GROUP, L.L.C.

PROVIDING VALUE ENGINEERING SERVICES

VALUE ENGINEERING STUDY

OF

I-65 Widening from North of Cumberland Interchange to North of Munfordville Interchange

PROJECT ITEM NUMBERS: 3-12.00, 3-13.00, 3-14.00, 4-13.00, 4-14.00

Frankfort, Kentucky

August 23--27, 2010

Final Report December 13, 2010
Prepared by:

VE GROUP, L.L.C.

In Association With:

KENTUCKY TRANSPORTATION CABINET
~DIVISION OF HIGHWAY SAFETY~

15 West King Street ~ Quincy, Florida 32351 ~ P. O. Box 179 ~ Quincy, Florida 32353
Phone: (850) 627-3900 ~ Fax (850) 875-1330 ~ E-*mail: sonja@vegroupllc.com*

VALUE ENGINEERING STUDY

OF

I-65 Widening from North of Cumberland Interchange to North of Munfordville Interchange

ITEM NUMBERS: 3-12.00, 3-13.00, 3-14.00, 4-13.00, 4-14.00

Frankfort, Kentucky
August 23-27, 2010

Final Report December 6, 2010

Prepared by:

VE GROUP, L.L.C.

In Association With:

KENTUCKY TRANSPORTATION CABINET

VE STUDY
TEAM LEADER

William F. Ventry, P.E., C.V.S.
C.V.S. Registration No. 840603(LIFE)

12/16/2010
DATE

TABLE OF CONTENTS

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

INTRODUCTION

This Value Engineering (VE) report summarizes the results of the VE study performed by VE Group, L.L.C., for the Kentucky Transportation Cabinet (KYTC). The study was performed during the week of August 23-27, 2010.

The subject of the study was the widening of I-65 from north of Cumberland Parkway Interchange to north of Munfordville Interchange.

PROJECT DESCRIPTION

The project will widen the existing facility from four lanes to six lanes from MP 43.8 to MP 64.8. Improvements will also be made to the following interchanges including bridge replacements:

- Exit 48 – KY 255 (Park City)
- Exit 53 – KY 70 (Cave City)
- Exit 58 – KY 218 (Horse Cave)
- Exit 65 – US 31W (Munfordville)

In addition, the following other existing bridges will be replaced:

- Green River Bridge
- CSX Railroad (Two Crossings)
- US 31 W Grade Separation
- KY 88 Grade Separation
- KY 2746 Grade Separation

I. EXECUTIVE SUMMARY

METHODOLOGY

The VE Team followed the basic VE procedure for conducting this type of analysis.

This process included the following phases:

1. Investigation
2. Speculation
3. Evaluation
4. Development
5. Presentation
6. Report Preparation

Evaluation criteria identified as a basis for the comparison of alternatives included the following:

- Future Maintenance Cost
- Construction Time
- Construction Cost
- Constructability
- Service Life
- Salvage Value
- Design Requirements
- Construction Impacts to Traffic
- Life Cycle Cost

I. EXECUTIVE SUMMARY

The following areas of focus were analyzed by the VE Team and from these areas the following VE alternatives were developed and are recommended for Implementation:

SUMMARY OF RECOMMENDATIONS

Area of Focus	Description of Recommendation	Const. Cost Savings	Life Cycle Cost (LCC) Savings	VE Team Top Picks
A. Pavement and Base	***VE Alternative 1A:*** Revises the pavement design for the new pavement. Reduce the amount of drainage blanket for the asphalt pavement.	$ 2,799,627	$2,799,627	X
	VE Alternative 1B: Revises the pavement design for the new pavement. Reduce the amount of drainage blanket for the concrete pavement.	$ 1,850,753	$ 1,850,753	
	VE Alternative 1C: Use partial depth shoulders for the asphalt pavement.	$ 2,052,078	$ 2,052,078	X
	VE Alternative 1C: Revise the pavement design for both the asphalt and concrete pavement.	$ 1,985,125	$ 1,985,125	X
B. Earthwork	***VE Alternative 2:*** Eliminate the rock cut throughout the project on the outside based on the latest traffic trends and relocating traffic lanes.	$ 8,945,325	$ 8,945,325	X
C. Green River Bridge	***VE Alternative 3:*** Utilizes the existing steel bridge and constructs a new steel bridge in the median.	$ 2,792,206	$ 803,142	
	VE Alternative 4: Uses a new concrete structure.	$ (720,098) INCREASE	$ 57,007	X

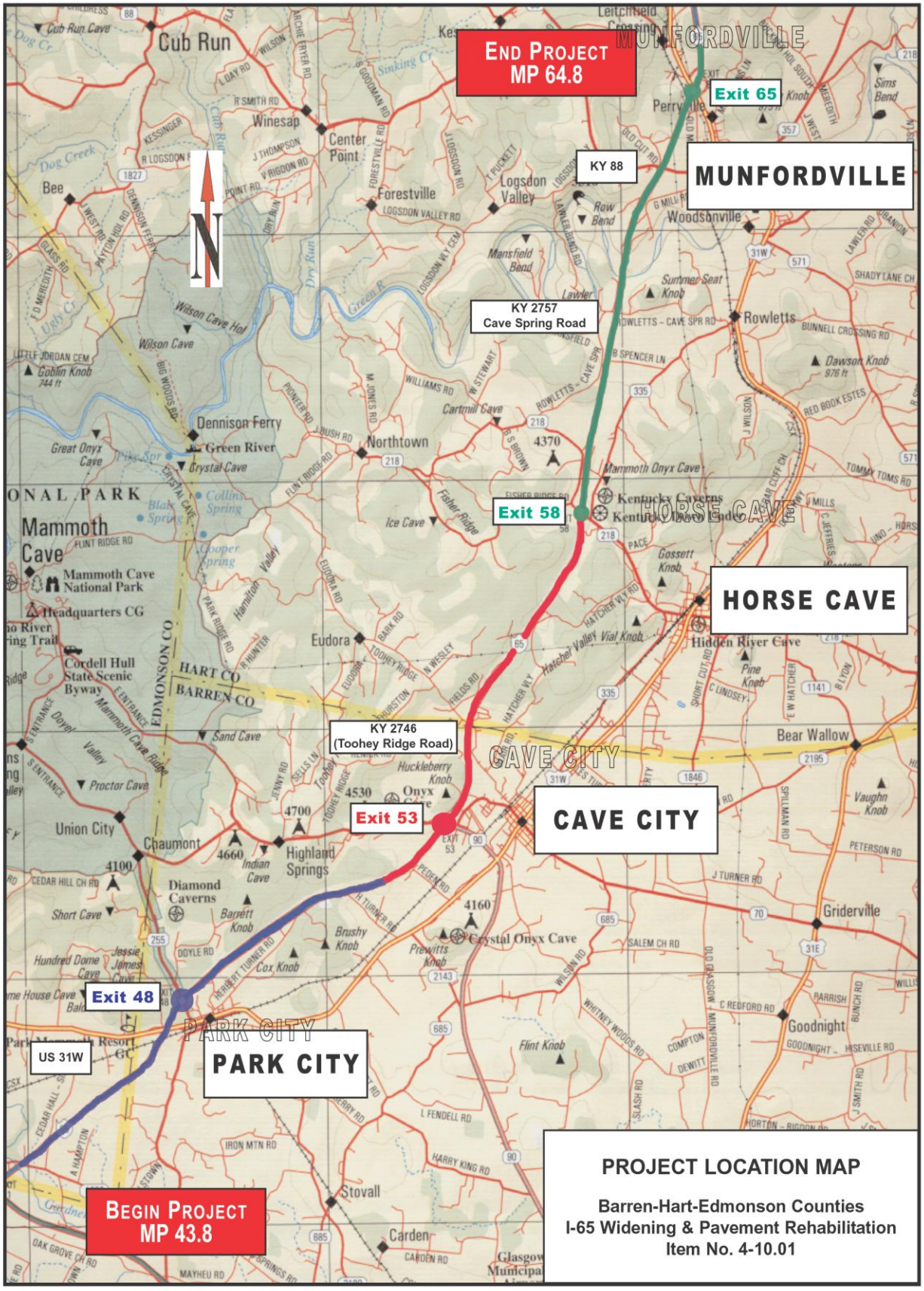
continued

Area of Focus	Description of Recommendation	Const. Cost Savings	Life Cycle Cost (LCC) Savings	VE Team Top Picks
D. US 31 W Interchange	***VE Alternative 5:*** Uses a roundabout at the terminus of the southbound "On" and "Off" ramps.	$ 255,786	$ 255,786	X
	VE Alternative 6: Shortens the bridges by eliminating the end spans and using walls.			
	Option 1: Use Mechanically Stabilized Earth (MSE) Walls.	$ 1,072,070	$ 1,072,070	
	Option 2: Use Modular Block Walls.	$ 1,271,990	$ 1,271,990	X
E. South CSX Railroad Bridge	***VE Alternative 7:*** Shortens the bridges by eliminating the end spans and using walls.			
	Option 1: Use Mechanically Stabilized Earth (MSE) Walls.	$ 1,299,643	$ 1,299,643	
	Option 2: Use Modular Block Walls.	$ 1,715,377	$ 1,715,377	X
F. US 31 W Grade Separation Bridge	***VE Alternative 8:*** Shortens the bridges by eliminating the end spans and using walls.			
	Option 1: Use Mechanically Stabilized Earth (MSE) Walls.	$ 647,847	$ 647,847	
	Option 2: Use Modular Block Walls.	$ 861,162	$ 861,162	X
G. KY 218 Interchange	***VE Alternative 9:*** Uses a diamond interchange with roundabouts.			
	Option 1: Use the same bridge length as the Original Design bridge.	$ 675,742	$ 675,742	
	Option 2: Shorten the bridge length.	$ 1,173,537	$ 1,173,537	X
	VE Alternative 10: Shortens the bridges by eliminating the end spans and using walls.			
	Option 1: Use Mechanically Stabilized Earth (MSE) Walls.	$ 454,181	$ 454,181	
	Option 2: Use Modular Block Walls.	$ 568,135	$ 568,135	

continued

Area of Focus	Description of Recommendation	Const. Cost Savings	Life Cycle Cost (LCC) Savings	VE Team Top Picks
H. KY 88 Grade Separation Bridge	***VE Alternative 11:*** Utilizes the existing bridge by jacking and widening the bridge to obtain vertical clearance.	$ 646,710	$ 343,032	X
I. KY 255 Interchange Bridge	***VE Alternative 12:*** Shortens the bridges by eliminating the end spans and using walls.			
	Option 1: Use Mechanically Stabilized Earth (MSE) Walls.	$ 222,661	$ 222,661	
	Option 2: Use Modular Block Walls.	$ 475,560	$ 475,560	X
J. KY 70/KY 90 Interchange	***VE Alternative 13:*** Uses a diverging diamond interchange design.			
	Option 1: Use the Original Design bridge length.	$ 690,339	$ 690,339	
	Option 2: Shorten the bridge length.	$ 1,286,875	$ 1,286,875	X
	VE Alternative 14: Shortens the bridges by eliminating the end spans and using walls.			
	Option 1: Use Mechanically Stabilized Earth (MSE) Walls.	$ 708,676	$ 708,676	
	Option 2: Use Modular Block Walls.	$ 822,631	$ 822,631	
	VE Alternative 15: Revises the proposed typical section KY 70/KY 90.	$ 162,877	$ 162,877	X
K. KY 2746 Grade Separation Bridge	***VE Alternative 16:*** Shortens the bridges by eliminating the end spans and using walls.			
	Option 1: Use Mechanically Stabilized Earth (MSE) Walls.	$ 80,580	$ 80,580	
	Option 2: Use Modular Block Walls.	$ 309,586	$ 309,586	X
Summary/combination of VE Team selected Alternatives		**$23,221,517**	**$23,694,944**	

II. LOCATION OF PROJECT



III. TEAM MEMBERS AND PROJECT DESCRIPTION

TEAM MEMBERS

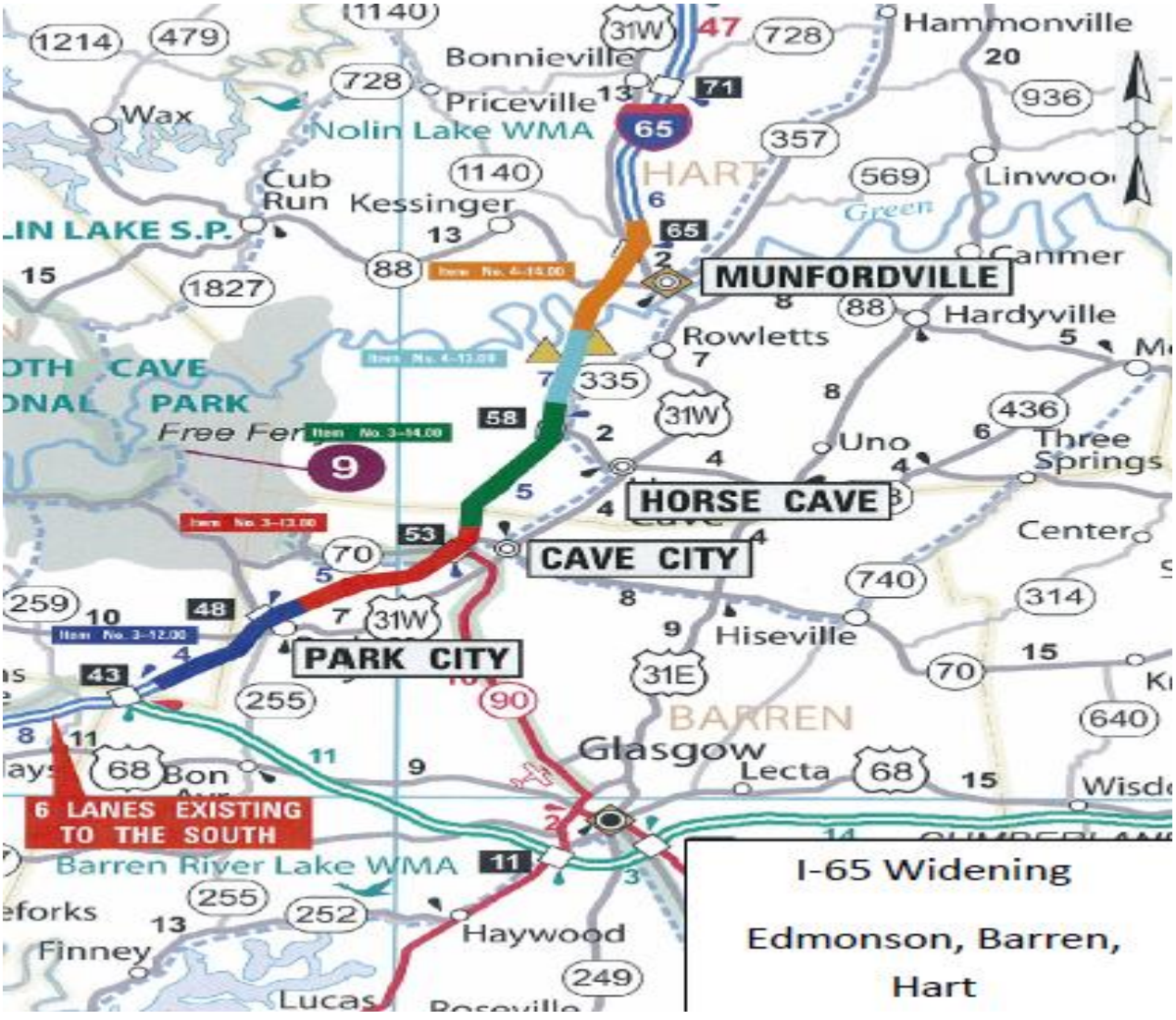
NAME	AFFILIATION	EXPERTISE	PHONE
William F. Ventry, P.E., C.V.S.~Life	VE Group, L.L.C.	Team Leader	850/627-3900 bill@vegroupllc.com
Tom Hartley, P.E., C.V.S.	VE Group, L.L.C.	Roadway, Interchanges, CADD	850/627-3900 tom@vegroupllc.com
Duncan Silver, P.E.,L.S.	VE Group, L.L.C.	Pavement Design, Interchanges, Traffic	850/627-3900 silver@ditell.com
Rodney Little, P.E.	KYTC	Construction	606/387-7705 502/229-7688
Brent Sweger, P.E.	KYTC	Traffic, Planning, VE	502/564-3280 brent.sweger@ky.gov
J C Pyles, P.E.	KYTC	Structural Design	502/564-4560 jcpyles@ky.gov
Vicki Boldrick, P.E.	KYTC	Roadway Design	502/564-3280 Vicki.boldrick@ky.gov
Donald Smith, P.E.	KYTC	Construction, Traffic	502/564-4556 donald.smith@ky.gov

III. TEAM MEMBERS AND PROJECT DESCRIPTION

PROJECT DESCRIPTION

The I-65 widening and rehabilitation project is divided into five separate sections. The limits of the project for each of the itemized sections are summarized in the table and map below:

Item #	Begin MP	End MP	Length
3-12.00	43.8	48.3	4.5
3-13.00	48.3	52.8	4.5
3-14.00	52.8	58.1	5.3
4-13.00	58.1	61.2	3.1
4-14.00	61.2	64.8	3.6
Total	43.8	64.8	21.0



III. TEAM MEMBERS AND PROJECT DESCRIPTION

PROJECT DESCRIPTION

The project will widen the existing facility from four lanes to six lanes from MP 43.8 to MP 64.8. Improvements will also be made to the following interchanges including bridge replacements:

- Exit 48 – KY 255 (Park City)
- Exit 53 – KY 70 (Cave City)
- Exit 58 – KY 218 (Horse Cave)
- Exit 65 – US 31W (Munfordville)

In addition, the following other existing bridges will be replaced:

- Green River Bridge
- CSX Railroad (Two Crossings)
- US 31 W Grade Separation
- KY 88 Grade Separation
- KY 2746 Grade Separation

IV. INVESTIGATION PHASE

VE STUDY BRIEFING
I-65 WIDENING FROM NORTH OF CUMBERLAND PARKWAY INTERCHANGE TO NORTH OF MUNFORDVILLE INTERCHANGE
August 23, 2010

