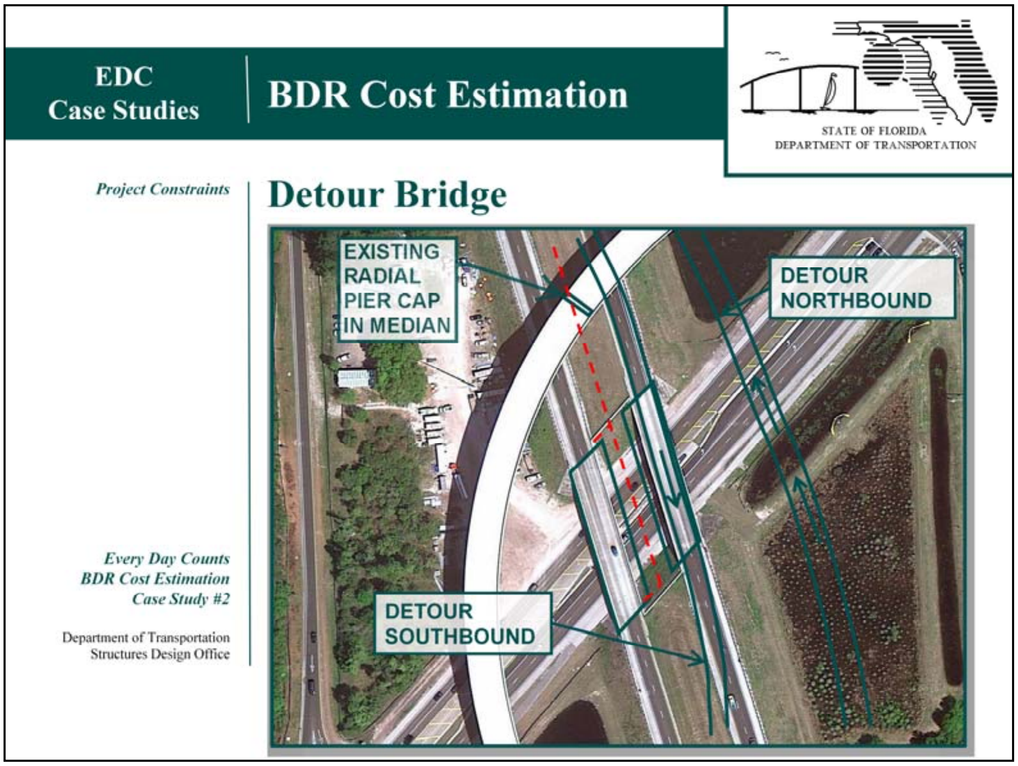
➢ The new bridge location has been shifted slightly downstation so the new piles will not interfere with the existing foundations. There are also utilities which run parallel with the local road alignment. There is a large expense for relocating these utilities, thus the new foundations have also been laid out to avoid utility relocation.

➢ It can be seen from the superposition that removal of the existing fill slopes is required to accommodate the upgrades, as well as a substantial change in the interstate vertical profile.

➢ The conventional construction approach assumes the existing four-span bridges to be replaced by two-span structures with wrap-around MSE wall end bents.

➢ The cross-section of the existing bridge consists of AASHTO girders.

➢ Like Case Study #1, Florida I-Beams have been used to minimize the girder depth. This is critical in limiting the increase in vertical profile required to accommodate the transit corridor.



- A challenge for this project is determining a method to demolish the existing bridges and construct the new ones while minimizing impacts to interstate traffic and the local road below.
- Although the existing flyover ramp is higher than in Case Study #1, this case study is still constrained vertically when the higher interstate profile is accommodated. Due to these constraints, the bridges can only be widened to the inside of the median, or high side of the cross-section due to structure depth and vertical clearance limitations.
  - Like Case Study #1, this segment of the interstate is currently experiencing lengthy backups from commuter traffic, as well as being a hurricane evacuation route. Therefore, the Department was concerned that if a vehicle was to breakdown or be involved in an accident during construction, the interstate would be down to only one lane of traffic, causing gridlock and jeopardizing response time from emergency service vehicles from nearby hospitals and fire departments. With this special situation in mind, the Department decided to maintain two active lanes of traffic and a six foot outside shoulder in both directions at all times throughout construction.
  - Similar to Case Study #1, phased construction would require “overbuilding” the bridge widths to maintain two active lanes, and would interfere with the existing radial hammerhead pier cap of the flyover, as it does not provide the minimum required vertical clearance for the temporary travel lanes. This scenario is depicted by the dashed red lines on the slide.
  - Like Case Study #1, these project constraints eliminate phased construction as an option.
- Therefore, a detour bridge will be constructed to temporarily divert northbound traffic, and allow southbound traffic onto the current northbound alignment. The detour for northbound traffic will be shifted slightly away from the existing bridges to provide the contractor adequate access to the site.

