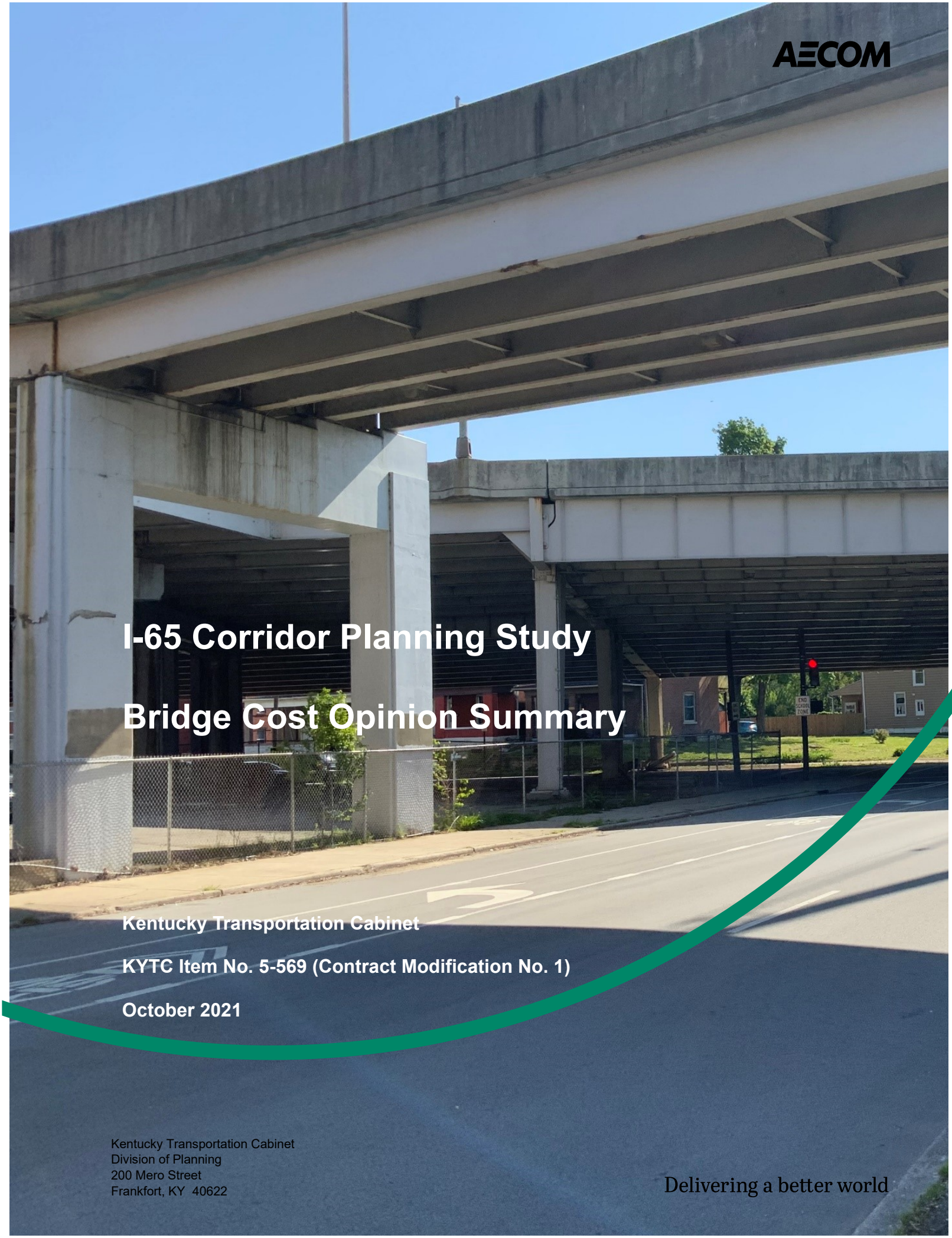

I-65 Corridor Planning Study

Bridge Cost Opinion Summary

Kentucky Transportation Cabinet

KYTC Item No. 5-569 (Contract Modification No. 1)

October 2021

Kentucky Transportation Cabinet
Division of Planning
200 Mero Street
Frankfort, KY 40622

Delivering a better world

1. Overview

1.1. Original Scope: The Kentucky Transportation Cabinet (KYTC) requested the AECOM-led consultant team to provide cost opinions for the replacement of three bridges within the study area of KYTC Item No. 5-569, the I-65 Corridor Planning Study. In April 2021, KYTC issued a contract modification to AECOM for this bridge cost opinion evaluation.