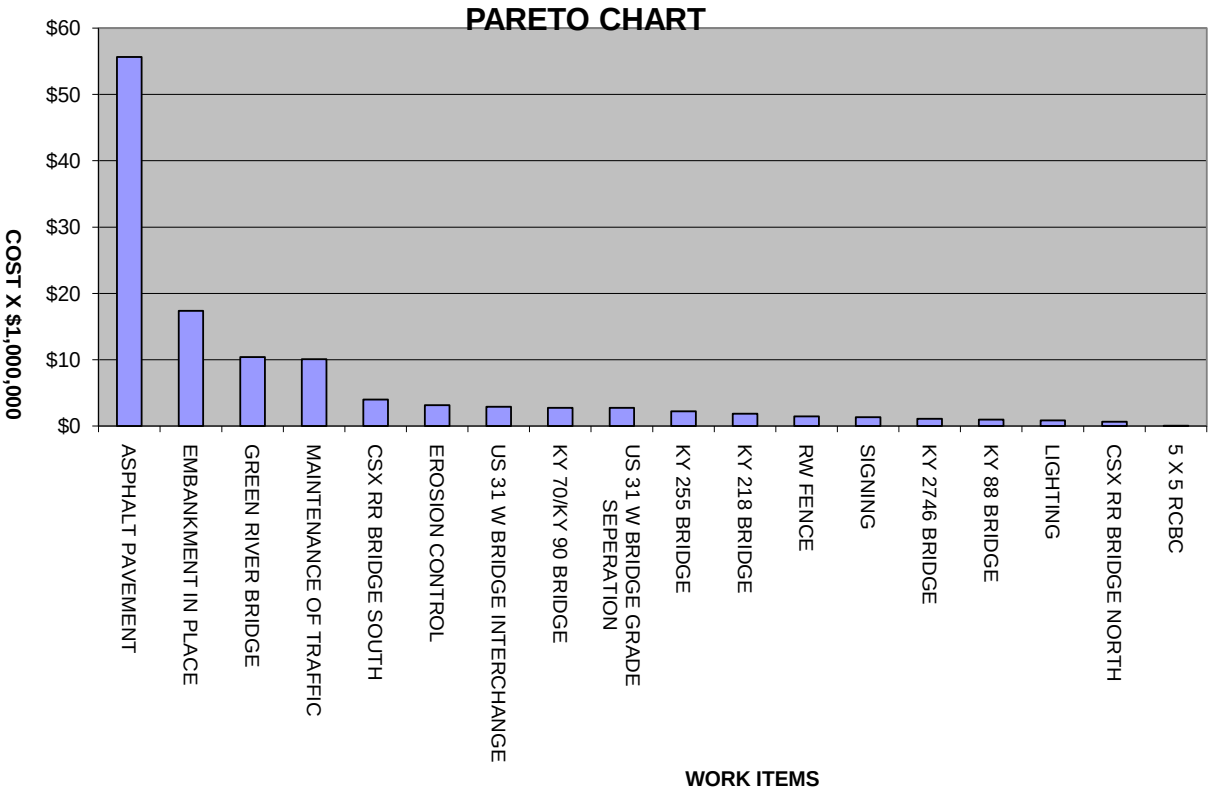
NAME	AFFILIATION	PHONE
Taylor Kelly	QK4	502/229-2226
Bill Ventry	VE Group, L.L.C.	850/627-3900
Tom Hartley	VE Group, L.L.C.	850/627-3900
Duncan Silver	VE Group, L.L.C.	850/627-3900
Rodney Little	KYTC	606/678-4016
Brent Sweger	KYTC	502/564-3280
J C Pyles	KYTC	502/564-4560
Vicki Boldrick	KYTC	502/564-3280
Donald Smith	KYTC	502/564-4556

STUDY RESOURCES
I-65 WIDENING FROM NORTH OF CUMBERLAND PARKWAY INTERCHANGE TO NORTH OF MUNFORDVILLE INTERCHANGE
August 23, 2010

NAME	AFFILIATION	PHONE
Leo Frank	KYTC, Pavement	502/564-3280
Andre Johanes	KYTC, Design	502/564-3280
Bob Farley	KYTC, Design	502/564-3280
Taylor Perkins	Entran	659/233-2100

IV. INVESTIGATION PHASE

PARETO CHART WORKSHEET



FUNCTIONAL ANALYSIS WORKSHEET
I-65 WIDENING FROM NORTH OF CUMBERLAND PARKWAY INTERCHANGE TO NORTH OF MUNFORDVILLE INTERCHANGE

August 23-27, 2010

ITEM	FUNCT. VERB	FUNCT. NOUN	* TYPE	COST	WORTH	VALUE INDEX
Pavement and Base	Support Improve	Vehicles Capacity	B S	$56,000,000	$46,000,000	1.22
Earthwork	Establish	Grades	B	$17,000,000	$13,000,000	1.31
Maintenance of Traffic	Maintain	Traffic	B	$10,000,000	$10,000,000	1.00
Temporary Erosion Control	Control	Erosion	B	$3,200,000	$3,200,000	1.00
Green River Bridge	Span	Green River	B	$18,500,000	$16,600,000	1.11
US 31 W Interchange Bridge	Span	US 31 W	B	$2,300,000	$1,600,000	1.44
South CSX RR Bridge	Span	Railroad	B	$2,200,000	$1,500,000	1.43
US 31 W Grade Separation Bridge	Span	US 31 W	B	$1,900,000	$,300,000	1.46
KY 218 Interchange Bridge	Span	I-65	B	$1,700,000	$1,200,000	1.41
KY 88 Grade Separation Bridge	Span	I-65	B	$1,200,000	$600,000	2.00
KY 255 Interchange Bridge	Span	KY 255	B	$2,200,000	$1,500,000	1.46
KY 70/KY 90 Interchange Bridge	Span	I-65	B	$2,300,000	$1,600,000	1.38
KY 2746 Grade Separation Bridge	Span	I-65	B	$1,000,000	$700,000	1.40
North CSX RR Bridge	Span	Railroad	B	$750,000	$750,000	1.00
R/W Fence	Protect	R/W	S	$1,500,000	$1,500,000	1.00
Signing	Inform	Motorist	B	$1400,000	$1,400,000	1.00
5’ x 5’ Box Culvert	Convey	Water	B	$20,000	$20,000	1.00

***B – Basic S – Secondary**

** Note: This worksheet is a tool of the VE process and is only used for determining the areas that the VE Team should focus on for possible alternatives. The column for COST indicates the approximate amount of the cost as shown in the cost estimate. The column for WORTH is an estimated cost for the lowest possible alternative that would provide the FUNCTION shown. Many times the lowest cost alternatives are not considered implementable but are used only to establish a worth for a function. A value index greater than 1.00 indicates the VE Team intends to focus on this area of the project.

IV. INVESTIGATION PHASE

The following areas have a value index greater than 1.00 on the preceding Functional Analysis Worksheet and therefore have been identified by the VE Team as areas of focus and investigation for the VE process:

A. PAVEMENT AND BASE

B. EARTHWORK (ROCK CUT)

C. GREEN RIVER BRIDGE

D. US 31 W INTERCHANGE

E. SOUTH CSX RAILROAD BRIDGE

F. US 31 W GRADE SEPARATION BRIDGE

G. KY 218 INTERCHANGE

H. KY 88 GRADE SEPARATION BRIDGE

I. KY 255 INTERCHANGE BRIDGE

J. KY 70/KY 90 INTERCHANGE

K. KY 2746 GRADE SEPARATION BRIDGE

V. SPECULATION PHASE

Ideas generated, utilizing the brainstorming method, for performing the functions of previously identified areas of focus.

A. PAVEMENT AND BASE

- Revise the pavement design for the new pavement
- Revise the pavement design for the rehabilitation of the existing pavement

B. EARTHWORK (ROCK CUT)

- Use the KYTC District Three method for rock cut, do everything based on an ultimate 4-lane cross section
- Use the KYTC District Four method for rock cut, do only those sections that do not meet minimal clear zone requirements
- No rock cut and use protection for areas that fall within the clear zone
- Reduce or eliminate rock cut throughout the project based on the latest traffic trends and using a consistent approach

C. GREEN RIVER BRIDGE

- Use a concrete structure
- Use concrete on the end spans and steel on the center span
- Widen the existing bridge

D. US 31 W INTERCHANGE

- Use a typical diamond interchange design
- Use a diverging diamond interchange design
- Use the Original Design Interchange design but shorten the bridges using vertical walls to eliminate the end spans

E. SOUTH CSX RAILROAD BRIDGE

- Shorten the bridges using walls to eliminate the end spans
- Use MSE Walls
- Use Modular Block Walls

V. SPECULATION PHASE

F. US 31 W GRADE SEPARATION BRIDGE

- Shorten the bridges using walls to eliminate the end spans
- Use MSE Walls
- Use Modular Block Walls

G. KY 218 INTERCHANGE

- Use a diverging diamond interchange design
- Use a diamond interchange with roundabouts
- Use the Original Design interchange design but shorten the bridges using vertical walls to eliminate the end spans

H. KY 88 GRADE SEPARATION BRIDGE

- Utilize the existing bridge by jacking the bridge up to obtain vertical clearance
- Shorten the bridges using walls to eliminate the end spans
- Use MSE Walls
- Use Modular Block Walls

I. KY 255 INTERCHANGE BRIDGE

- Shorten the bridges using walls to eliminate the end spans
- Use MSE Walls
- Use Modular Block Walls

J. KY 70/KY 90 INTERCHANGE

- Use a diverging diamond interchange design
- Use the Original Design interchange design but shorten the bridges using vertical walls to eliminate the end spans

K. KY 2746 GRADE SEPARATION BRIDGE

- Shorten the bridges using walls to eliminate the end spans
- Use MSE Walls
- Use Modular Block Walls

VI. EVALUATION PHASE

• ALTERNATIVES

The following alternatives were formulated during the "eliminate and combine" portion of the Evaluation Phase.

A. PAVEMENT AND BASE

VE Alternative 1A: Revise the pavement design for the new pavement, Reduce the amount of drainage blanket for both the asphalt and concrete pavement.

VE Alternative 1B: Use partial depth shoulders for the asphalt pavement.

VE Alternative 1C: Revise the pavement design for both the asphalt and concrete pavement.

B. EARTHWORK (ROCK CUT)

VE Alternative 2: Reduce or eliminate rock cut throughout the project based on the latest traffic trends and consistency by using one of the following:

Option 1: Use the KYTC District Three method for rock cut.

Option 2: Use the KYTC District Four method for rock cut.

Option3: Reduce rock cuts except for areas that fall within the clear zone.

C. GREEN RIVER BRIDGE

VE Alternative 3: Utilize the existing bridge and construct a new bridge in the median.

VE Alternative 4: Use a concrete structure.

D. US 31 W INTERCHANGE

VE Alternative 5: Use a roundabout at the terminus of the southbound "On and Off" ramps.

VE Alternative 6: Use the Original Design interchange design but shorten the bridges using vertical walls to eliminate the end spans.

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

VI. EVALUATION PHASE

- **ALTERNATIVES** *(continued)*

E. SOUTH CSX RAILROAD BRIDGE

VE Alternative 7: Shorten the bridges by eliminating the end spans and using walls by one of the following:

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

F. US 31 W GRADE SEPARATION BRIDGE

VE Alternative 8: Shorten the bridges by eliminating the end spans and using walls by one of the following:

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

G. KY 218 INTERCHANGE

VE Alternative 9: Use a diamond interchange with roundabouts.

Option 1: Use the Original Design bridge length.

Option 2: Shorten the bridge length.

VE Alternative 10: Use the Original Design interchange design but shorten the bridges using vertical walls to eliminate the end spans.

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

H. KY 88 GRADE SEPARATION BRIDGE

VE Alternative 11: Utilize the existing bridge by widening and jacking the bridge up to obtain vertical clearance.

I. KY 255 INTERCHANGE BRIDGE

VE Alternative 12: Shorten the bridges by eliminating the end spans and using walls by one of the following:

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

VI. EVALUATION PHASE

- **ALTERNATIVES** *(continued)*

J. KY 70/KY 90 INTERCHANGE

VE Alternative 13: Use a diverging diamond interchange design.

Option 1: Use the Original Design bridge length.

Option 2: Shorten the bridge length.

VE Alternative 14: Use the Original Design interchange design but shorten the bridges using vertical walls to eliminate the end spans by one of the following:

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

VE Alternative 15: Revise the proposed typical section KY 70/KY 90.

K. KY 2746 GRADE SEPARATION BRIDGE

VE Alternative 16: Shorten the bridges by eliminating the end spans and using walls by one of the following:

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

VI. EVALUATION PHASE

- **ADVANTAGES AND DISADVANTAGES**

The following Advantages and Disadvantages were developed for the VE Alternatives previously generated during the speculation phase. It also includes the Advantages and Disadvantages for the Original Design. The team then decided whether to carry each alternative forward for further evaluation in the Development Phase.

A. PAVEMENT AND BASE

Original Design : Asphalt Design - 8" cement modified subbase, 6" dense graded aggregate base, 10" drainage blanket, 12 ½" asphalt base and 1 1/2" wearing surface. Concrete Design - 8" cement modified subbase, 6" dense graded aggregate base, 12 ½"" drainage blanket, 12" Portland cement concrete pavement.

Advantages

- Meets structural requirements
- Alternate bids should give a low price
- Provide for drainage of pavement

Disadvantages

- May use more drainage than required
- Cost of full depth pavement under shoulders

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 1: Revise the pavement design for the new pavement.

Option 1: Reduce the amount of drainage blanket for both the asphalt and concrete pavement.

Option 2: Use partial depth shoulders for the asphalt pavement.

Option 3: Revise the pavement design for both the asphalt and concrete pavement.

Advantages

- May use less drainage blanket
- Latest traffic trends may reduce thickness under shoulders
- May reduce overall thickness of pavement

Disadvantages

- None apparent

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

B. EARTHWORK (ROCK CUT)

Original Design: **Different amounts for different districts based on previous projected traffic.**

Advantages

- May be more economical to do future work now
- Doing all at one time would be less disruptive to traffic

Disadvantages

- May have high material costs
- Longer construction time
- May have more disruption to traffic
- More environmental issues

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 2: Reduce or eliminate rock cut throughout the project based on the latest traffic trends and consistency by using one of the following:

Option 1: Use the KYTC District Three method for rock cut.

Option 2: Use the KYTC District Four method for rock cut.

Option 3: Reduce the rock cuts except for areas that fall within the clear zone.

Advantages

- Lower construction cost
- Less impact to utilities
- Less environmental issues
- Less construction time
- Less traffic disruption

Disadvantages

- None apparent

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

C. GREEN RIVER BRIDGE

Original Design : **Replace the existing bridge with a new steel bridge.**

Advantages

- Consistent bridge type
- Long service life

Disadvantages

- Higher construction cost
- Higher future maintenance of steel structure

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 3: ***Utilize the existing bridge and construct a new bridge in the median.***

Advantages

- Lower construction cost
- Lower life cycle cost
- Utilizes the remaining life of the existing structure

Disadvantages

- Not as long service life on the remaining existing portion

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 4: Use a concrete structure.

Advantages

- May have lower construction cost than steel
- Less future maintenance than steel
- Long service life

Disadvantages

- Uses special beams

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

D. US 31 W INTERCHANGE

Original Design: **Half cloverleaf with improvements.**

Advantages

- Improves existing interchange
- Somewhat better separation from driveway and ramp terminus

Disadvantages

- Higher risk of wrong way movements

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 5: Use a roundabout at the terminus of the southbound "On" and "Off" ramps.

Advantages

- Better traffic operations
- Improves access management

Disadvantages

- Higher construction cost

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 6: Use the Original Design interchange design but shorten the bridges using vertical walls to eliminating the end spans.

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

Advantages

- Lower construction cost
- Lower future bridge maintenance because less bridge area
- May have easier construction
- May have less construction time

Disadvantages

- Not typical KYTC design

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

E. SOUTH CSX RAILROAD BRIDGE

Original Design: **Multiple spans with spill through abutments.**

Advantages

- Typical KYTC design

Disadvantages

- Higher construction cost
- Higher future maintenance because more bridge area

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 7: Shorten the bridges by eliminating the end spans and using walls by one of the following:

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

Advantages

- Lower construction cost
- Lower future bridge maintenance because less bridge area
- May have easier construction
- May have less construction time

Disadvantages

- Not typical KYTC design

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

- **ADVANTAGES AND DISADVANTAGES** *(continued)*

F. US 31 W GRADE SEPARATION BRIDGE

Original Design: **Multiple spans with spill through abutments.**

Advantages

- Typical KYTC design

Disadvantages

- Higher construction cost
- Higher future maintenance because more bridge area

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 8: Shorten the bridges by eliminating the end spans and using walls by one of the following:

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

Advantages

- Lower construction cost
- Lower future bridge maintenance because less bridge area
- May have easier construction
- May have less construction time

Disadvantages

- Not typical KYTC design

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT .

- **ADVANTAGES AND DISADVANTAGES** *(continued)*

G. KY 218 INTERCHANGE

Original Design: **Typical diamond with turn lanes.**

Advantages

- Typical design

Disadvantages

- Higher construction cost

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 9: Use a diamond interchange with roundabouts.

Option 1: Use the Original Design bridge length.

Option 2: Shorten the bridge length.

Advantages

- Better traffic operations
- Less conflict points
- Less bridge required
- Less construction cost

Disadvantages

- Driver expectation

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

- **ADVANTAGES AND DISADVANTAGES** *(continued)*

G. KY 218 INTERCHANGE

VE Alternative 10: Use the Original Design interchange design but shorten the bridges using vertical walls to eliminating the end spans.

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

Advantages

- Lower construction cost
- Lower future bridge maintenance because less bridge area
- May have easier construction
- May have less construction time

Disadvantages

- Not typical KYTC design

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

H. KY 88 GRADE SEPARATION BRIDGE

Original Design: **Replace the existing bridge with a new structure.**

Advantages

- Typical KYTC design
- Long service life
- Could meet horizontal and vertical clearances

Disadvantages

- Higher construction cost
- Higher future maintenance because more bridge area

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 11: Utilize the existing bridge by widening and jacking the bridge up to obtain vertical clearance.

Advantages

- Lower construction cost
- May have easier construction
- May have less construction time

Disadvantages

- Existing portion would have lower service life

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

I. KY 255 INTERCHANGE BRIDGE

Original Design: **Multiple span bridge with spill through abutments.**

Advantages

- Typical KYTC design

Disadvantages

- Higher construction cost
- Higher future maintenance because more bridge area

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 12: Shorten the bridges by eliminating the end spans and using walls by one of the following:

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

Advantages

- Lower construction cost
- Lower future bridge maintenance because less bridge area
- May have easier construction
- May have less construction time

Disadvantages

- Not typical KYTC design

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

J. KY 70/KY 90 INTERCHANGE

Original Design : **Typical diamond with turn lanes.**

Advantages

- Typical KYTC design

Disadvantages

- Higher construction cost

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 13: Use a diverging diamond interchange design.

Option 1: Use the Original Design bridge length.

Option 2: Shorten the bridge length.

Advantages

- Reduced conflict points
- Less traffic delays
- Less bridge cost

Disadvantages

- Driver expectation

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

J. KY 70/KY 90 INTERCHANGE

VE Alternative 14: Use the Original Design interchange design but shorten the bridges using vertical walls to eliminating the end spans.

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

Advantages

- Lower construction cost
- Lower future bridge maintenance because less bridge area
- May have easier construction
- May have less construction time

Disadvantages

- Not typical KYTC design

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 15: Revise the proposed typical section for KY 70/KY 90.