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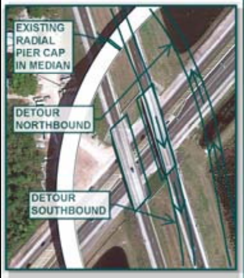
Project Constraints



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Conventional Construction Approach

- Interstate Detours (diversions) – Southbound diverted while exiting SB demolished and reconstructed. Northbound diverted for entire duration while both bridges are demolished and reconstructed.
- M.O.T. – crossovers will be used for local road; however the two current dedicated turning lanes (at detour location) will be compromised
- Lanes – only 2 lanes can be maintained in each direction on local road
- Demolition – 2-3 days per span
- Overhead work – girder placement, deck forms, and deck pours at night, but crossovers still required for local road below.

This slide summarizes traffic impacts for the conventional construction approach. Except for the fact that the MSE walls and new interstate bridges are higher, this approach and associated impacts are identical to that presented in Case Study #1.

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Prefabricated Alternative

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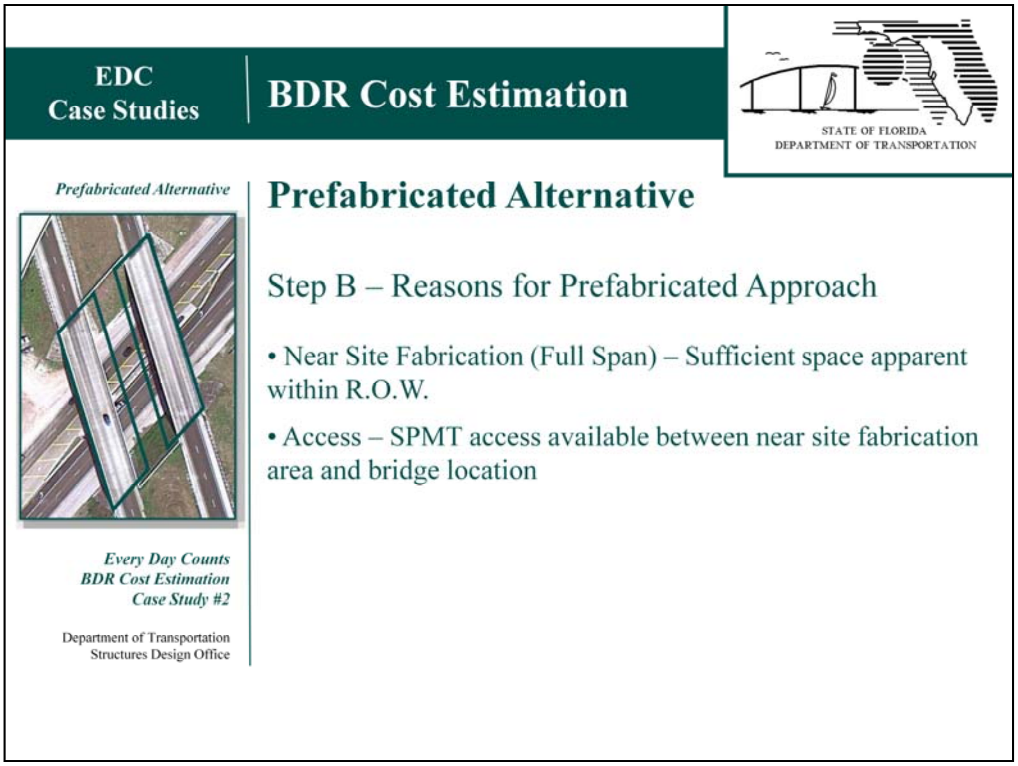
Prefabricated Alternative

Step A – Questionnaire, Significant Responses

FDOT Structures Bulletin C11-04, Questionnaire:	
Question	Answer
Will prefabrication reduce traffic impacts?	Yes
Is this a hurricane evacuation route which accelerated delivery is beneficial?	Yes
Does project site have sufficient R/W for near-site fabrication yard?	Yes
Are lifting weights practical given assumed equipment, access, and construction method?	Yes

Using guidance from the Structures Design Bulletin, the Step A questionnaire was completed for this case study. A few of the relevant questions for this case study are listed, many of which are similar to Case Study #1.