1.2. Bridge Cost Opinion Context: As the I-65 Corridor study was initiated, KYTC introduced KYTC Item No. 5-20061 into the Transportation Improvement Program (TIP) of the Kentuckiana Regional Planning and Development Agency (KIPDA). The scope of KYTC 5-20061 includes the replacement of the three bridges described in Paragraph 1.5. KYTC 5-20061 has $2 million programmed in design funding and $54 million in construction funding. The construction funds were programed for 2023. During the study, KYTC 5-20061 was amended into KIPDA's TIP and subsequently into Kentucky's Statewide Transportation Improvement Program (STIP). The intent of this evaluation is to provide a more "intentional" cost opinion, with consideration of maintenance of traffic and accelerated bridge construction techniques, which would allow KYTC to seek additional funding if needed for this project.

1.3. Consultant Team: AECOM is partnered with Qk4 on the 5-569 Planning Study. The consultant team is referenced as the AECOM/Qk4 team throughout this report.

1.4. Additional Bridge Considered: As the AECOM/Qk4 team examined the three bridges identified in the 5-20061 project, it was apparent that a fourth bridge should also be considered. Of the original three bridges, the northern most bridge, 056B00191N, shares a pier with 056B00192N which was not one of the three bridges identified for replacement. KYTC agreed that the AECOM/Qk4 team should also provide a cost opinion for the replacement of this fourth bridge. It was understood that this fourth bridge was not in the current scope of KYTC 5-20061.

1.5. Bridges Under Consideration: Three primary and one additional:

1.5.1. Bridge 056B00179N – I-65 Bridge over E Hill Street, CSX Railroad, and E Burnett Avenue at MP 133.873

1.5.2. Bridge 056B00183N – I-65 Bridge over E Kentucky Street and S Brook Street at MP 134.753 and I-65 southbound ramp bridge to St. Catherine over E Kentucky Street.

1.5.3. Bridge 056B00191N – I-65 Bridge over E Jacob Street, E Broadway, and E Gray Street at MP 135.273

1.5.4. Bridge 056B00192N – I-65 Bridge over E Chestnut Street at MP 135.43 (this is the fourth bridge that was added to the original scope)

1.6. Air-Space Considerations: During the preliminary stages of this effort, KYTC clarified, that as part of the cost opinion evaluation, the AECOM/Qk4 team should investigate the Air-Space Agreements associated with these bridges.

1.7. ABC Considerations: The consultant team reviewed Accelerated Bridge Construction (ABC) strategies and evaluated the potential use of ABC on the reconstruction of these I-65 Bridges.

2. Background

Bridge Locations: The bridges considered are in Jefferson County, Kentucky along the I-65 corridor between I-264 and downtown Louisville. The bridges are spread over an approximate 3 mile stretch of I-65 between Mile Point 133 and Mile Point 136. Figure 1 provides a study area map showing the location of the bridges.

Figure 1: Study Area Map – Louisville, Kentucky

2.1. Bridge Summary: Table 1 provides a brief overview of the four bridges included in the study. The bridge condition shown is the lowest condition rating as defined in the Federal Highway Administration's *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* (commonly referred to as NBIS) from either the deck, superstructure, or substructure as provided in the most recent inspection report.

Reconstruction of the bridge over Brook and Kentucky Streets provides the greatest challenge due to the intersection directly below the elevated structure. This geometry, in combination with vertical clearance requirements, necessitates the use of integral bents to support the elevated structure. Integral bents are transverse elements, typically constructed of steel or post-tensioned concrete, that are at the same depth and height of the girders or beams.

Table 1: Bridge summary

BRIDGE	SUPERSTRUCTURE	LENGTH	SPANS	CONDITION
Hill/CSX/Burnett 056B00179N	Steel girders	338-ft	5	Poor
Brook/Kentucky 056B00183N	Steel girders on integral steel bent caps	461-ft	3	Poor
Jacob/Broadway 056B00191N	Steel, prestressed, and reinforced concrete girders	1,208-ft	21	Fair
Chestnut 056B00192N	Prestressed concrete girders	435-ft	9	Fair

Figure 2: Photographs of each bridge

2.2. Implementation of the I-65 Corridor Study (KYTC Item No. 5-569) recommendations: KYTC leadership expressed optimism that some improvement concepts developed as part of the I-65 Corridor Planning Study could be implemented as part of KYTC Item No. 5-20061 bridge replacement/pavement rehabilitation project. This implementation would be dependent on funding available. The costs associated with these items are not included in the Section 3 Cost Opinions. The improvement concepts to be considered and their associated cost opinions are:

2.2.1. Improvement Concept A: Drainage Improvements to be accomplished in conjunction with future resurfacing or pavement rehabilitation. Cost of $615,000 beyond cost of paving work.