Advantages

- Lower construction cost
- Meets the traffic requirement for the facility

Disadvantages

- None apparent

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

K. KY 2746 GRADE SEPARATION BRIDGE

Original Design : **Multiple span bridge with spill through abutments.**

Advantages

- Typical KYTC design

Disadvantages

- Higher construction cost
- Higher future maintenance because more bridge area

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VE Alternative 16: Shorten the bridges by eliminating the end spans and using walls by one of the following:

Option 1: Use MSE Walls.

Option 2: Use Modular Block Walls.

Advantages

- Lower construction cost
- Lower future bridge maintenance because less bridge area
- May have easier construction
- May have less construction time

Disadvantages

- Not typical KYTC design

Conclusion

CARRY FORWARD FOR FURTHER EVALUATION AND DEVELOPMENT.

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE

- **ORIGINAL DESIGN**
- ***VE Alternative 1: Revise the pavement design for the new pavement.***

  Option 1: Reduce the amount of drainage blanket for both the asphalt and concrete pavement.

  Option 2: Use partial depth shoulders for the asphalt pavement.

  Option 3: Revise the pavement design for both the asphalt and concrete pavement.

B. EARTHWORK (ROCK CUT)

- **ORIGINAL DESIGN**
- ***VE Alternative 2: Reduce or eliminate rock cut throughout the project based on the latest traffic trends and consistency by using one of the following:***

  Option 1: Use the KYTC District Three method for rock cut.

  Option 2: Use the KYTC District Four method for rock cut.

  Option 3: Reduce the rock cuts except for areas that fall within the clear zone.

C. GREEN RIVER BRIDGE

- **ORIGINAL DESIGN**
- ***VE Alternative 3: Utilize the existing bridge and construct a new bridge in the median.***
- ***VE Alternative 4: Use a concrete structure.***

VII. DEVELOPMENT PHASE

D. US 31 W INTERCHANGE

- **ORIGINAL DESIGN**

- ***VE Alternative 5: Use a roundabout at the terminus of the southbound "On" and "Off" ramps.***
- ***VE Alternative 6: Use the Original Design interchange design but shorten the bridges using walls to eliminating the end spans.***

  Option 1: Use MSE Walls.

  Option 2: Use Modular Block Walls.

E. SOUTH CSX RAILROAD BRIDGE

- **ORIGINAL DESIGN**

- ***VE Alternative 7: Shorten the bridges by eliminating the end spans and using walls by one of the following:***

  Option 1: Use MSE Walls.

  Option 2: Use Modular Block Walls.

F. US 31 W GRADE SEPARATION BRIDGE

- **ORIGINAL DESIGN**

- ***VE Alternative 8: Shorten the bridges by eliminating the end spans and using walls by one of the following:***

  Option 1: Use MSE Walls.

  Option 2: Use Modular Block Walls.

VII. DEVELOPMENT PHASE

G. KY 218 INTERCHANGE

- **ORIGINAL DESIGN**

- ***VE Alternative 9: Use a diamond interchange with roundabouts.***

  Option 1: Use the Original Design bridge length.

  Option 2: Shorten the bridge length.

- ***VE Alternative 10: Use the Original Design interchange design but shorten the bridges using walls to eliminating the end spans.***

  Option 1: Use MSE Walls.

  Option 2: Use Modular Block Walls.

H. KY 88 GRADE SEPARATION BRIDGE

- **ORIGINAL DESIGN**

- ***VE Alternative 11: Utilize the existing bridge by widening and jacking bridge up to obtain vertical clearance.***

I. KY 255 INTERCHANGE BRIDGE

- **ORIGINAL DESIGN**

- ***VE Alternative 12: Shorten the bridges by eliminating the end spans and using walls by one of the following:***

  Option 1: Use MSE Walls.

  Option 2: Use Modular Block Walls.

VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE

- **ORIGINAL DESIGN**

- ***VE Alternative 13: Use a diverging diamond interchange design.***

  Option 1: Use the Original Design bridge length.

  Option 2: Shorten the bridge length.

- ***VE Alternative 14: Use the Original Design interchange design but shorten the bridges using walls to eliminating the end spans.***

  Option 1: Use MSE Walls.

  Option 2: Use Modular Block Walls.

- ***VE Alternative 15: Revise the proposed typical section for KY 70/KY 90.***

K. KY 2746 GRADE SEPARATION BRIDGE

- **ORIGINAL DESIGN**

- ***VE Alternative 16: Shorten the bridges by eliminating the end spans and using walls by one of the following:***

  Option 1: Use MSE Walls.

  Option 2: Use Modular Block Walls.

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE(ASPHALT AND CONCRETE)

Original Design

Asphalt Typical Sections:

The Original Design typical section and pavement details for the median pavement construction using the asphalt alternate requires a minimum 10" layer of asphalt treated drainage blanket (ATDB) for the entire width of the new pavement. The other components of the pavement structure in the median includes: 8" of cement-modified roadbed, 6" of Dense Graded Aggregate base (DGA), 12.5" of asphalt base (AB), and 1.5" of asphalt surface (AS). At the location of the joint between the existing pavement and new full-depth pavement, the bottom of the proposed drainage layer is located at approximately the same location as the bottom of the existing concrete (broke & seated) pavement. This layer is sloped toward the centerline and will provide drainage for a portion of the existing pavement along with the entire new median pavement.

Concrete Typical Sections:

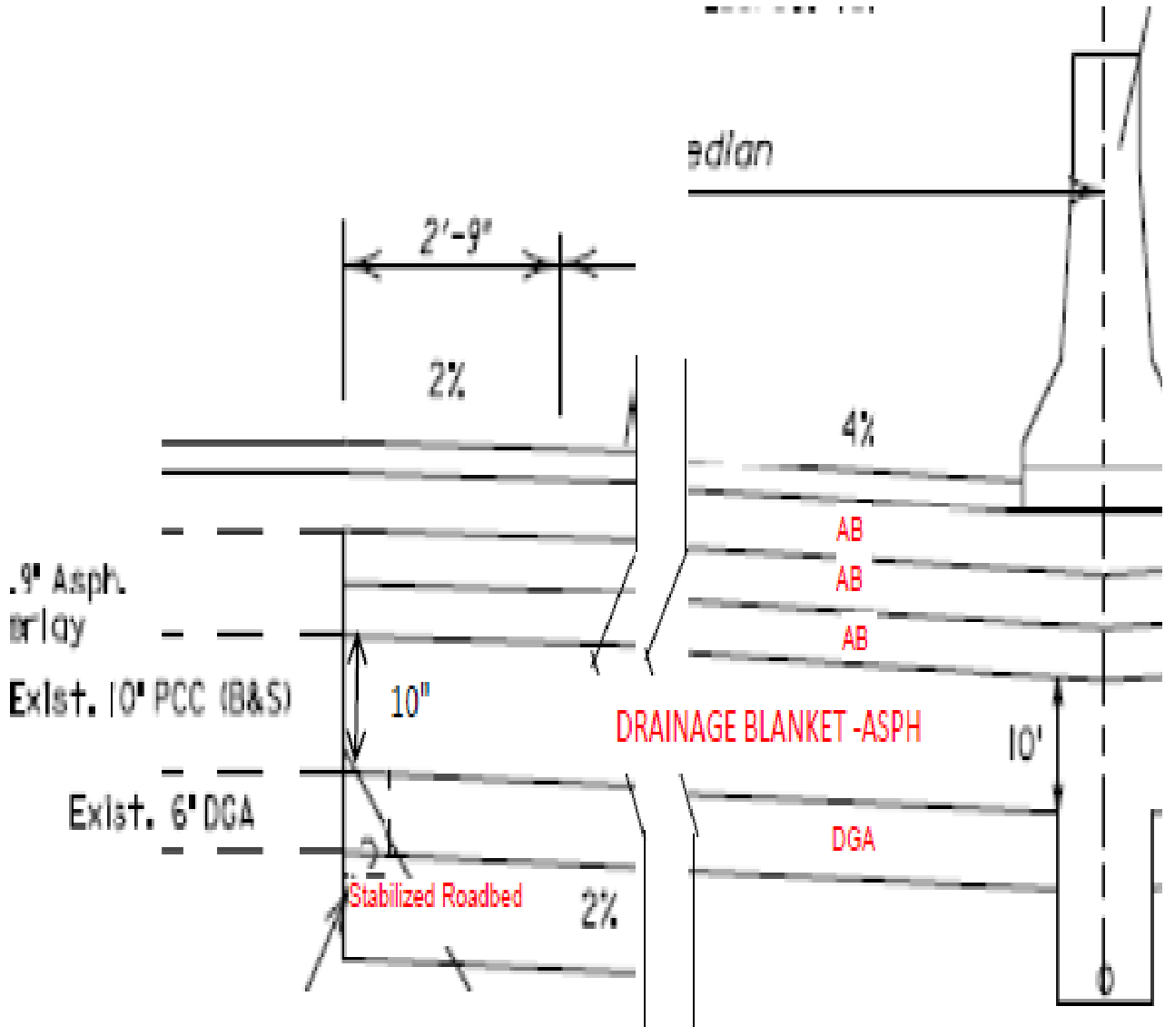
The Original Design typical section and pavement details for the median pavement construction using the concrete alternate requires a minimum 11" layer of cement treated drainage blanket for the entire width of new pavement. The other components of the pavement structure in the median includes: 8" of cement-modified roadbed, 6" of DGA, and 12" of Jointed Plain Concrete (JPC) Pavement. At the location of the joint between the existing pavement and the new full-depth pavement, the drainage layer is 12.5" thick with the bottom of proposed drainage layer located at approximately the same location as the bottom of the existing concrete (broke & seated) pavement. This layer is sloped toward the centerline and will provide drainage for a portion of the existing pavement along with the entire new median pavement.

(Note: Information obtained from Item Number 3-12.00 plan set. The VE Team is assuming the other 4 projects will have similar design.)

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE(ASPHALT AND CONCRETE)

Original Design

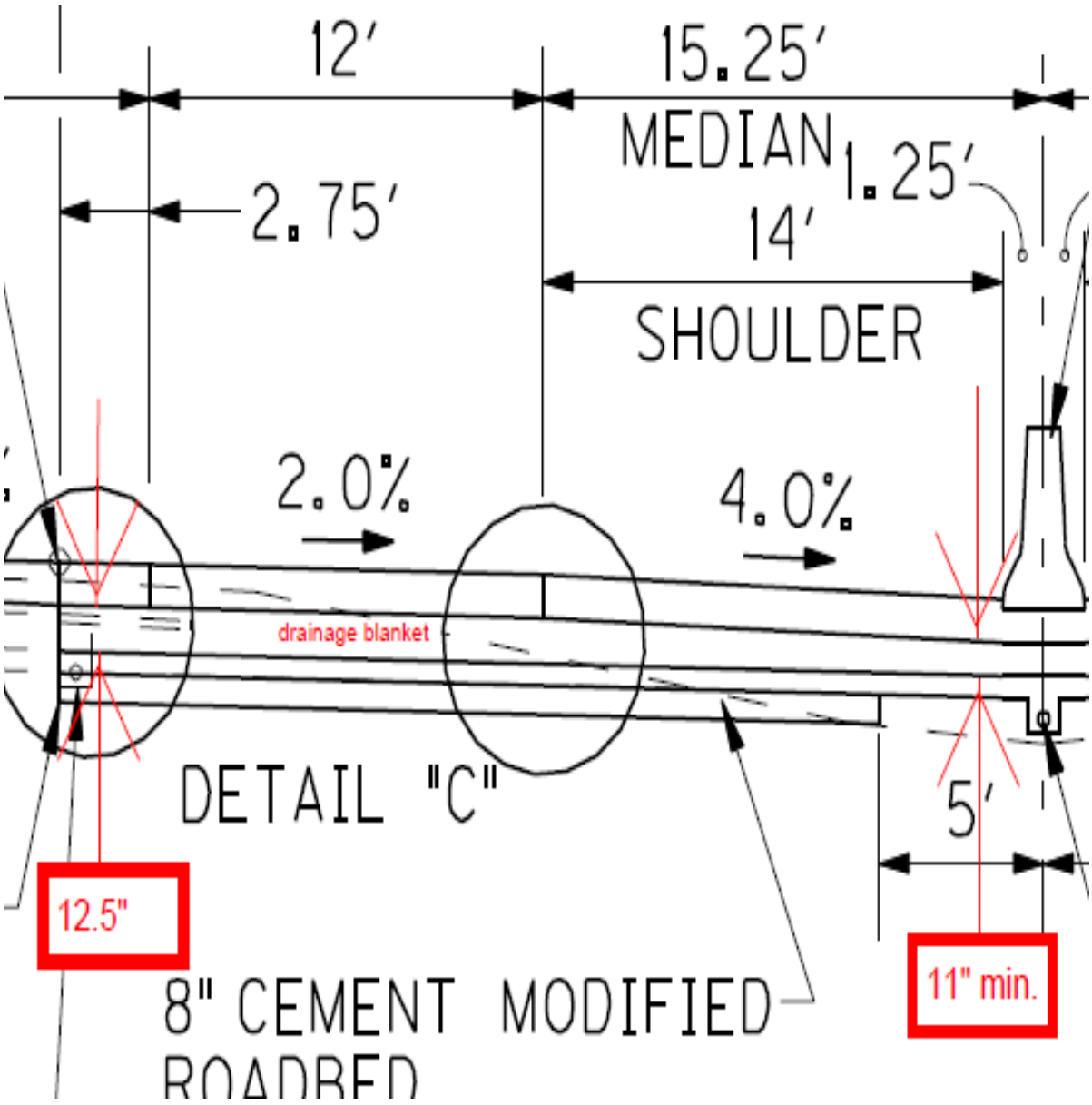


ORIGINAL DESIGN (Asphalt Alternate) from Item Number 3-12.00

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE(ASPHALT AND CONCRETE)

Original Design



ORIGINAL DESIGN Typical Section (Concrete Alternate) from Item Number 3-12.00

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE(ASPHALT AND CONCRETE)

VE Alternative 1A

Asphalt Typical Section:

The VE Team recommends revising the typical section by tapering the thickness of the asphalt treated drainage blanket in the median sections down to a minimum of 6" instead of 10" at centerline. The drainage layer will remain at 10" at the tie-in to existing roadway in order to maintain the drainage of the existing pavement. All other pavement layers will remain the same, with the decrease in drainage blanket layer being made by revising the sub-grade slope. This will result in an approximate 2" average decrease of the drainage layer thickness for the width of median pavement.

Concrete Typical Section:

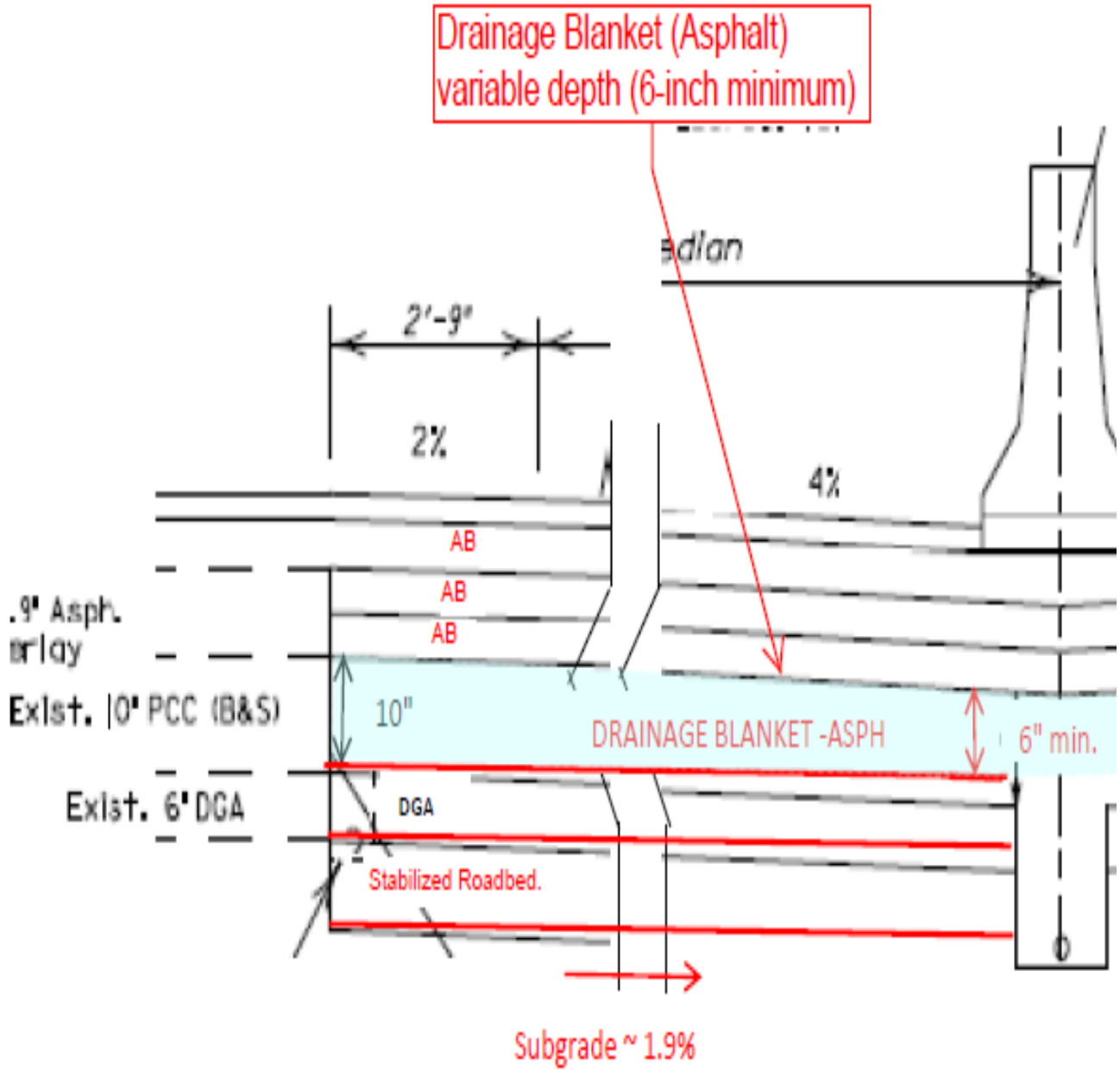
The VE Team recommends revising the typical section by tapering the thickness of cement treated drainage blanket (Type III) in the median sections down to a minimum of 7" instead of 11" at centerline. The drainage layer will remain at 12.5" at the tie-in to the existing roadway in order to maintain the drainage of the existing pavement. All other pavement layers will remain the same, with the decrease in drainage blanket layer being made by revising the sub-grade slope. This will result in an approximate 1.4" average decrease of the drainage layer thickness for the width of the median pavement.