Given the change in interstate profile, and that the alignment cannot change, it is determined that a detour will be required to replace the bridges. This will greatly impact interstate traffic. Therefore, the prefabricated alternative will focus on methods to minimize user impacts, while at the same time shortening construction schedule. Like in Case Study #1, Step B has identified that heavy lifting techniques utilizing SPMT's may accomplish the goal of reduced user impacts.

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Step C – Prefabricated Alternative – Solutions

Strategies for Overcoming Project Constraints	
Objective	**Solution**
Raising interstate profile by eight feet	Detour bridge required during build up of approach roadway
Reduce user impacts (limit detour time)	Use full-span superstructure erection, using SPMTs with near-site fabrication
Reduce construction time	Remove superstructure construction from critical path during construction
Simplify PBES alternate	Use same bridge configuration and materials as conventional construction does. Use identical traffic phasing.

➢ Step C involves developing a preliminary prefabricated alternative and comparing it against conventional construction.

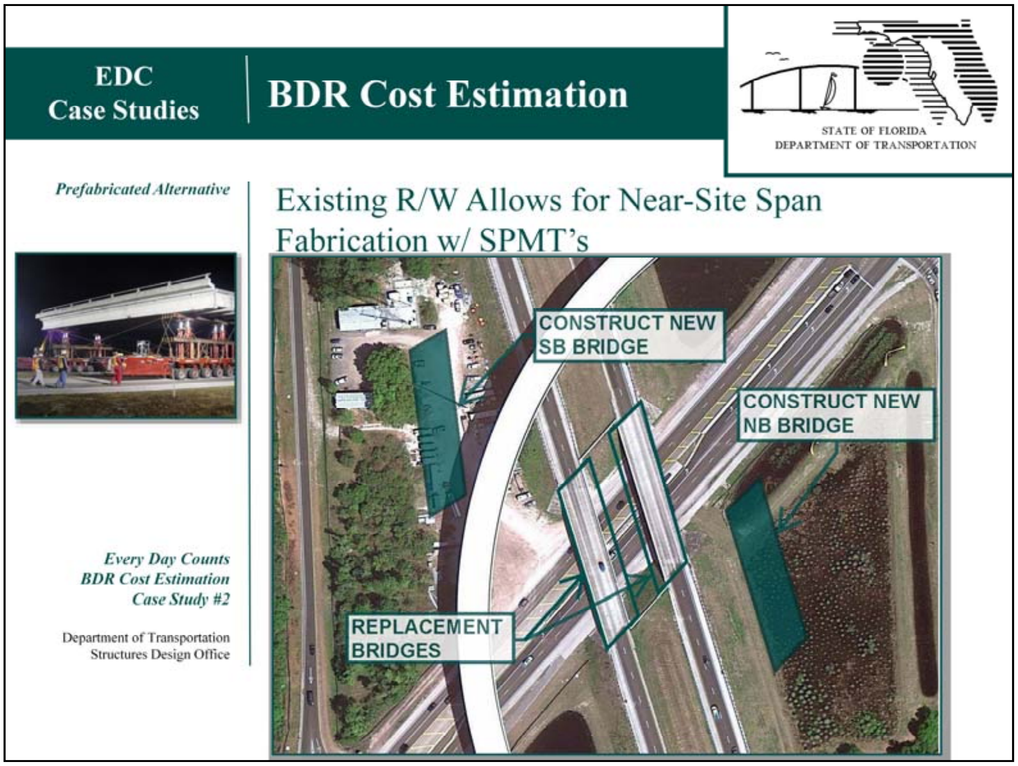
➢ Objectives and solutions for the prefabricated alternative are listed here:

➢ Given the project constraints, a detour for interstate traffic is necessary to raise the profile of the bridge and 2,000 feet of approach roadway. Therefore the prefabricated alternate will concentrate on reducing the detour duration. By building the superstructures adjacent to the bridge site and then moving them into place using SPMTs, it will remove the bridge superstructures from the critical path of construction. Under this scenario they can be built concurrently, or even in advance of the bridge substructures and approach embankments.