2.2.1.1. NB at Bradley: added an inlet in the flat area. Cost ≈ $125,000
2.2.1.2. NB at Arthur: added 2 inlets. Cost ≈ $145,000
2.2.1.3. SB at Jackson: added 2 inlets. Cost ≈ $135,000
2.2.1.4. SB at Brook: added an inlet at bridge end. Cost ≈ $145,000
2.2.1.5. NB at Jacob: replace vane grate with DBI Type 1. Cost ≈ $65,000

2.2.2. Improvement Concept B: Striping Improvements to be accomplished in conjunction with future resurfacing or pavement rehabilitation. Nominal cost increase to cost of paving work.

2.2.3. Improvement Concept C: Signage Improvements to be accomplished in conjunction with future resurfacing or pavement rehabilitation. Nominal cost increase to cost of paving work.

2.2.4. Improvement Concept D: ITS Deployments to be accomplished in conjunction with future resurfacing or pavement rehabilitation. Scope of work yet to be determined. Cost range from $200,000 for two curve warning systems to $7 million for robust deployment that would include fiberoptic communication, back of queue, curve, and bridge deck warning systems. These ITS Deployment concepts are discussed in Section 7.2.3 of I-65 Corridor Study Report dated October 2021.

2.2.5. Improvement Concept K: Extend I-65 northbound on-ramp from St Catherine Street to allow for longer acceleration/merge area. - Construction cost $1,000,000.

2.2.6. Improvement Concept N: Remove middle of three I-65 southbound on-ramps from First Street (near Jacob Street) and lengthen merge area for northern First Street on-ramp (near Liberty) - Construction Cost $6,050,000

3. Cost Opinions

3.1. Major Item Unit Cost: The AECOM/Qk4 team considered the following major/significant items associated with the bridge replacement(s) and researched appropriate unit costs. The team utilized their professional experience to develop conceptual designs to determine approximate quantities for significant bid items. These conceptual quantities are provided in Appendix A. The team reviewed average unit bridge prices from construction lettings in Kentucky in 2019 and 2020 and exercised professional judgment to determine the estimated unit bid prices shown in Table 2.

Table 2: Unit price estimates for significant bid items

ITEM DESCRIPTION	UNIT	UNIT PRICE
BRIDGE DEMOLITION	SF	$30.00
CONCRETE-CLASS A	CY	$800.00
CONCRETE-CLASS AA	CY	$1,000.00
STEEL REINFORCEMENT – EPOXY COATED	LBS	$1.35
STEEL REINFORCEMENT	LBS	$1.30
MSE WALL	SF	$100.00
MSE GRANULAR EMBANKMENT	CY	$35.00
PILES-STEEL HP12X53	LF	$100.00
RAILING	LF	$125.00
RAILING ON MOMENT SLAB	LF	$250.00
MEDIAN BARRIER	LF	$110.00
PRECAST PC BOX BEAM	LF	$300.00
PPC I-Beam TYPE HN60-48	LF	$480.00
PRECAST PC I BEAM TYPE 3	LF	$335.00
STRUCTURAL STEEL	LBS	$2.75

3.2. Cost Opinion General Discussion: The cost opinions or estimates provided are based on experience and judgment. Market conditions, inflation, bidding procedures, etc. could result in great variability of the construction bids. Bridge construction will be challenging due to the dense urban setting which includes commercial and residential developments directly adjacent to the project, limited staging areas, utility and railroad considerations, and the high traffic volume carried by I-65. Various cost adjustments were applied to compensate for these conditions including mobilization, demobilization, railroad coordination, and a general contingency. The contingency is included to account for incidental items and uncertainties and risks involved with this complex project.

3.3. Cost Opinion. Table 3 presents the summary of the cost opinions for bridge reconstruction. A number of variations to the cost estimates were considered as discussed below depending on the scope of the project and desired maintenance of traffic scheme.