This VE Alternative will require less drainage blanket material resulting in lower costs and reduction of construction time, while maintaining the purpose of draining pavement structure.

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE(ASPHALT AND CONCRETE)

VE Alternative 1A

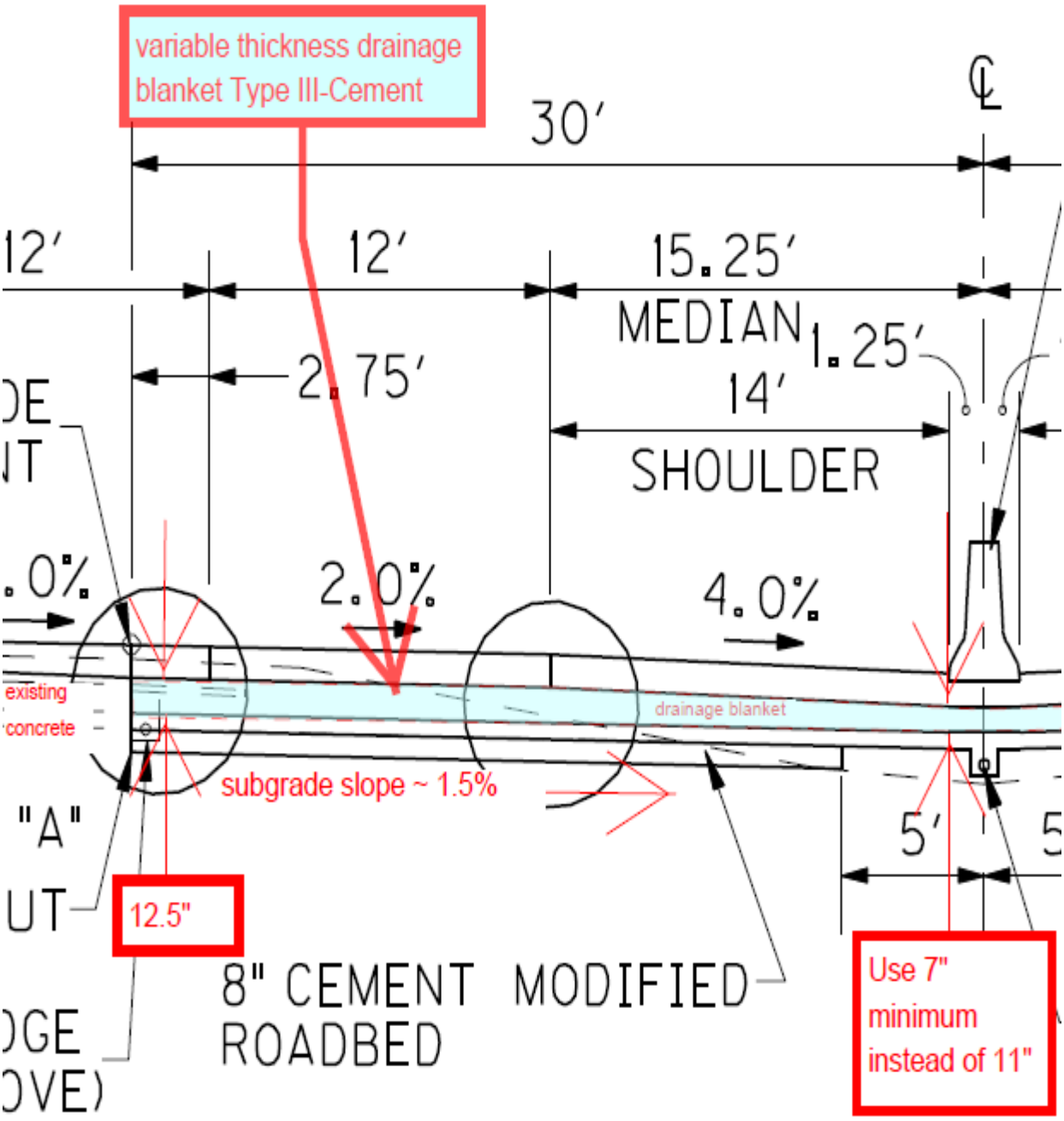


VE ALTERNATIVE 1A (Asphalt)

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE(ASPHALT AND CONCRETE)

VE Alternative 1A



VE ALTERNATIVE 1A (Concrete)

PAVEMENT AND BASE
VE ALTERNATIVE 1A
(ASPHALT)
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
DRAINAGE BLANKET-TYPE II-ASPH	TON	$33.10	231,825.0	$7,672,248	164,123.0	$5,431,651
SUBTOTAL				**$7,672,248**		**$5,431,651**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		4.5%		$379,776		$268,867
TRAFFIC CONTROL/MOT		10.0%		$767,225		$543,165
CONTINGENCY		10.0%		$767,225		$543,165
GRAND TOTAL				**$9,586,474**		**$6,786,848**

POSSIBLE SAVINGS: $2,799,627

PAVEMENT AND BASE
VE ALTERNATIVE 1A
(CONCRETE)
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
DRAINAGE BLANKET-TYPE III-CEM	CY	$59.00	202,308.0	$11,936,172	177,203.0	$10,454,977
SUBTOTAL				**$11,936,172**		**$10,454,977**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		4.5%		$590,841		$517,521
TRAFFIC CONTROL/MOT		10.0%		$1,193,617		$1,045,498
CONTINGENCY		10.0%		$1,193,617		$1,045,498
GRAND TOTAL				**$14,914,247**		**$13,063,494**

POSSIBLE SAVINGS: $1,850,753

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS – VE 1A

PAVEMENT AND BASE - (ASPHALT ALTERNATE)

REDUCE DRAINAGE BLANKET AT CENTER IN MEDIAN SECTIONS

Use variable thickness of drainage blanket with 10" at interface with exist.ing pavement tapered down to 6" minimum at center.

	Estimate Price	
DRAINAGE BLANKET-TYPE II-ASPHALT	$ 33.10	/TON

Width (FT)	Average decrease (in)	Unit Weight (lbs/sy/inch of depth)	Decrease per Linear Foot of Roadway (TONS)
58.82	2	110	0.719

	Length Median Sections (LF)	DECREASE (TONS)		COST DECREASE
3-12	22251	15996		$ 529,404
3-13	13983	10053		$ 332,689
3-14	22164	15934		$ 527,334
4-13	16300	11718		$ 387,816
4-14	19475	14001		$ 463,356
		67702	**Total All Projects =**	**$ 2,240,598**

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS – VE 1A

PAVEMENT AND BASE - (CONCRETE ALTERNATE)

REDUCE DRAINAGE BLANKET AT CENTER IN MEDIAN SECTIONS

Use variable thickness of drainage blanket with 12.5" at interface with existing pavement tapered down to 7" minimum at center.
Subgrade slope to be revised.

DRAINAGE BLANKET-TYPE III-CEMENT

Depths (Inches):	@ existIng Pavement	shoulder/driving lane joint	~ Centerline	Average Depth (inches)
Original	12.5	12	11	11.8
Revised	12.5	11.6	7	10.4

Width (FT)	Avg decrease (in)	Revised % decrease
58.82	1.4	11.83%

	Length Median Sections (LF)	AREA (SY)	ORIGINAL VOLUME (CY)	REVISED VOLUME (CY)
3-12	22251	145423	47801	41876
3-13	13983	91387	30039	26316
3-14	22164	144854	47614	41713
4-13	16300	106530	35017	30677
4-14	19475	127280	41837	36652
		615473	202308	177233

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE (ASPHALT)

Original Design

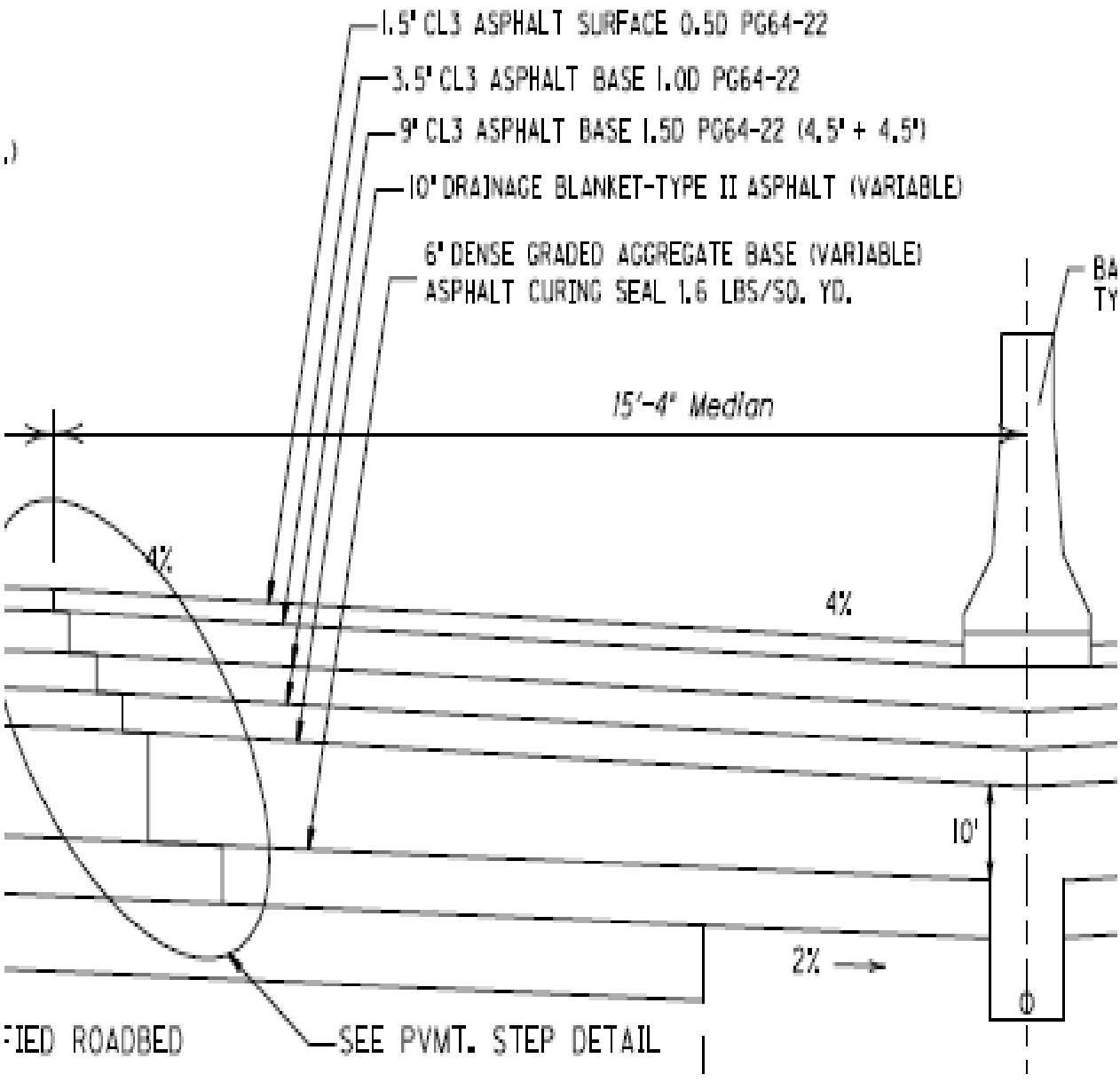
The Original Design typical section for the asphalt alternate specifies the same asphalt base thickness (full depth) for the interior shoulders in the median sections as the driving lanes. The total proposed thickness of asphalt base in the shoulder area is 12.5". The other components of the pavement structure in the shoulder area are: 8" of cement-modified roadbed, 6" of DGA Base, 10" of asphalt treated drainage blanket (ATDB), and 1.5" of asphalt surface.

(Note: Information obtained from Item Number 3-12.00 plan set. The VE Team is assuming the other 4 projects will have similar design.)

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE (ASPHALT)

Original Design



ORIGINAL DESIGN (Item Number 3-12.00)

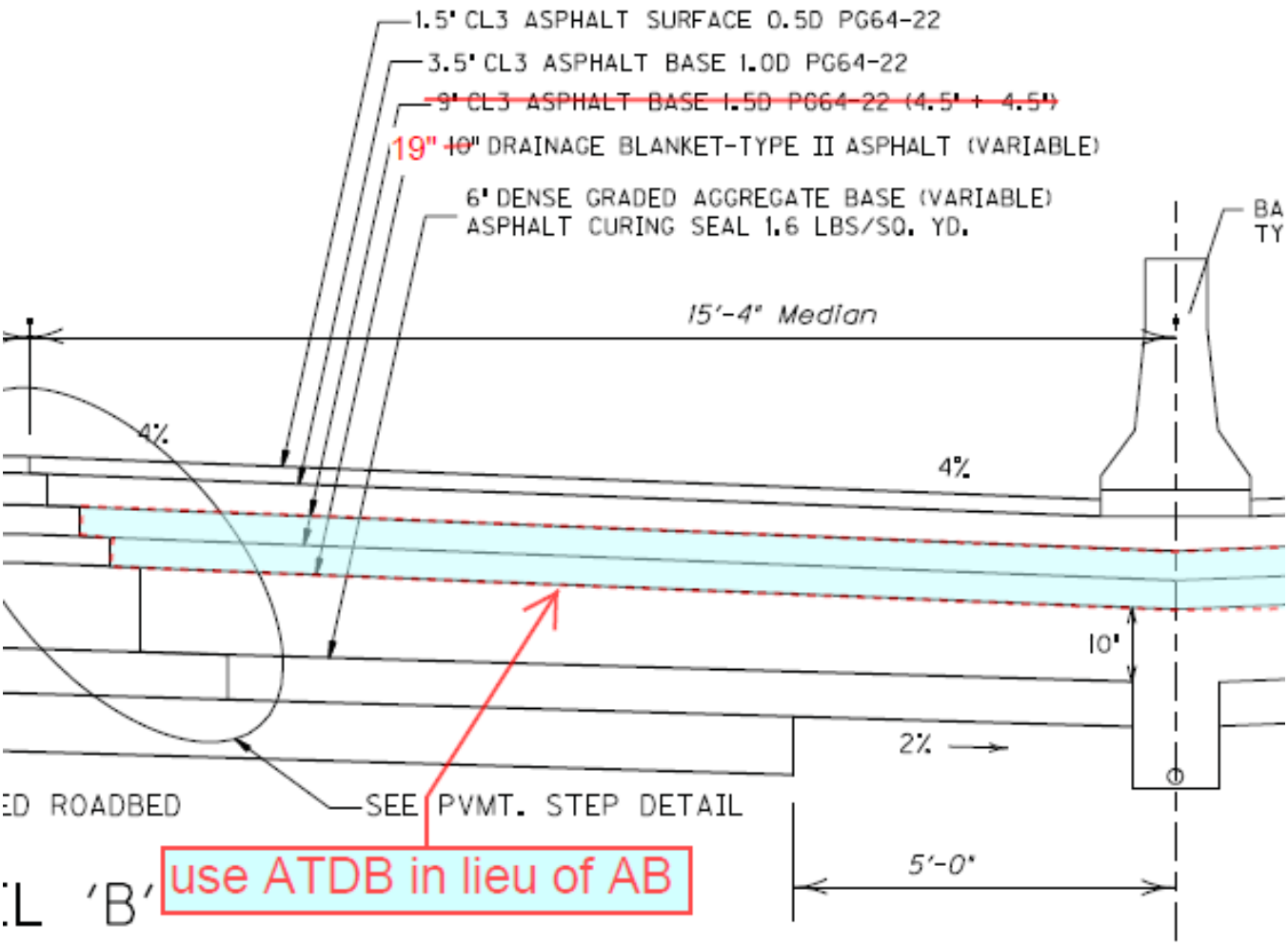
VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE (ASPHALT)

VE Alternative 1B

The VE Team recommends revising the pavement structure of the interior shoulders in the median sections by utilizing asphalt-treated drainage blanket (ATDB) in lieu of the proposed bottom two courses of asphalt base (AB). This would replace 9" of asphalt base with a less expensive material.

This VE Alternative will result in a project cost savings while still providing a suitable shoulder pavement.



PAVEMENT AND BASE
VE ALTERNATIVE 1B
(ASPHALT)
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
ASPHALT PAVEMENT	TON	$44.93	1,078,442.0	$48,454,399	939,674.0	$42,219,553
DRAINAGE BLANKET-TYPE II-ASPH	TON	$33.10	231,825.0	$7,672,248	370,593.0	$12,264,775
SUBTOTAL				**$56,126,647**		**$54,484,328**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		4.5%		$2,778,269		$2,696,974
TRAFFIC CONTROL/MOT		10.0%		$5,612,665		$5,448,433
CONTINGENCY		10.0%		$5,612,665		$5,448,433
GRAND TOTAL				**$70,130,246**		**$68,078,168**

POSSIBLE SAVINGS: $2,052,078

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 1B

PAVEMENT AND BASE - (ASPH ALT)

Interior shoulder (Median) - use Asphalt treated drainage blanket (ATDB) in lieu of Asphalt base (2 Courses)

					Unit Price
CL3 Asphalt Base 1.50 D PG64-22					$ 44.93
DRAINAGE BLANKET-TYPE II-ASPHALT					$ 33.10
	layer depth (inch)	width (Ft)		Ton/LF roadway	
2nd course	4.5	27.17		0.747	
1st course	4.5	26.42		0.726	
			both =	1.474	

	Length Median Sections (LF)		TONS	ATDB	CL3 ASPHALT BASE	NET DIFFERENCE
3-12	22251		32788	$ 1,085,113	$ (1,473,157)	$ (388,044)
3-13	13983		20605	$ 681,908	$ (925,763)	$ (243,855)
3-14	22164		32660	$ 1,080,870	$ (1,467,397)	$ (386,527)
4-13	16300		24019	$ 794,901	$ (1,079,163)	$ (284,262)
4-14	19475		28697	$ 949,736	$ (1,289,368)	$ (339,632)
			138768		**Total All Projects =**	**$ (1,642,319)**
					(does not include add-ons)	

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE (ASPHALT)

Original Design

The Original Design pavement design for I-65, from North of the Cumberland Interchange to the Munfordville Interchange, is based on 2010 annual average daily traffic (AADT) of 43,000 vehicles and an 2030 ADT of 70,000 vehicles.

The following is the Original Design pavement design.