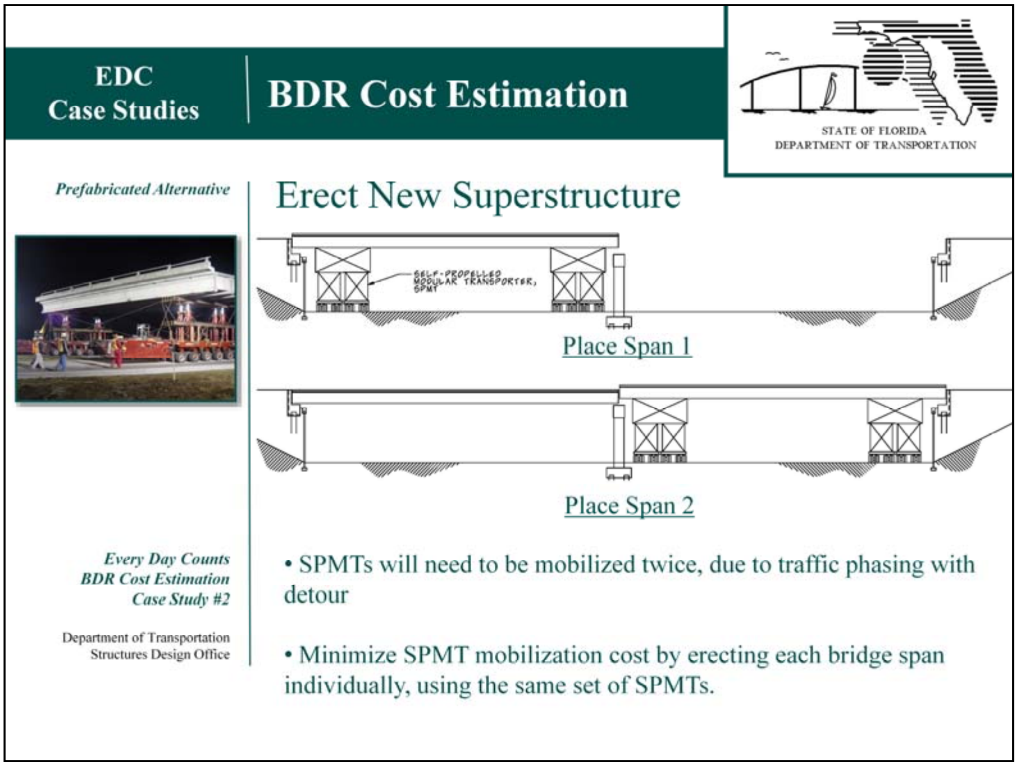
➢ This method of construction will also simplify this alternate, as using SPMTs to erect the superstructure will allow traffic phasing to be identical to that used for the conventional alternate.

➢ The composition of the bridge components themselves will also not change for the prefabricated alternate. Therefore both conventional and prefabricated alternates will utilize 54" Florida I-Beams, the piers will be the same, and end bents will have wrap around MSE walls. The largest difference will be the method in which the bridge superstructures are constructed.

➢ In Case Study #1, a straddle pier with continuous steel superstructure with integral cap allowed for a single night removal and replacement of both structures by SPMTs. In this case, however, the 8 ft. raising of the interstate roadway profile is on the critical path, not the construction of the bridges themselves requiring a large lag time between SPMT moves. Therefore, lower cost 54" Florida I-Beams with conventional cast-in place piers with wrap around MSE walls were chosen for this precast option. In summary, both the precast alternate and conventional alternate will consist of the same bridge components – the only difference is that this precast option will utilize full span casting with SPMTs to reduce construction time and user impacts.



➢The entire superstructure will be fabricated in the available areas adjacent to the site, then the new fully assembled superstructure will be moved into place using SPMTs. This operation is assumed to occur during a nighttime closure of the local road below.



➢ The subtle differences in use of the SPMT's between this case study and Case Study #1 will have a direct impact on determining the SPMT cost.

➢ Cost of SPMT mobilization is high, so their use must achieve maximum efficiency. As mentioned previously, due to the increase in profile and nature of traffic shifts associated with the proposed detour, it is likely SPMT's will need to be mobilized twice, as there will be a significant time lapse between completion of the southbound and northbound substructures. This re-mobilization will dramatically increase costs.