3.3.1. Lower Range (Base): The base cost opinion considers the most economical structures and standard construction schedule. Reconstructed bridges are assumed to be smaller than existing bridges by placing the currently elevated structure on new embankments supported by retaining walls such as mechanical stabilized earth (MSE). Span lengths would be limited as much as feasible to cross only travel lanes, railroads, shoulders, and sidewalks. A normal construction schedule is assumed that does not require the contractor to utilize unique or innovative construction methods.

3.3.2. Match Existing Footprints: To maintain existing air space agreements, KYTC may look to re-build the existing bridges with a similar footprint to the existing. This would mean a similar width, length, and span arrangement. These new bridges, keeping a similar length and span layout to the existing condition may be also benefit viewshed considerations and any local commitments (for example – parking).

3.3.3. Accelerated Bridge Construction (ABC): The impact on the traveling public during construction is a major consideration and the chosen scheme will have a significant impact on the construction cost. Accelerated bridge construction will add project costs due to innovative construction techniques and added contractor risk. However, it will reduce the impacts and delays to the vehicles traveling this corridor. Maintenance of traffic cost is a separate consideration discussed below.

3.3.4. Upper Range: The upper range estimate combines the base, existing footprint, and accelerated bridge construction cost estimate opinions. KYTC may elect to incorporate any combination or portions thereof, thus the actual project cost could fall anywhere between the lower and upper limits.

3.3.5. Maintenance of Traffic (MOT): These costs (signage, channelization devices, police officers, etc.) were estimated by calculating a mobilization cost and a daily rate. Those estimates were cross-checked against other recently completely regional interstate construction projects and adjusted as needed. For this evaluation, it was assumed that construction would be completed on each directional bridge at a time (phased construction). The open bridge could carry one or two-directional traffic.

3.3.5.1. MOT for Conventional Construction (Base): It was assumed that conventional construction could be completed in approximately 90 closure days in each direction.

3.3.5.2. MOT for ABC: It was assumed that ABC could be completed with 30 closure days in each direction. The 30-day closure would not have to be continuous.

Note that in Table 3, ABC shows an estimated savings of $5,700,000 in maintenance of traffic costs over conventional construction. This provides an apples-to-apples comparison of utilizing ABC vs conventional construction; however, it does not consider user costs, which was outside the scope of this evaluation.

Table 3: Cost Opinion for Bridge Reconstruction

	Lower Range (Base)	+	Match Existing Footprint[1]	+	ABC[1]	=	Upper Range[1]
Hill/CSX/Burnett 056B00179N	$12,500,000	+	$400,000	+	$2,800,000	=	$15,700,000
Brook/Kentucky 056B00183N	$19,900,000	+	$3,400,000	+	$5,100,000	=	$28,400,000
Jacob/Broadway 056B00191N	$32,500,000	+	$11,300,000	+	$9,700,000	=	$53,500,000
MOT	$9,400,000	+	$0	-	($5,700,000)	=	$3,700,000
Sub Total – 3 Bridges	$74,300,000	+	$15,100,000	+	$11,900,000	=	$101,300,000
Chestnut 056B00192N	$10,500,000	+	$900,000	+	$2,500,000	=	$13,900,000
Grand Total – 4 Bridges	$84,800,000	+	$16,000,000	+	$14,400,000	=	$115,200,000

Note 1: The dollars shown in these columns are an addition (or deduction) to the Lower Range (Base) amount. For example, the MOT cost for "Match Existing Footprint" is the same as the "Lower Range (Base)", so $0 is show in that column, whereas, for ABC, there is a savings in $5,700,000 in MOT cost from the "Lower Range (Base)".

3.4. Discussion: Excluding the fourth bridge and with a focus on the primary three included in KYTC 5-20061, cost opinions to replace all three bridges range from $74 million to $102 million. The lower cost option is based on minimizing bridge footprints, utilizing conventional construction techniques, and a disruptive and long-term MOT plan. The highest cost option, assumes similar bridge footprints, preserving parking areas and space underneath the structures, utilizing ABC techniques, and implementing a MOT plan that minimizes the traffic impact to the extent practical.

Cost Opinion Recommendation for Programming Funding: Based on discussions with KYTC, the consensus was to use $100 million as a planning cost for funding requests and/or programming.

4. ABC Strategies

4.1. General: The consultant team reviewed Accelerated Bridge Construction (ABC) strategies and evaluated the potential use of ABC on the reconstruction of these I-65 Bridges. These strategies and applicability to the project were discussed with KYTC.