ASPHALT ALTERNATE

TRAFFIC LANES (FULL DEPTH)

1	DGA BASE	6 IN. DEPTH (variable)
358	ASPHALT CURING SEAL	1.6 LB/SQ YD
18	DRAINAGE BLANKET-TY II ASPHALT	10 IN. DEPTH (min.)
208	CL4 ASPH BASE 1.5D PG64-22	9 IN. DEPTH (4 ½" + 4 ½")
219	CL4 ASPH BASE 1.0D PG76-22	3 ½ IN. DEPTH
335	CL4 ASPH SURF 0.5A PG76-22	1 ½ IN. DEPTH

EXISTING TRAFFIC LANES RESURFACE

190	LEVELING AND WEDGING PG64-22	TON
219	CL4 ASPH BASE 1.0D PG76-22	3 ½ IN. DEPTH
335	CL4 ASPH SURF 0.5A PG76-22	1 ½ IN. DEPTH

MEDIAN SHOULDER (FULL DEPTH)

1	DGA BASE	6 IN. DEPTH (variable)
358	ASPHALT CURING SEAL	1.6 LB/SQ YD
18	DRAINAGE BLANKET-TY II ASPHALT	10 IN. DEPTH (variable)
205	CL3 ASPH BASE 1.5D PG64-22	9 IN. DEPTH (4 ½" + 4 ½")
214	CL3 ASPH BASE 1.0D PG64-22	3 ½ IN. DEPTH
312	CL3 ASPH SURF 0.5D PG64-22	1 ½ IN. DEPTH

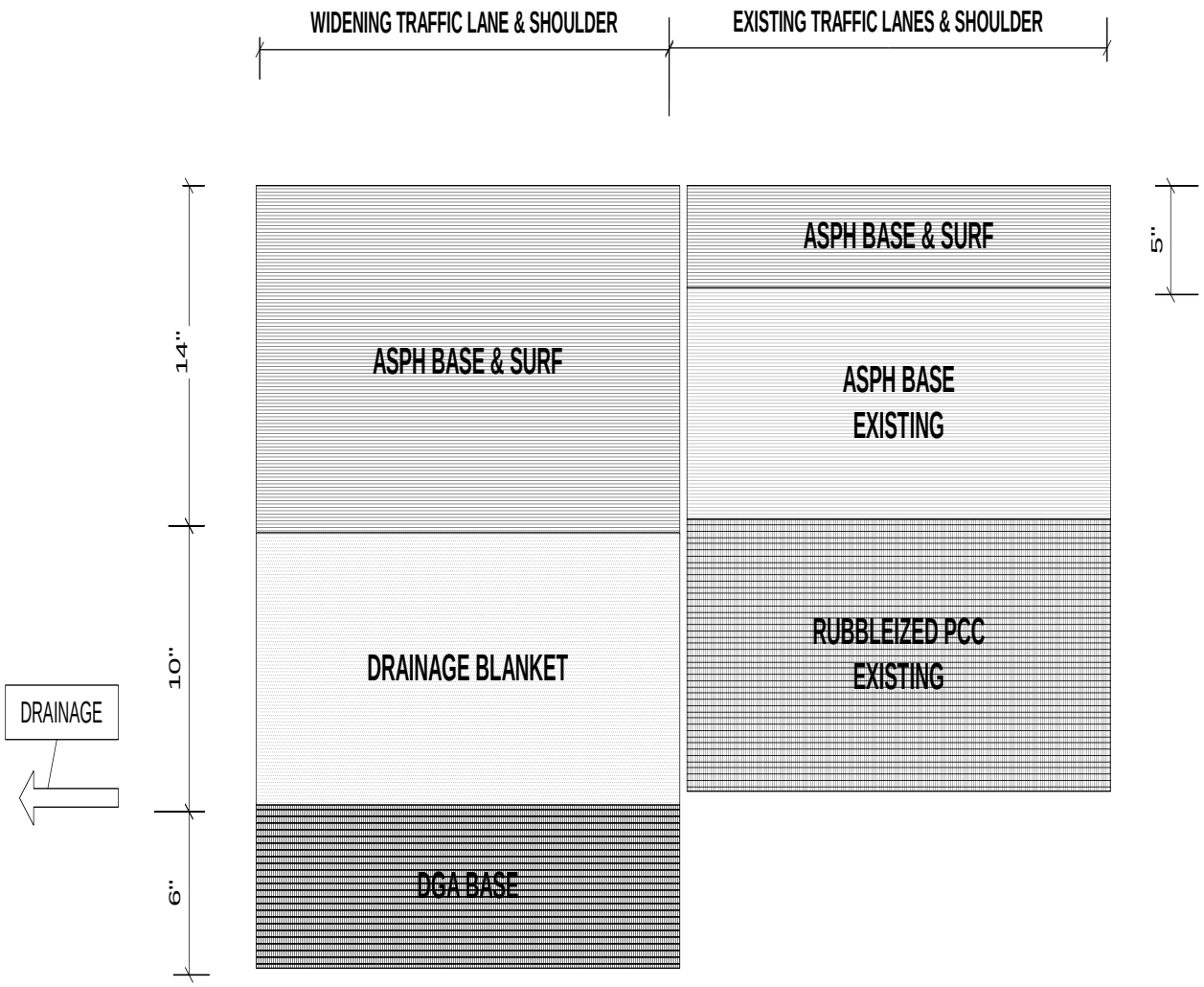
EXISTING SHOULDER RESURFACE

214	CL3 ASPH BASE 1.0D PG64-22	3 ½ IN. DEPTH
312	CL3 ASPH SURF 0.5D PG64-22	1 ½ IN. DEPTH

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE (ASPHALT)

Original Design



VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE (ASPHALT)

VE Alternative 1C

The VE Team recommends that the pavement design be reevaluated to account for the current traffic trends along I-65 from North of the Cumberland Parkway Interchange to the Munfordville Interchange.

The annual average daily traffic (AADT) for this section of I-65 in 1999 was 34,000 vehicles and the 2009 was 36,500 vehicles. Therefore, the last decade growth rate is 0.79 percent. Based on this growth rate, the forecasted traffic for this section of I-65 will be less than the pavement design estimate of 70,000 vehicles used to the design the pavement for Item No. 3-12.00.

The pavement alternatives of asphalt and concrete materials have a similar life cycle cost with the appropriate initial cost adjustment, therefore the calculated VE savings is anticipated to be the same for both pavement types.

The VE Team estimated that the required Structural Number for a practical pavement design with reduced traffic growth would be approximately 7.8. Therefore, the VE Team quantified a pavement that would satisfy the modified Structural Number of 7.8. The revised pavement design is:

ASPHALT ALTERNATE

TRAFFIC LANES (FULL DEPTH)

1	DGA BASE	6 IN. DEPTH (variable)
358	ASPHALT CURING SEAL	1.6 LB/SQ YD
18	DRAINAGE BLANKET-TY II ASPHALT	14 IN. DEPTH (min.)
208	CL4 ASPH BASE 1.5D PG64-22	5 IN. DEPTH
219	CL4 ASPH BASE 1.0D PG76-22	3 ½ IN. DEPTH
335	CL4 ASPH SURF 0.5A PG76-22	1 ½ IN. DEPTH

EXISTING TRAFFIC LANES RESURFACE

190	LEVELING AND WEDGING PG64-22	TON
219	CL4 ASPH BASE 1.0D PG76-22	3 ½ IN. DEPTH
335	CL4 ASPH SURF 0.5A PG76-22	1 ½ IN. DEPTH

MEDIAN SHOULDER (FULL DEPTH)

1	DGA BASE	6 IN. DEPTH (variable)
358	ASPHALT CURING SEAL	1.6 LB/SQ YD
18	DRAINAGE BLANKET-TY II ASPHALT	14 IN. DEPTH (variable)
205	CL3 ASPH BASE 1.5D PG64-22	5 IN. DEPTH
214	CL3 ASPH BASE 1.0D PG64-22	3 ½ IN. DEPTH
312	CL3 ASPH SURF 0.5D PG64-22	1 ½ IN. DEPTH

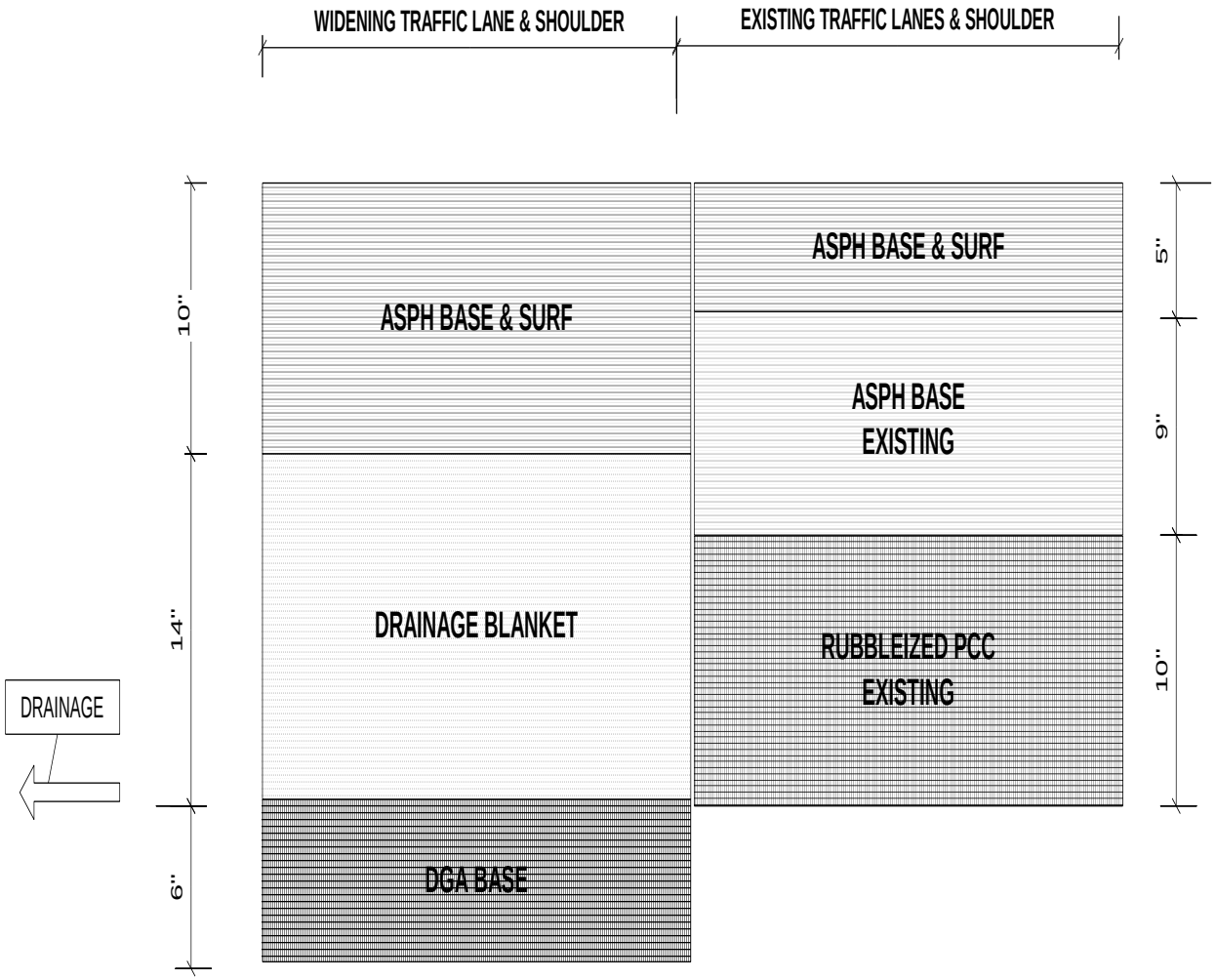
EXISTING SHOULDER RESURFACE

214	CL3 ASPH BASE 1.0D PG64-22	3 ½ IN. DEPTH
312	CL3 ASPH SURF 0.5D PG64-22	1 ½ IN. DEPTH

VII. DEVELOPMENT PHASE

A. PAVEMENT AND BASE (ASPHALT)

VE Alternative 1C



PAVEMENT AND BASE
VE ALTERNATIVE 1C
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
ASPHALT PAVEMENT	TON	$44.93	1,078,442.0	$48,454,399	955,093.0	$42,912,328
DRAINAGE BLANKET-TYPE II-ASPH	TON	$32.05	231,825.0	$7,429,991	355,174.0	$11,383,327
SUBTOTAL				**$55,884,390**		**$54,295,655**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		4.5%		$2,766,277		$2,687,635
TRAFFIC CONTROL/MOT		10.0%		$5,588,439		$5,429,566
CONTINGENCY		10.0%		$5,588,439		$5,429,566
GRAND TOTAL				**$69,827,546**		**$67,842,421**

POSSIBLE SAVINGS: $1,985,125

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 1C

GROWTH RATE CAL

YEAR	1999	2010	growth rate Growth Rate	2025	2030
ADT	34000	36785	1.00790	41723	43398
	2010	2030			
ADT	43000	70000	1.02466	61971	
ADT			#DIV/0!	#DIV/0!	
ADT			#DIV/0!	#DIV/0!	
ADT			#DIV/0!	#DIV/0!	

AP WIDENING

LAYER	Sn	IN	Total Sn
			8.6
ASPH SURF	0.44	1.5	0.66
ASPH BASE	0.4	12.5	5
DRAINAGE BI	0.21	10	2.1
DGA BASE	0.14	6	0.84
			0

AP EXISTING O/L

LAYER	Sn	IN	Total Sn
			6.89
ASPH SURF	0.44	1.5	0.66
ASPH BASE	0.4	3.5	1.4
ASPH (EXISTIN	0.31	9	2.79
RUB PCC	0.2	6	1.2
DGA BASE	0.14	6	0.84

VE WIDENING

LAYER	Sn	IN	Total Sn
			7.84
ASPH SURF	0.44	1.5	0.66
ASPH BASE	0.4	8.5	3.4
DRAINAGE BI	0.21	14	2.94
DGA BASE	0.14	6	0.84
			0

VII. DEVELOPMENT PHASE

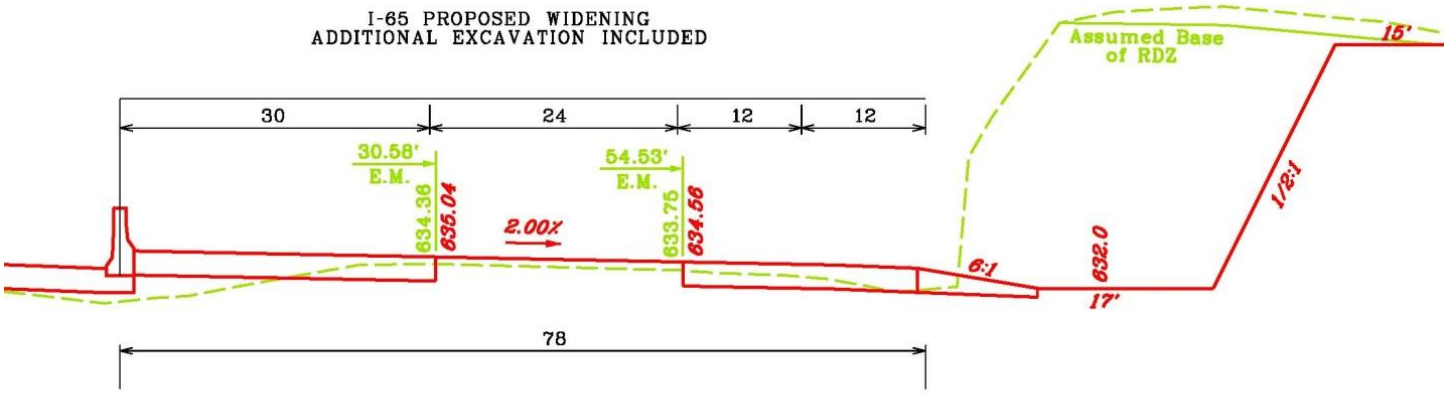
B. EARTHWORK (ROCK CUT)

Original Design

The Original Design typical section includes a median barrier wall, 14’ shoulder, three 12’ driving lanes, 12’ shoulder, a 6:1 slope to the ditch line, and depending on the location, an additional 12’ of roadway excavation to accommodate an ultimate build out of eight lanes. The Districts used differing philosophies concerning the area of excavation to be removed, described as follows:

1. (District 3) Do everything based on an ultimate 4-lane cross section

2. (District 4) Do only those sections that do not meet minimal clear zone requirements



1766•50

VII. DEVELOPMENT PHASE

B. EARTHWORK (ROCK CUT)

VE Alternative 2

The VE Team performed an analysis to look at the proposed additional 12' of excavation for an eight lane build out.

Criteria for evaluating additional 12' of excavation;

- Traffic volumes
- Clear zone
- Economics
  - Additional R/W
  - Additional Excavation
- Erosion Control and Environmental Concerns

Traffic Volumes:

1. Current volumes of similar roadway AADT:

a.	I-75/I-64 Fayette	82,000
b.	I-75Boone	150,000
c.	KY4Fayette	70,000
d.	I-64Louisville	130,000
e.	I-65Jefferson	140,000

2. Projected numbers for I-65 in 2025 is 42,000 ADT (using the last decade's growth factor).
3. Using 5,000 Design Hour Volume, with LOS C, ***five lanes total are needed***, equivalent to 50,000 ADT, Using 5,000 Design Hour Volume, with six lanes, a LOS B is obtained.

There is no justification for additional lanes based on current volumes and similar route volumes.

Clear Zone: Using the 60 foot median area, the entire alignment can be shifted 2.75' toward the centerline. The additional width of 2.75' adds enough space to achieve a clear zone of 30' throughout the project with little or no excavation.

Economics:

1. In the Original Design alternative, there is increased cost for Right-of-Way purchased, to allow for the additional roadway excavation.
2. Also in the Original Design alternative, there is wasted material that cannot be used now. If four lanes are ever built, since the excess material available now could not be used, it will create higher embankment cost in the future.
3. Reducing the limits means decreased cost for roadway excavation.

VII. DEVELOPMENT PHASE

B. EARTHWORK (ROCK CUT)

VE Alternative 2

Erosion Control and Environmental Concerns: This area is in the Mammoth Cave Region and contains many karst features that feed into the cave system. Any work that can be avoided would lessen the impact on the area. Also, containing the work to the inside would also make it easier to contain and filter the runoff.

Conclusion: The VE Team proposes that the roadway be developed for the planned typical section based on the preceding information. The team VE Team proposes that the roadway be constructed according to the typical section (shown in Figure1) and no roadway excavation be done unless minimum clear zone requirements are not met. This would reduce the amount of roadway excavation by an estimated $8,945,325. It is realized that some excavation will still need to be done as shown in Figure 2, on the outside and that some excavation is being done in the bifurcated sections that cannot be avoided. Therefore, all of the estimated savings above may not be realized, however, even being conservative the team feels that the estimated savings could be around $ 6 million.