➢ Fortunately, each span of the superstructure can be erected individually, using the same set of SPMT's, reducing the tonnage required versus lifting both spans simultaneously.

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Compare Alternatives

Direct Cost Comparison

Summary of Direct Costs - Taken from "Bottom-Up" Cost Estimate				
Item	Construction Type		Delta	Reason
	Conventional	Prefabricated		
Detour, SPMTs	$ 2,912,237	$ 4,148,495	$ 1,236,258	Addition of SPMTs
Contractor General Conditions	$ 1,239,334	$ 525,305	$ (714,029)	Schedule Reduction
Substructure	$ 1,462,144	$ 1,422,087	$ (40,059)	Schedule Reduction
Superstructure	$ 2,010,495	$ 1,893,502	$ (116,993)	Schedule Reduction, Location
Direct Cost Total	**$ 7,624,210**	**$ 7,989,389**	**$ 365,179**	--

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- $1.3M cost associated with using SPMTs
- Prefabrication shortens schedule from 30 months to 14 months
- Benefit in contractor general conditions due to reduced schedule

➢ Using a construction estimator, direct costs for each alternative have been calculated and are presented in this table.

➢ Looking at the first row, the most notable cost differential can be seen. This is the direct cost associated with construction of the detour for each alternate, as well as using SPMTs for the prefabricated alternate. Due to the detour being used for both scenarios, this cost is obviously in favor of conventional construction.

➢ The second row of the table represents the contractor’s general conditions. It reflects labor associated with permanent employees, as well as field offices and other overhead items incurred by the contractor. This item is in favor of the prefabricated alternate, and is a result of a reduced construction schedule. Using the prefabricated alternate, the schedule can be reduced by approximately 16 months.

➢ Rows three and four represent cost for the substructures and superstructures. While these costs are similar, there is a slight benefit for the prefabricated alternate, as the construction schedule is shorter and the superstructure is simplified due to be built at the near site ground location away from traffic.

➢ Overall, the prefabricated alternate has direct cost greater than conventional construction.

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Compare Alternatives

Cost Summary

Summary Table:

Alternate	Direct Costs	Indirect Costs							Direct + Indirect
		Lane Closures		Detour Time		Facility Closure		Σ Indirect	
		Days	$/Day	Days	$/Day	Days	$/Day		
Conventional	$ 7,624,210	18	$ 1,037	500	$ 12,426			$ 6,231,666	**$13,855,876**
Prefabricated	$ 7,989,389			300	$ 12,426	4	$ 26,804	$ 3,835,016	**$11,824,405**

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- Direct cost for conventional construction less than prefabricated
- Indirect cost for conventional construction larger
- Overall, prefabricated construction has the potential to save $2M

➢ The combination of direct and indirect costs associated with each construction scenario is shown here.

➢ As expected, conventional construction has a lower direct cost, but a higher indirect cost.

➢ When looking at the summations, the prefabricated alternative is $2M dollars less than conventional construction, and supports the indication that prefabricated elements should be considered for the project.

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Compare Alternatives

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Assessment Matrix

Selection Factor	Factor Weight (%)	PREFABRICATED		CONVENTIONAL	
		Score (0 to 5)	Weighted Score*	Score (0 to 5)	Weighted Score*
Total Direct Costs	55	4	220	5	275
Total Indirect Costs	20	2	40	1	20
Factor 3 - *Constructability*	5	3	15	5	25
Factor 4 - *Traffic Impacts*	0		0		0
Factor 5 - *Construction Duration*	10	5	50	3	30
Factor 6 - *Durability*	0		0		0
Factor 7 - *Environmental Impacts*	0		0		0
Factor 8 - *Aesthetics*	0		0		0
Factor 9 - *Project Risk*	10	3	30	5	50
Factor 10 - *Other*	0		0		0
TOTAL (Σ Factor Weights = 100%)	100	--	355	--	***400***
TOTAL (Excluding Indirect Cost Factor)**	80	--	315	--	***380***

• Conventional alternative is more favorable

➢ This slide presents the assessment matrix prepared for this case study. As explained in Case Study #1, this matrix is yet another tool in the decision making process. Its goal is to evaluate parameters relevant to the project in addition to cost, then produce an overall score for each alternative.

➢ This case study has been divided into the categories shown, each with its relative significance to the project. Looking at the last two rows of the table, conventional construction is more favorable then the prefabricated alternative.