4.2. Potential ABC Strategies

4.2.1. Prefabricated Bridge Elements

4.2.1.1. Precast footers

4.2.1.2. Precast concrete pier caps and columns

4.2.1.3. Precast concrete deck panels with Ultra High-Performance Concrete joints

4.2.1.4. Precast concrete abutment with cast-in-place concrete backwall

4.2.1.5. Super structure girder slab units

4.2.2. Bridge Movement & Installation Methods (I-65 corridor constraints may not be conducive to these options)

4.2.2.1. Self-Propelled Modular Transporter (SPMT)

4.2.2.2. Bridge Slide

4.2.3. Rapid Embankment & Retaining Wall Construction

4.2.3.1. Lightweight fill for MSE retaining walls

4.2.3.2. Expanded Polystyrene (EPS) Geofoam for MSE retaining wall

4.2.3.3. Ground modification

4.2.3.4. Wick Drains

4.2.3.5. Precast moment slabs for MSE retaining walls/barrier walls

4.2.3.6. Stone Columns

4.2.3.7. Micropiles

4.2.4. Contracts & Bidding

4.2.4.1. Construction Manager / General Contractor (CM/GC)

4.2.4.2. Design-Build

4.2.4.3. Advanced beam procurement

4.2.4.4. Advanced MSE wall procurement

4.2.4.5. A + B (Cost plus Time Bidding)

4.2.4.6. Dis-incentives

4.2.4.7. Lane Rental

5. CM/GC Discussion

5.1. General: During discussions of ABC strategies, KYTC expressed interest in utilizing the Construction Manager / General Contractor (CM/GC) project delivery method. In the CM/GC process, KYTC would hire a contractor during the design phase to provide feedback prior to the start of construction. This contractor will be given the opportunity to provide a non-competitive bid to the owner on the project and carry out negotiations on the price. If all parties are agreeable to the terms, the construction phase with the contractor can begin.

5.2. CM/GC Viability: The consultant team studied CM/GC and had dialogue with an AECOM professional knowledgeable and experienced with CM/GC contracting. We examined the applicability as it pertains to the project and determined that KYTC 5-20061 met the criteria to be a good candidate for CM/GC consideration. The team provided an overview of CM/GC contracting to KYTC.

5.3. CM/GC is recommended when:

5.3.1.1. High levels of project risk need to be mitigated

5.3.1.2. Traditional means and methods may not apply

5.3.1.3. Schedules are challenging

5.3.1.4. Projects are technically complex

5.3.1.5. A high level of construction staging/phasing may be appropriate

5.3.1.6. Input is needed on constructability, means & methods, and non-standard costs

5.3.1.7. Public Involvement is significant

5.4. CM/GC Benefits:

5.4.1. Promotes Innovation

5.4.2. Integrated Design Process

5.4.3. Risk Mitigation

5.4.4. Improved Constructability

5.4.5. Efficient Construction

5.4.6. Staging/Maintenance of Traffic

5.4.7. Expedited Construction

5.4.8. Public Coordination Certainty

5.5. CM/GC Challenges

5.5.1. New Time Frames and Needs

5.5.2. Determination of Cost

5.5.3. New Contracting Method for Cabinet, Design and Construction Industries

5.5.4. Potential pushback from local contracting industry

6. Air-Space Considerations

6.1. Previous Air-Space Investigations: The *I-65 Bridges Study*, dated August 2019, examined bridges along I-65 in Jefferson County between I-264 and the Kennedy Interchange. Information on existing Air-Space Agreements was included in that study's report as *Appendix C: Under-Bridge Parking Agreements*.

6.2. Further Air-Space Investigations: The AECOM/Qk4 team further investigated the areas underneath the bridges related to this Bridge Cost Opinion Report to provide KYTC with additional information to assist in decision making. Details are in provided in Appendix B.

7. Other Considerations

7.1. Additional considerations and decisions may be needed to refine the cost estimates. These considerations are highlighted below:

7.1.1. Closure and construction time – what can KYTC and the community tolerate?

7.1.2. Is bridge rehabilitation a feasible alternate? Could the existing substructure be used?

7.1.3. Will KYTC be agreeable to certain accelerated bridge construction methods, such as rapid setting concrete?

7.1.4. Would KYTC consider reducing or eliminating parking under the bridges? This would require revoking Air-Space Agreements discussed in Section 6.

7.2. Construction cost is only one component of a cost analysis. Additional considerations could include:

7.2.1. User cost

7.2.2. Life cycle cost

7.2.3. Potential loss of toll revenue

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