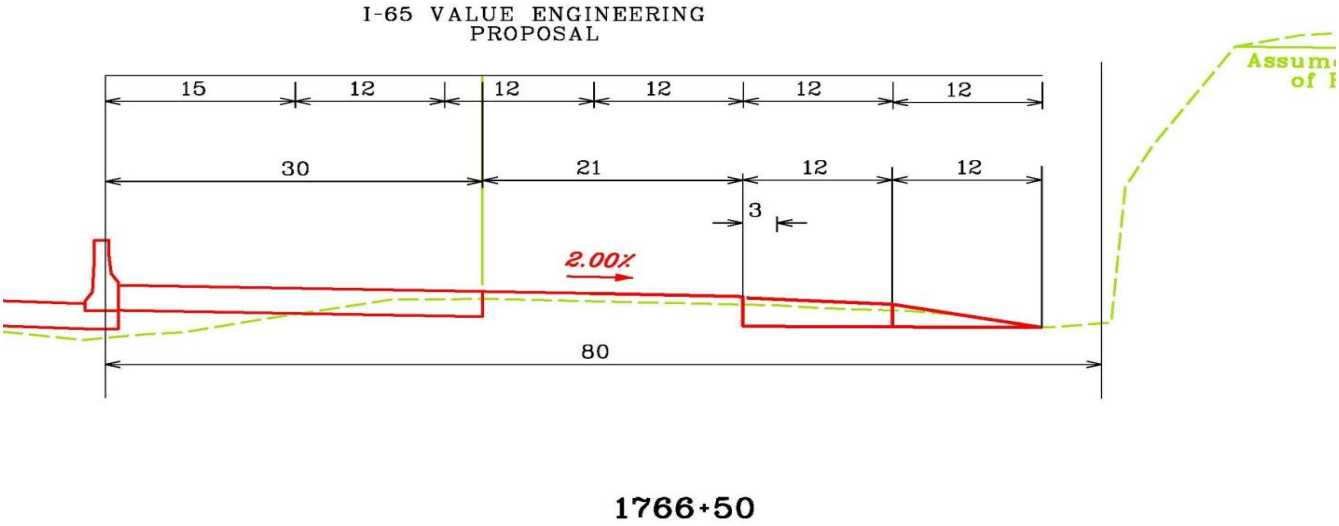


FIGURE 1

VII. DEVELOPMENT PHASE

B. EARTHWORK (ROCK CUT)

VE Alternative 2

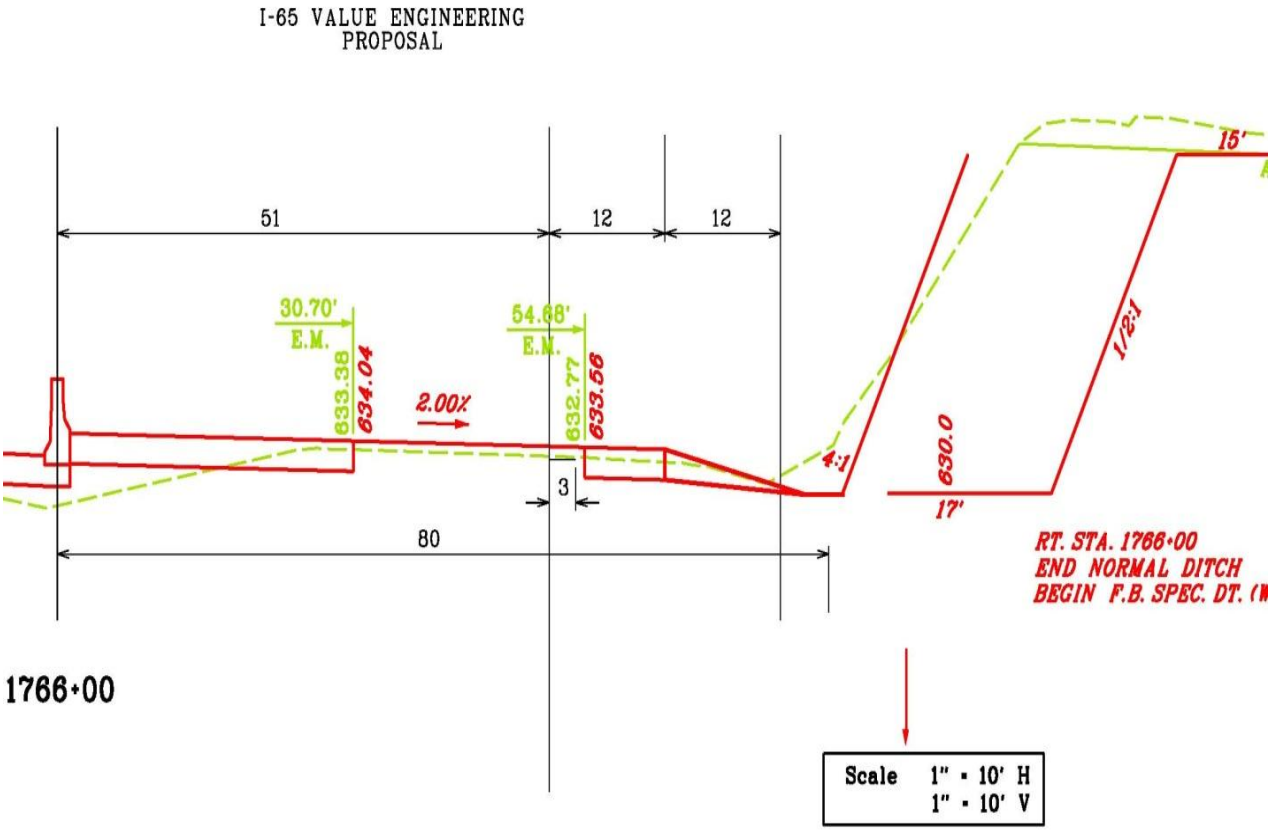


FIGURE 2

EARTHWORK (ROCK CUT)
VE ALTERNATIVE 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
Roadway Excavation	Cu Yd	5.00	1,930,000	9,650,000	493,000	2,465,000
SUBTOTAL			**1,930,000**	**9,650,000**	**493,000**	**2,465,000**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		4.5%		434,250		110,925
TRAFFIC CONTROL		10%		965,000		246,500
CONTINGENCY		10%		965,000		246,500
GRAND TOTAL				**12,014,250**		**3,068,925**

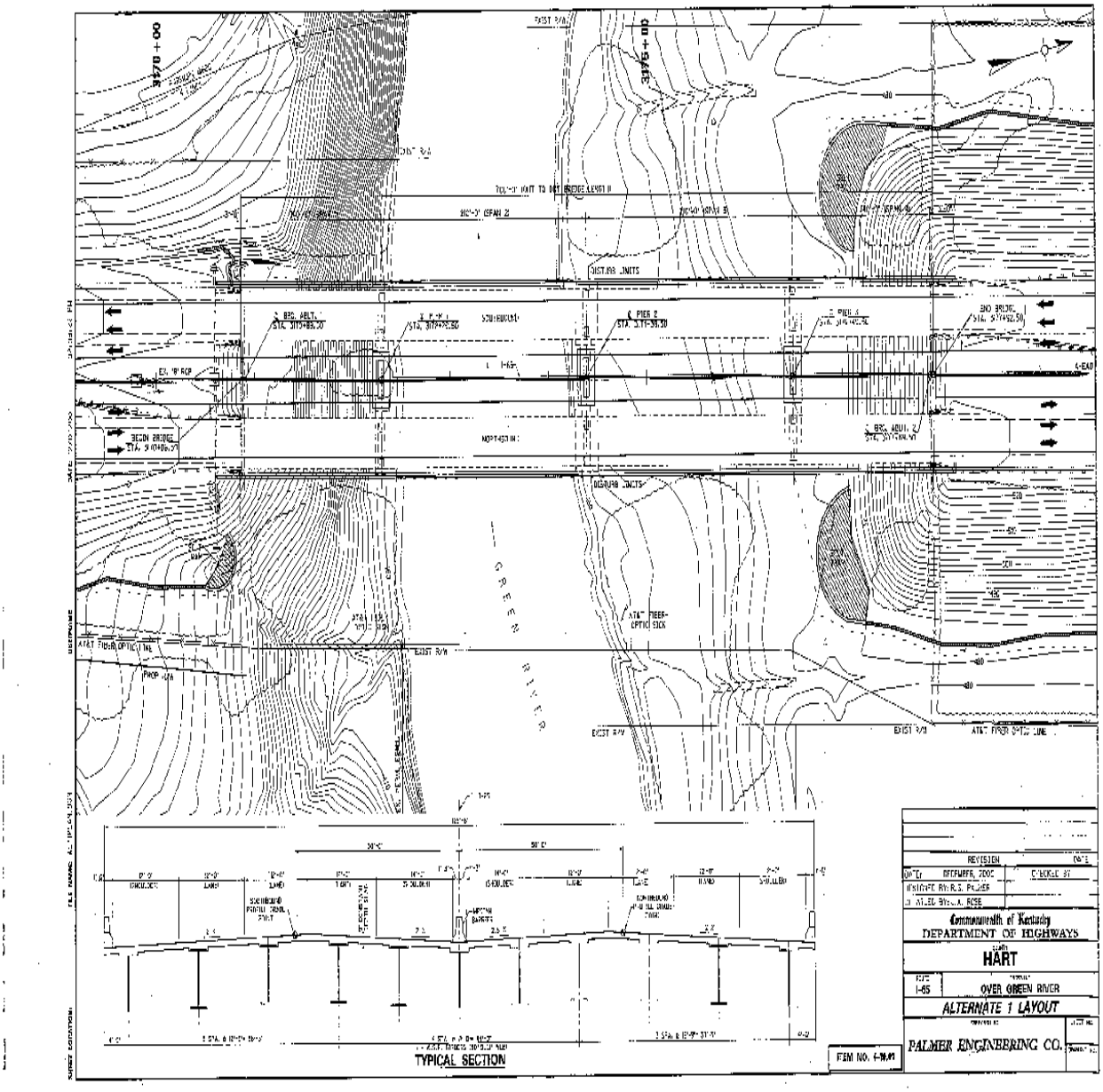
POSSIBLE SAVINGS: $8,945,325

VII. DEVELOPMENT PHASE

C. GREEN RIVER BRIDGE

Original Design

The Original Design alternative for the Green River Bridge is to completely replace the superstructure with a new welded plate steel girder superstructure and reuse as much of the existing substructure as practicable.



ORIGINAL DESIGN

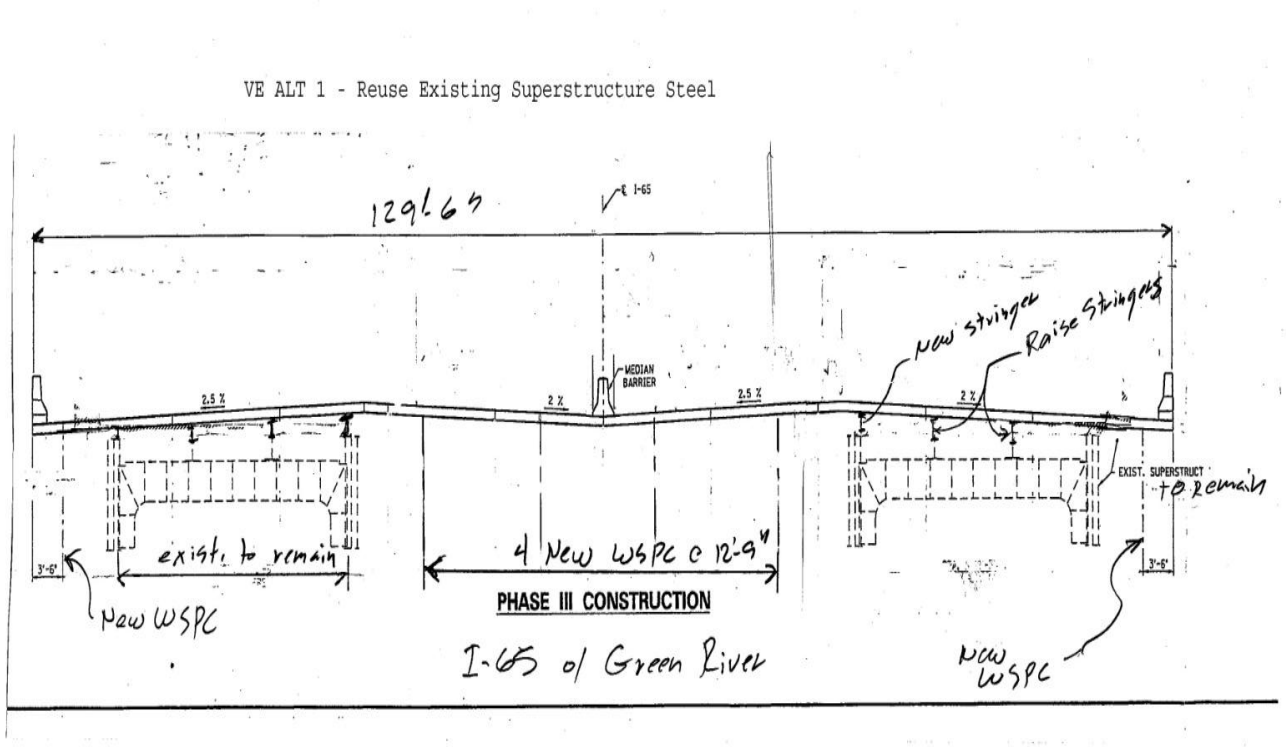
VII. DEVELOPMENT PHASE

C. GREEN RIVER BRIDGE

VE Alternative 3

Since the existing steel girders are in relatively good condition, VE Alternative 3 is to salvage the existing steel, add new welded steel plate girders for the median area and add an exterior girder to the existing bridge while completely replacing the existing deck.

The existing steel girders will require jacking and new bearings to match the proposed roadway grade. Since the existing girders will become an integral part of a multi-beam superstructure they will no longer be considered fracture critical and some maintenance inspections and operations will no longer be required.



VE ALTERNATIVE 3 – REUSE EXISTING SUPERSTRUCTURE STEEL

I-65 OVER THE GREEN RIVER (REUSE EXIST STEEL SUPERSTRUCTURE)
VE ALTERNATIVE 3
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$10,385,818		$8,151,159
SUBTOTAL				**$10,385,818**		**$8,151,159**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$514,098		$403,482
TRAFFIC CONTROL/MOT			10.0%	$1,038,582		$815,116
CONTINGENCY			10.0%	$1,038,582		$815,116
GRAND TOTAL				**$12,977,080**		**$10,184,873**

POSSIBLE SAVINGS: $2,792,206

NOTE: costs shown include costs associated with modifications and additions to and rehabilitation of existing piers to accept new superstructure components.

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 3

PROJECT

REPLACE BRIDGE - WIDEN TO THE MEDIAN

50 Year Life Cycle Cost Comparison

Enter the Interest Rate = 5%

		ORIGINAL DESIGN		ALT 3, Reuse & widen exist bridge	
Year		**Total**	**Present Worth**	**Total**	**Worth**
0	INITIAL COST	$12,977,080	-$12,977,080	$10,184,873	-$10,184,873
1	MAINT	$2,500	-$2,381	$5,000	-$4,762
2	MAINT	$2,500	-$2,268	$5,000	-$4,535
3	MAINT	$2,500	-$2,160	$5,000	-$4,319
4	MAINT	$2,500	-$2,057	$5,000	-$4,114
5	MAINT	$2,500	-$1,959	$5,000	-$3,918
6	MAINT	$2,500	-$1,866	$5,000	-$3,731
7	MAINT	$2,500	-$1,777	$5,000	-$3,553
8	MAINT	$2,500	-$1,692	$5,000	-$3,384
9	MAINT	$2,500	-$1,612	$5,000	-$3,223
10	MAINT	$2,500	-$1,535	$5,000	-$3,070
11	MAINT	$2,500	-$1,462	$5,000	-$2,923
12	MAINT	$2,500	-$1,392	$5,000	-$2,784
13	MAINT	$2,500	-$1,326	$5,000	-$2,652
14	MAINT	$2,500	-$1,263	$5,000	-$2,525
15	MAINT	$2,500	-$1,203	$5,000	-$2,405
16	MAINT	$2,500	-$1,145	$5,000	-$2,291
17	MAINT	$2,500	-$1,091	$5,000	-$2,181
18	MAINT	$2,500	-$1,039	$5,000	-$2,078
19	MAINT	$2,500	-$989	$5,000	-$1,979
20	PAINT	$1,500,000	-$565,334	$1,500,000	-$565,334
21	MAINT	$2,500	-$897	$5,000	-$1,795
22	MAINT	$2,500	-$855	$5,000	-$1,709
23	MAINT	$2,500	-$814	$5,000	-$1,628
24	MAINT	$2,500	-$775	$5,000	-$1,550
25	MAINT	$2,500	-$738	$5,000	-$1,477
26	MAINT	$2,500	-$703	$5,000	-$1,406
27	MAINT	$2,500	-$670	$5,000	-$1,339
28	MAINT	$2,500	-$638	$5,000	-$1,275
29	MAINT	$2,500	-$607	$5,000	-$1,215
30	MAINT	$2,500	-$578	$5,000	-$1,157

Year		Total	Worth	Total	Worth
31	MAINT	$2,500	-$551	$5,000	-$1,102
32	MAINT	$2,500	-$525	$5,000	-$1,049
33	MAINT	$2,500	-$500	$5,000	-$999
34	MAINT	$2,500	-$476	$5,000	-$952
35	REPLACE BRIDGE	$2,500	-$453	$8,651,387	-$1,568,412
36	MAINT	$2,500	-$432	$5,000	-$863
37	MAINT	$2,500	-$411	$5,000	-$822
38	MAINT	$2,500	-$392	$5,000	-$783
39	MAINT	$2,500	-$373	$5,000	-$746
40	PAINT	$1,500,000	-$213,069	$1,500,000	-$213,069
41	MAINT	$2,500	-$338	$5,000	-$676
42	MAINT	$2,500	-$322	$5,000	-$644
43	MAINT	$2,500	-$307	$5,000	-$614
44	MAINT	$2,500	-$292	$5,000	-$584
45	MAINT	$2,500	-$278	$5,000	-$556
46	MAINT	$2,500	-$265	$5,000	-$530
47	MAINT	$2,500	-$252	$5,000	-$505
48	MAINT	$2,500	-$240	$5,000	-$481
49	MAINT	$2,500	-$229	$5,000	-$458
50	MAINT	$2,500	-$218	$5,000	-$436
50	SALVAGE	$0	$0	$4,325,693	-$377,217

-$13,799,825	**-$12,996,683**

Life Cycle Cost Savings	**$803,142**

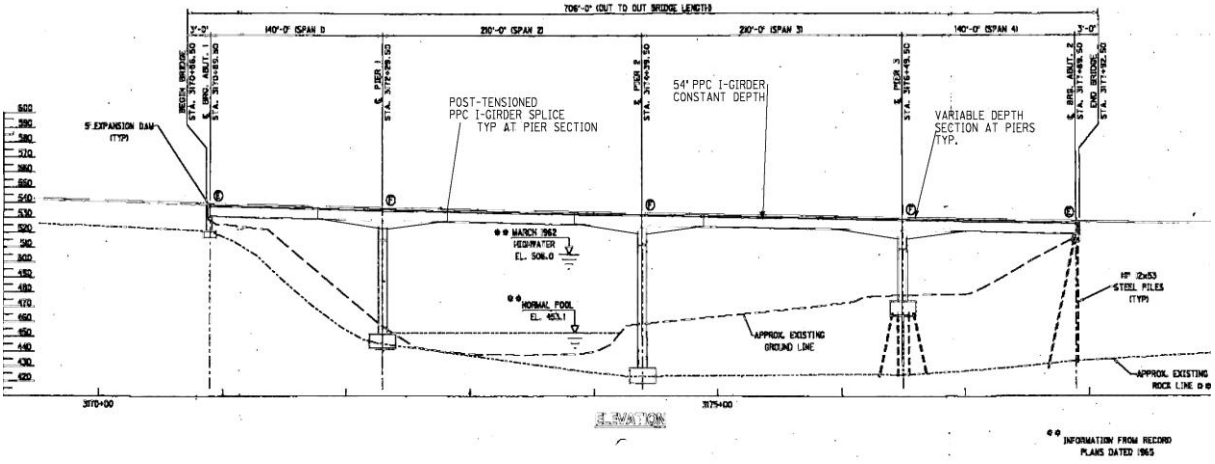
VII. DEVELOPMENT PHASE

C. GREEN RIVER BRIDGE

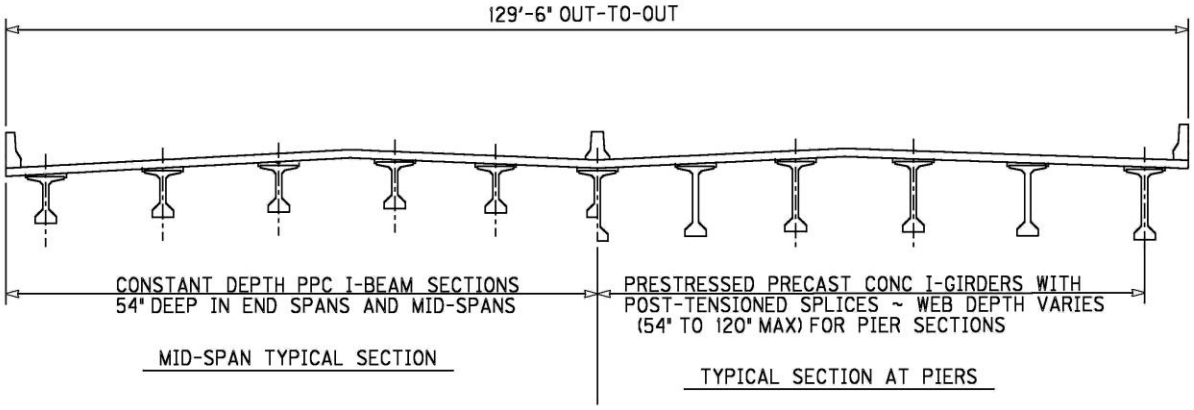
VE Alternative 4

A VE Alternative 4 was considered to reduce future maintenance. This proposal would replace the entire superstructure with a new concrete superstructure using spliced Precast Prestressed Concrete (PPC) I-beams with post-tensioning at the pier sections. Although the estimated cost exceeds the original proposed bridge replacement, the cost savings in limiting future maintenance inspections, repairs, and painting should offset the increase in initial cost.

This structure would still have a lower life cycle cost.



ELEVATION VIEW of PPC 'SPLICED' I-BEAM



TYPICAL SECTION THRU DECK

I-65 OVER THE GREEN RIVER (CONCRETE SUPERSTRUCTURE)
VE ALTERNATIVE 4
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$10,385,818		$10,962,127
SUBTOTAL				**$10,385,818**		**$10,962,127**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		4.5%		$514,098		$542,625
TRAFFIC CONTROL/MOT		10.0%		$1,038,582		$1,096,213
CONTINGENCY		10.0%		$1,038,582		$1,096,213
GRAND TOTAL				**$12,977,080**		**$13,697,178**

POSSIBLE ADDED COST: $720,098

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 4

PROJECT

REPLACE BRIDGE - WIDEN TO THE MEDIAN

50 Year Life Cycle Cost Comparison

Enter the Interest Rate = 5%

		ORIGINAL DESIGN		ALT 4, New Concrete Bridge	
Year		**Total**	**Present Worth**	**Total**	**Worth**
0	INITIAL COST	$12,977,080	-$12,977,080	$13,697,178	-$13,697,178
1	MAINT	$2,500	-$2,381	$2,500	-$2,381
2	MAINT	$2,500	-$2,268	$2,500	-$2,268
3	MAINT	$2,500	-$2,160	$2,500	-$2,160
4	MAINT	$2,500	-$2,057	$2,500	-$2,057
5	MAINT	$2,500	-$1,959	$2,500	-$1,959
6	MAINT	$2,500	-$1,866	$2,500	-$1,866
7	MAINT	$2,500	-$1,777	$2,500	-$1,777
8	MAINT	$2,500	-$1,692	$2,500	-$1,692
9	MAINT	$2,500	-$1,612	$2,500	-$1,612
10	MAINT	$2,500	-$1,535	$2,500	-$1,535
11	MAINT	$2,500	-$1,462	$2,500	-$1,462
12	MAINT	$2,500	-$1,392	$2,500	-$1,392
13	MAINT	$2,500	-$1,326	$2,500	-$1,326
14	MAINT	$2,500	-$1,263	$2,500	-$1,263
15	MAINT	$2,500	-$1,203	$2,500	-$1,203
16	MAINT	$2,500	-$1,145	$2,500	-$1,145
17	MAINT	$2,500	-$1,091	$2,500	-$1,091
18	MAINT	$2,500	-$1,039	$2,500	-$1,039
19	MAINT	$2,500	-$989	$2,500	-$989
20	PAINT	$1,500,000	-$565,334	$2,500	-$942
21	MAINT	$2,500	-$897	$2,500	-$897
22	MAINT	$2,500	-$855	$2,500	-$855
23	MAINT	$2,500	-$814	$2,500	-$814
24	MAINT	$2,500	-$775	$2,500	-$775
25	MAINT	$2,500	-$738	$2,500	-$738
26	MAINT	$2,500	-$703	$2,500	-$703
27	MAINT	$2,500	-$670	$2,500	-$670
28	MAINT	$2,500	-$638	$2,500	-$638
29	MAINT	$2,500	-$607	$2,500	-$607

Year		Total	Present Worth	Total	Worth
30	MAINT	$2,500	-$578	$2,500	-$578
31	MAINT	$2,500	-$551	$2,500	-$551
32	MAINT	$2,500	-$525	$2,500	-$525
33	MAINT	$2,500	-$500	$2,500	-$500
34	MAINT	$2,500	-$476	$2,500	-$476
35	MAINT	$2,500	-$453	$2,500	-$453
36	MAINT	$2,500	-$432	$2,500	-$432
37	MAINT	$2,500	-$411	$2,500	-$411
38	MAINT	$2,500	-$392	$2,500	-$392
39	MAINT	$2,500	-$373	$2,500	-$373
40	PAINT	$1,500,000	-$213,069	$2,500	-$355
41	MAINT	$2,500	-$338	$2,500	-$338
42	MAINT	$2,500	-$322	$2,500	-$322
43	MAINT	$2,500	-$307	$2,500	-$307
44	MAINT	$2,500	-$292	$2,500	-$292
45	MAINT	$2,500	-$278	$2,500	-$278
46	MAINT	$2,500	-$265	$2,500	-$265
47	MAINT	$2,500	-$252	$2,500	-$252
48	MAINT	$2,500	-$240	$2,500	-$240
49	MAINT	$2,500	-$229	$2,500	-$229
50	MAINT	$2,500	-$218	$2,500	-$218
50	SALVAGE	$0	$0	$0	$0
			-$13,799,825		**-$13,742,818**

Life Cycle Cost Savings	**$57,007**

VII. DEVELOPMENT PHASE

D. US 31 W INTERCHANGE

Original Design

The Original Design keeps the basic layout of the existing interchange. Although access management is an issue at this location, little has been incorporated into the design to improve or control access. The proposed bridge replacement over US 31W is 177' wide; containing three spans (57'-94'-41').

CURRENT RAMP CONFIGURATION

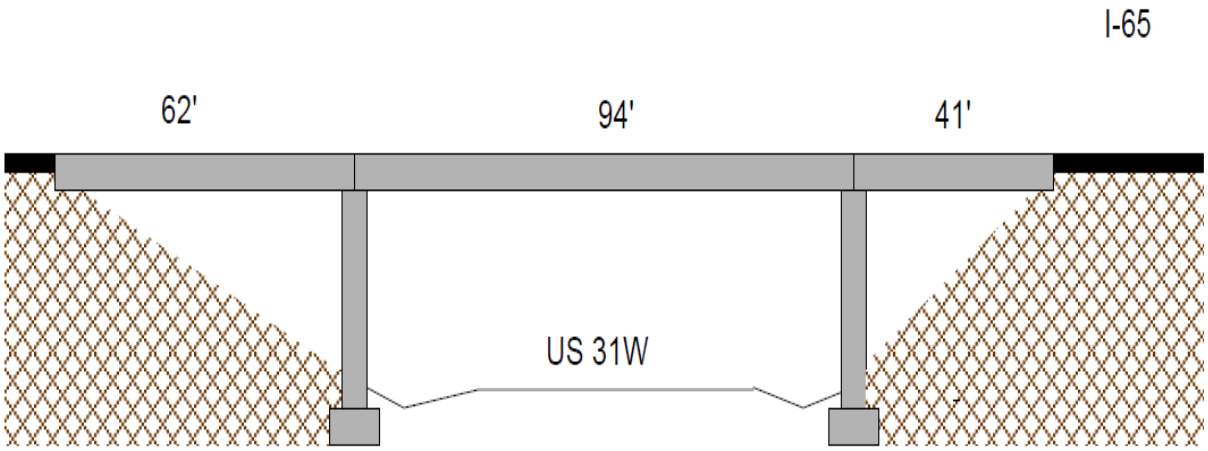
HIGH NUMBER of ACCESS POINTS WEST of the I-65 SB RAMPS

MULTIPLE DRIVEWAYS per PROPERTY and FULL FRONTAGE OPENINGS

VII. DEVELOPMENT PHASE

D. US 31 W INTERCHANGE

Original Design



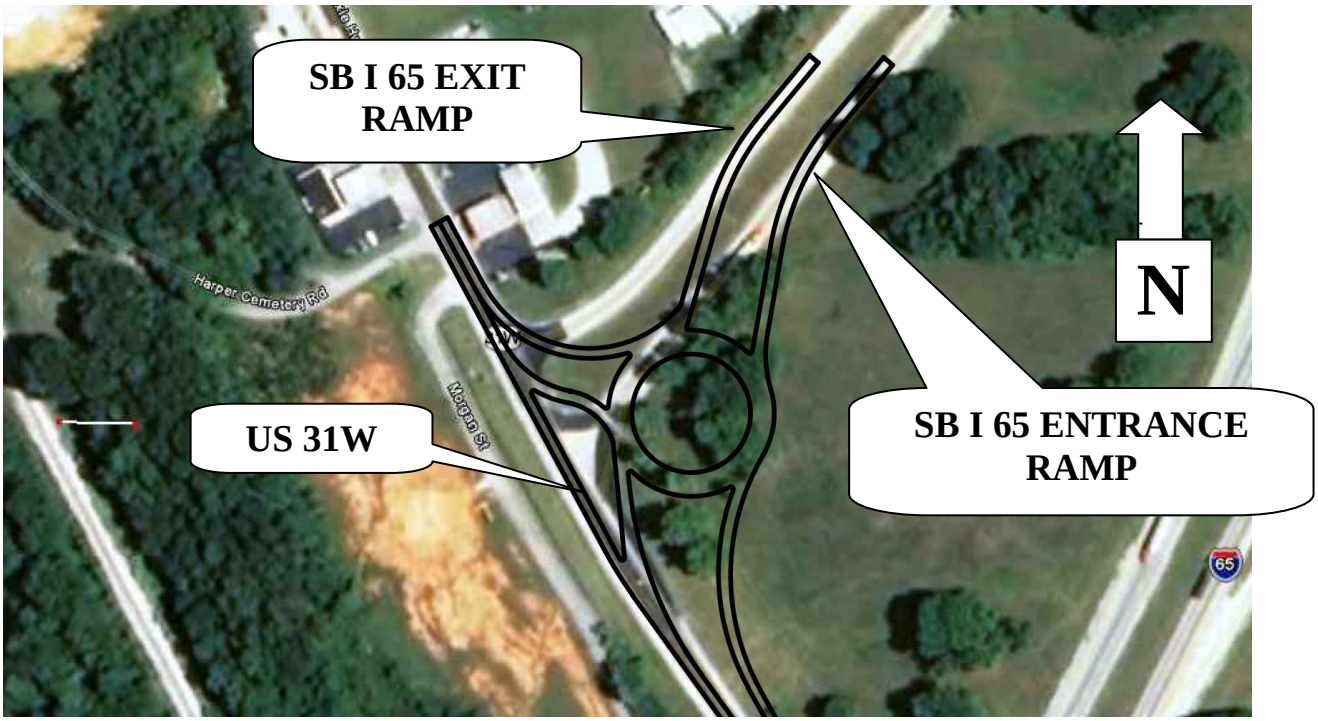
ORIGINAL DESIGN US 31 W BRIDGE SPAN CONFIGURATION

D. US 31W Interchange

VE Alternative 5

Roundabout at SB Ramps

The recommendation is to add a roundabout to termini of the I 65 southbound entrance and exit ramps at US 31W. The primary purpose of adding the roundabout will be to eliminate the need for left turn lane on the western leg that would conflict with the operations of the driveways of businesses in that vicinity. This alternative provides very good traffic operations and spare capacity for future growth. Also, the use of roundabouts allows for safer operations due to low, consistent operating speeds through the intersections and a reduced number of conflict points. It appears the roundabout can be built entirely within existing right-of-way.



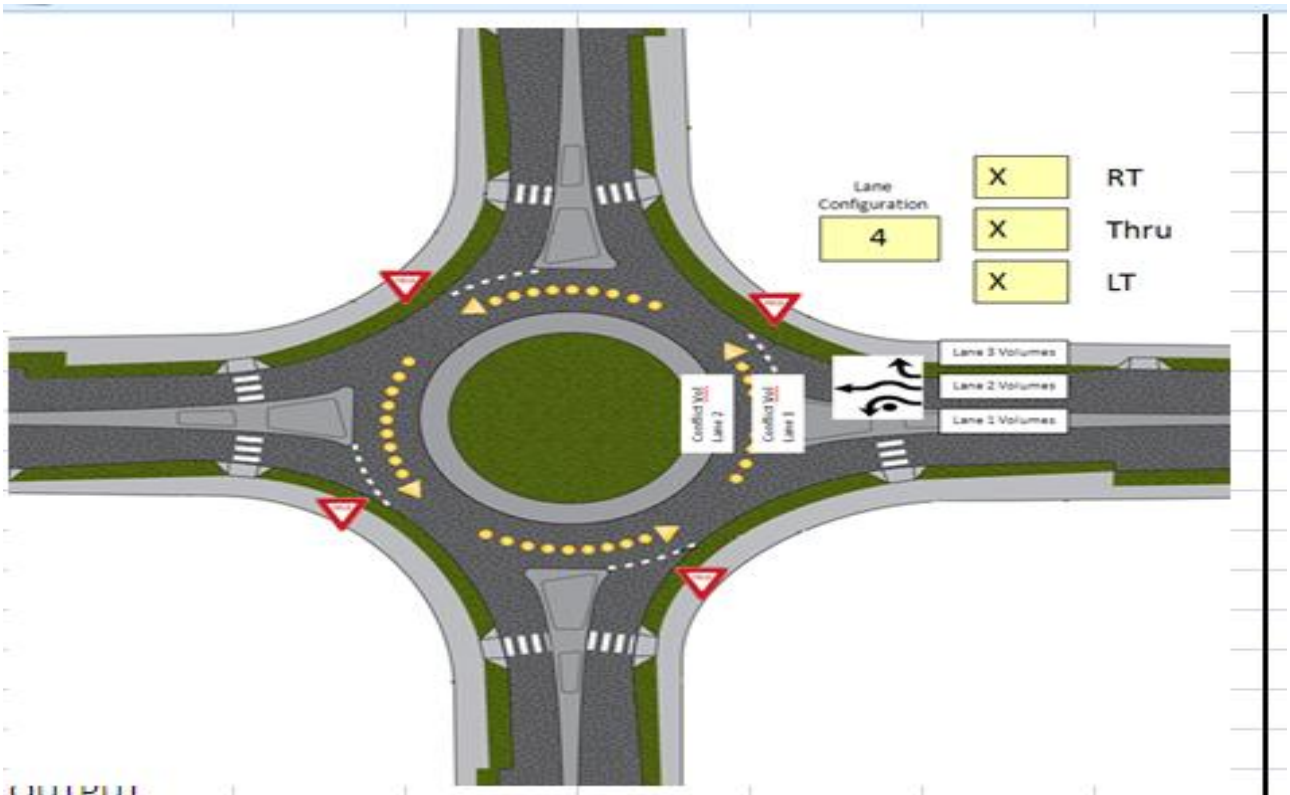
ROUNDABOUT INTERSECTION NEAR A DIAMOND INTERCHANGE

In addition to constructing the roundabout, the VE Team recommends including Access Control of Driveways. The recommendation is to reconfigure the driveways along US 31W, within the first 1000' of the interchange to minimize and delineate driveway openings. There are many redundant driveways and poorly designed driveways that can lead to potential safety and operational problems, especially as traffic generating businesses increase and resulting traffic grows. Businesses with multiple driveways should be redesigned to have a single driveway and those with wide openings should be reconfigured so that the driveway meets acceptable width standards (two (2) or (3) lanes of width).

VII. DEVELOPMENT PHASE

D. US 31W INTERCHANGE

VE Alternative 5



OUTPUT

Approach	Lane	Volume	Capacity	V/C	Delay (s)	Queue
Eastbound	1	610	906.8462	0.672661	4.477905	25
	2	0	906.8462	0	3.969802	0
	3	0	906.8462	0	3.969802	0
Westbound	1	650	1064.194	0.610791	3.714012	25
	2	0	1064.194	0	3.382842	0
	3	0	1064.194	0	3.382842	0
Northbound	1	0	492.7357	0	7.306148	0
	2	0	492.7357	0	7.306148	0
	3	0	492.7357	0	7.306148	0
Southbound	1	320	645.4662	0.495766	5.919578	25
	2	0	645.4662	0	5.577364	0
	3	0	645.4662	0	5.577364	0

SB RAMP US 31W

ROUNDABOUT TRAFFIC ANALYSIS USING KYTC SPREADSHEET

US 31W INTERCHANGE ROUNDABOUT @ SOUTHBOUND RAMP TERMINI
VE ALTERNATIVE 5
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	33,984.0	$2,888,640	33,984.0	$2,888,640
ADDITIONAL PAVEMENT	SY	$37.44	0.0	$0	5,468.3	$204,710
PEDESTRIAN SAFETY FENCE	LF	$247.00	0.0	$0	0.0	$0
ROADWAY EXCAVATION	CY	$7.00	0.0	$0	0.0	$0
MSE	SF	$45.00	0.0	$0	0.0	$0
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	0.0	$0
SUBTOTAL				**$2,888,640**		**$3,093,350**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$142,988		$153,121
TRAFFIC CONTROL/MOT			10.0%	$288,864		$309,335
CONTINGENCY			10.0%	$288,864		$309,335
GRAND TOTAL				**$3,609,356**		**$3,865,141**

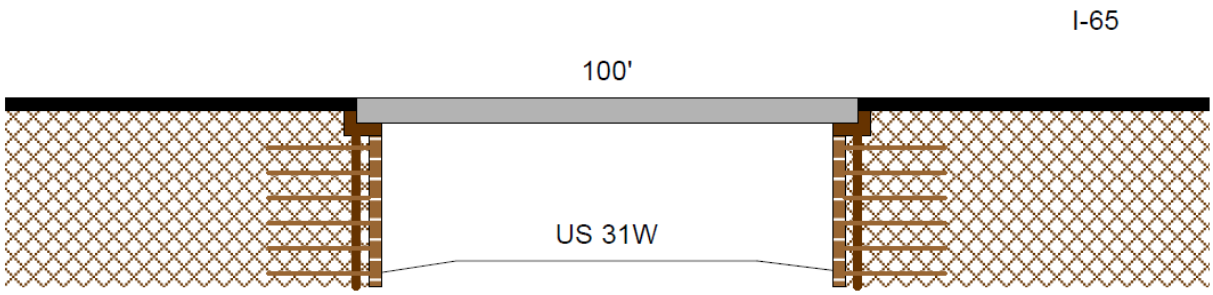
POSSIBLE ADDED COST: $255,786

VII. DEVELOPMENT PHASE

D. US 31W INTERCHANGE

VE Alternative 6

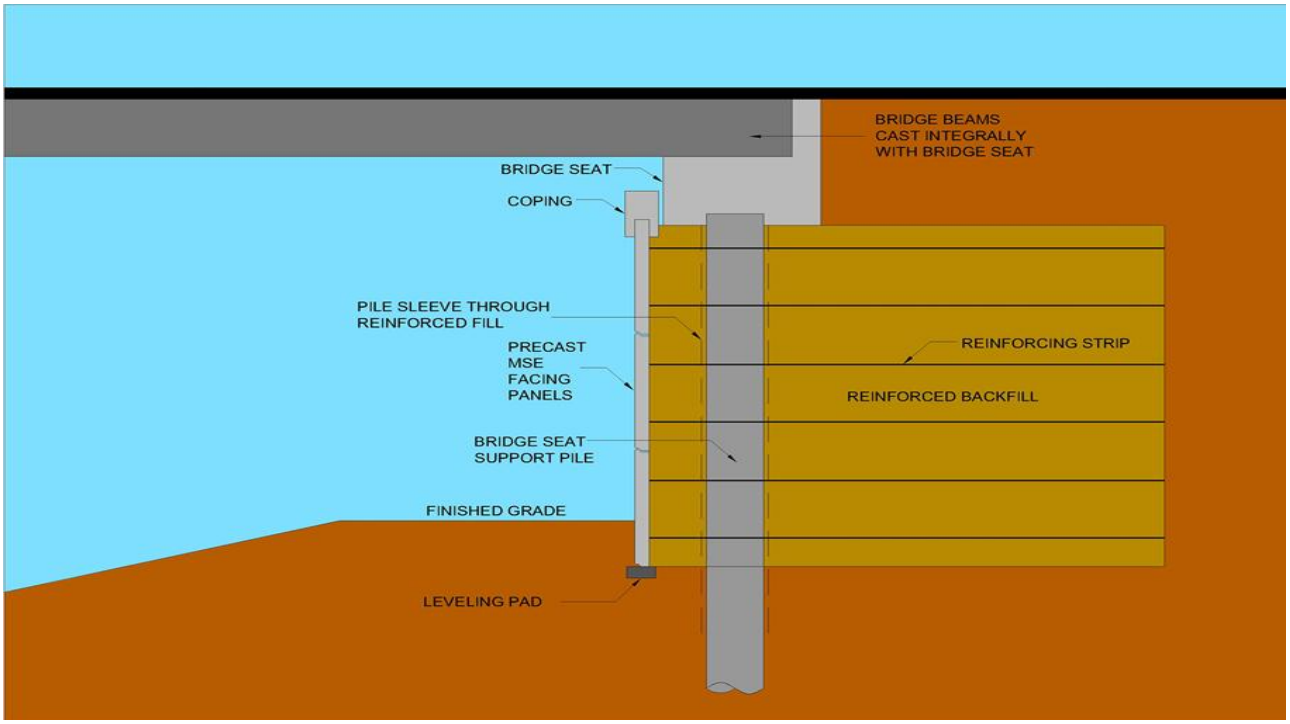
The VE Team evaluated constructing the I-65 Bridge over US 31W as a single span structure using Mechanically Stabilized Earth (MSE) Walls as shown below.



Reduced Span Length with MSE or Modular Block Walls

VE ALTERNATIVE 6
I-65 BRIDGE OVER US 31W SPAN CONFIGURATION

Either metal straps or Geogrid mats that extend from the wall into the earth fill a distance of 70% of the height of the wall will reinforce the earth. Using reinforced earth and panels reduces the length of the structure which saves on bridge construction and maintenance costs. With a smaller deck, there is less area that could freeze during cold weather.



DETAILS OF MSE WALL CONSTRUCTION

VII. DEVELOPMENT PHASE

D. US 31W INTERCHANGE

VE Alternative 6

Option 1: Construct the walls using MSE Walls.

The MSE Panels that form the wall serve only to contain the earth at the edges of the reinforcement and provide some aesthetics.

CONSTRUCTION OF MSE WALL

Option 2: Construct the walls with modular blocks.

The construction of the Modular Block Walls is completed with manual labor and requires little or no support or special equipment while being constructed. The Modular Blocks that form the walls serve only to contain the earth at the edges of the reinforcement and provide some aesthetics.

MODULAR BLOCK WALL UNDER CONSTRUCTION

VII. DEVELOPMENT PHASE

D. US 31W INTERCHANGE

VE Alternative 6

VE ALTERNATIVE 6 WITH MODULAR BLOCK WALLS

US 31W INTERCHANGE SINGLE SPAN BRIDGE MSE VERTICAL ABUTMENT
VE ALTERNATIVE 6, OPTION 1
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	33,984.0	$2,888,640	17,700.0	$1,504,500
ADDITIONAL PAVEMENT INTERSTATE	SY	$68.21	0.0	$0	1633.3	$111,406
ADDITIONAL PAVEMENT CROSSROAD	SY	$37.44	0.0	$0	0.0	$0
PEDESTRIAN SAFETY FENCE	LF	$247.00	0.0	$0	0.0	$0
ROADWAY EXCAVATION	CY	$7.00	0.0	$0	7259.3	$50,815
MSE	SF	$45.00	0.0	$0	8000.0	$360,000
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	196.0	$3,920
SUBTOTAL				**$2,888,640**		**$2,030,641**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$142,988		$100,517
TRAFFIC CONTROL/MOT			10.0%	$288,864		$203,064
CONTINGENCY			10.0%	$288,864		$203,064
GRAND TOTAL				**$3,609,356**		**$2,537,285**

POSSIBLE SAVINGS: $1,072,070

US 31W INTERCHANGE SINGLE SPAN BRIDGE MODULAR BLOCK VERTICAL ABUTMENT
VE ALTERNATIVE 6, OPTION 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	33,984.0	$2,888,640	17,700.0	$1,504,500
ADDITIONAL PAVEMENT INTERSTATE	SY	$68.21	0.0	$0	1,633.3	$111,406
ADDITIONAL PAVEMENT CROSSROAD	SY	$37.44	0.0	$0	0.0	$0
PEDESTRIAN SAFETY FENCE	LF	$247.00	0.0	$0	0.0	$0
ROADWAY EXCAVATION	CY	$7.00	0.0	$0	7,259.3	$50,815
MODULAR BLOCK WALL	SF	$25.00	0.0	$0	8,000.0	$200,000
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	196.0	$3,920
SUBTOTAL				**$2,888,640**		**$1,870,641**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$142,988		$92,597
TRAFFIC CONTROL/MOT			10.0%	$288,864		$187,064
CONTINGENCY			10.0%	$288,864		$187,064
GRAND TOTAL				**$3,609,356**		**$2,337,365**

POSSIBLE SAVINGS: $1,271,990

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 5 & VE 6

Computations for the square yard cost of crossroad pavement:

CROSS ROAD PAVEMENT

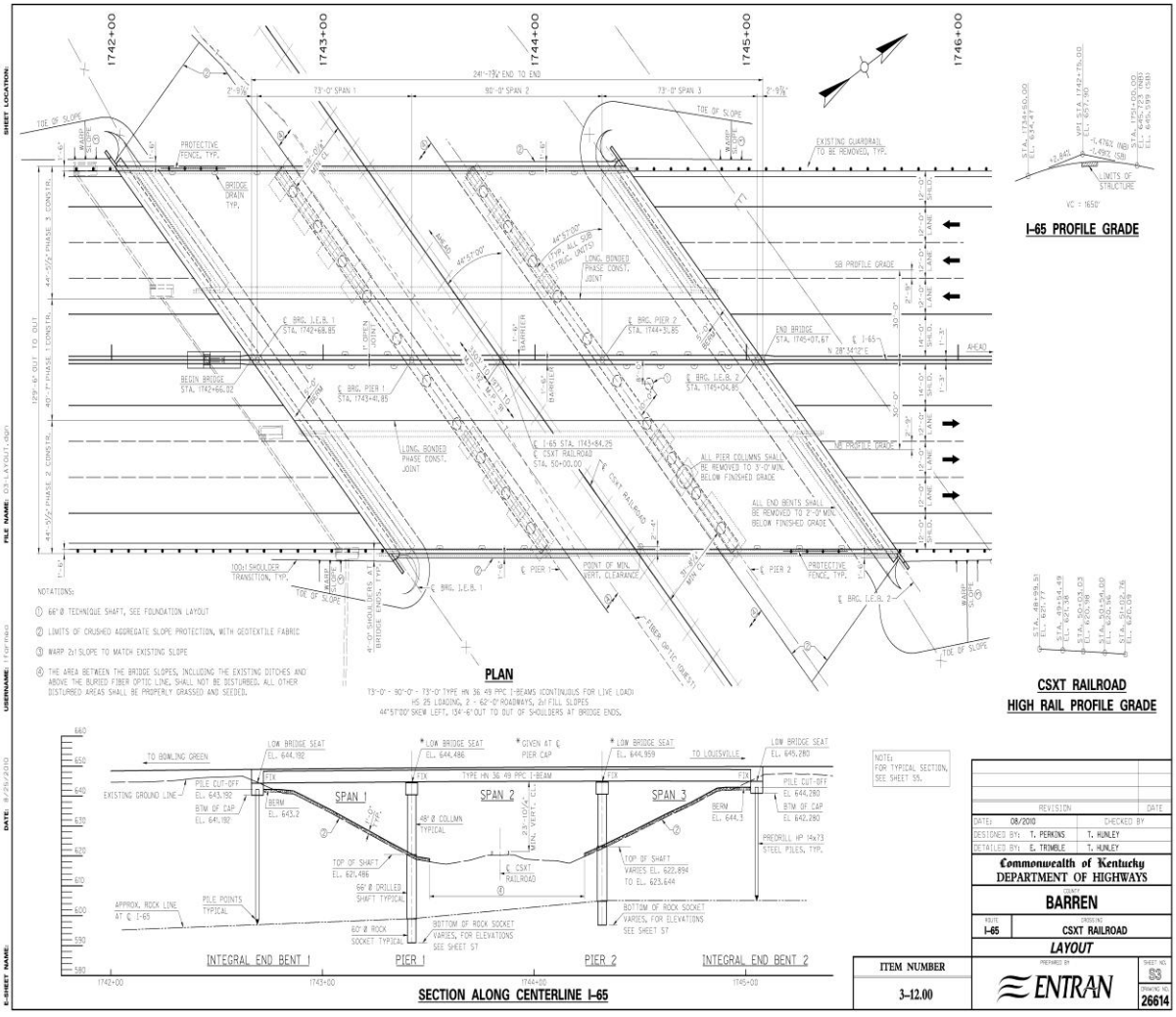
	RATE	TN	PRICE	COST
1.5 CL3 ASPHALT SURFACE 0.5D PG64-22	165	0.083	$ 69.75	$ 5.75
3" ASPHALT BASE 1.0D PG76-22	330	0.165	$ 52.57	$ 8.67
7.25" CL3 ASPHALT BASE 1.0D PG64-22	797.5	0.399	$ 48.62	$ 19.39
6" CRUSHED STONE BASE	450	0.225	$ 16.09	$ 3.62
Pavement per SY				**$ 37.44**

VII. DEVELOPMENT PHASE

E. SOUTH CSX RAILROAD BRIDGE

Original Design

The Original Design crossing of the CSX Railroad in the southern portion of the project by I-65 is a 3-span 129’-6” wide Precast Prestressed Concrete (PPC) I-Beam bridge completely replacing the existing structure. Pier construction is complicated by the karst features in the immediate vicinity of the crossing and drilled shafts with deep rock sockets are required to mitigate the impact of rock voids. The cost for replacement is estimated to be $4,982,166. The relatively high cost of the bridge is directly attributable to the extensive use of deep drilled shaft foundations at the piers due to the karst features.



ORIGINAL DESIGN

VII. DEVELOPMENT PHASE

E. SOUTH CSX RAILROAD BRIDGE

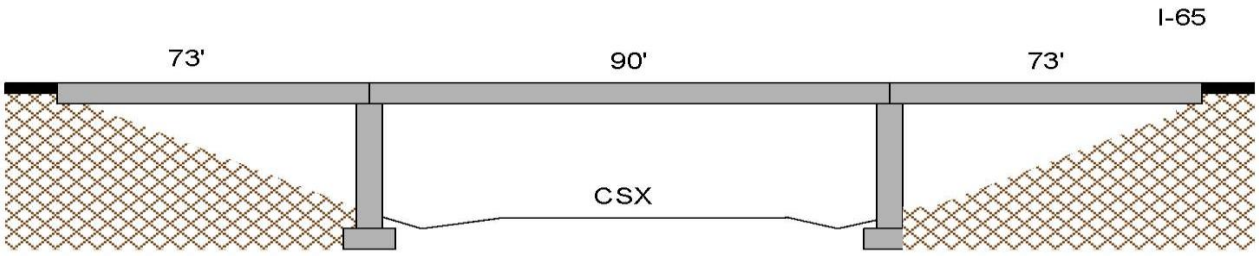
VE Alternative 7

The VE Alternative proposes to build the bridge with the proposed width and alignment but to shorten the bridges by the eliminating the end spans while maintaining the required railroad horizontal clearances and replacing them with:

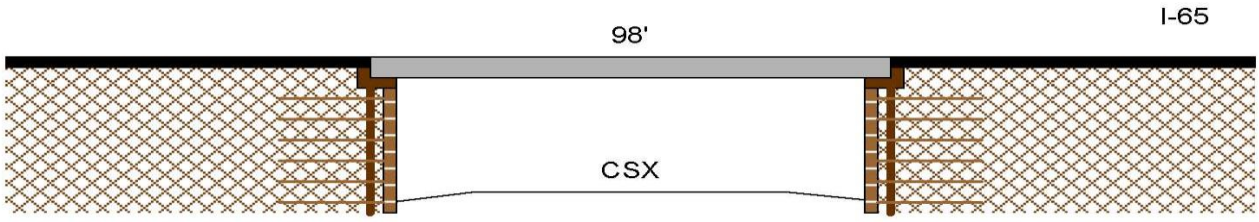
Option 1. Mechanically Stabilized Earth (MSE) Walls. The cost to replace the end spans with MSE abutments is estimated to be $3,682,523.

Option 2. Modular Block Walls. The cost to replace the end spans with Modular Block abutments is estimated to be $3,266,790.

Eliminating the end spans provides increased economy and using MSE or Modular Block abutments provides enhanced redundancy in case of a railroad derailment.



ORIGINAL DESIGN



Reduced Span Length with MSE or Modular Block Walls

I-65 OVER THE CSX RR SOUTH CROSSING(MSE WALL ALTERNATE)
VE ALTERNATIVE 7, OPTION 1
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$3,987,328		$2,821,033
ADDITIONAL PAVEMENT	SY	$37.44	0.0	$0	1,985.0	$74,318
ADDITIONAL EMBANKMENT	CY	$7.00			6,618.0	$46,326
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	276.0	$5,520
SUBTOTAL				**$3,987,328**		**$2,947,197**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		4.5%		$197,373		$145,886
TRAFFIC CONTROL/MOT		10.0%		$398,733		$294,720
CONTINGENCY		10.0%		$398,733		$294,720
GRAND TOTAL				**$4,982,166**		**$3,682,523**

POSSIBLE SAVINGS: $1,299,643

I-65 OVER CSX RR SOUTH CROSSING (MODULAR WALL ALTERNATE)
VE ALTERNATIVE 7, OPTION 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$3,987,328		$2,488,313
ADDITIONAL PAVEMENT	SY	$37.44			1,985.0	$74,318
ADDITIONAL EMBANKMENT	CY	$7.00			6,618.0	$46,326
ADDITIONAL GUARD RAIL	LF	$20.00			276.0	$5,520
SUBTOTAL				**$3,987,328**		**$2,614,477**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$197,373		$129,417
TRAFFIC CONTROL/MOT			10.0%	$398,733		$261,448
CONTINGENCY			10.0%	$398,733		$261,448
GRAND TOTAL				**$4,982,166**		**$3,266,790**

POSSIBLE SAVINGS: $1,715,377

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 7

E. I-65 over CSX RR South - MSE Abutment Alternate

origcost := 398732 from Stage I Final Plans

$VEcost := origcost + 2 \cdot 8318 ft^2 \cdot \frac{45}{ft^2}$ add estimated MSE wall area at $45/SF

estimate that eliminating 2 piers will be approx

$VEcost := VEcost - 0.60 \cdot 126256$ 60% of drilled shaft items from SIF Plans

$VEcost := VEcost - \left(3129 ft^2 - 102 ft \cdot 129.5 ft\right) \cdot \frac{64}{ft^2}$ deduct eliminated span area at $64/SF

Compute Alt 1B - Cost with Modular Block Abutments
estimate cost of Modular Block installed at $25/SF

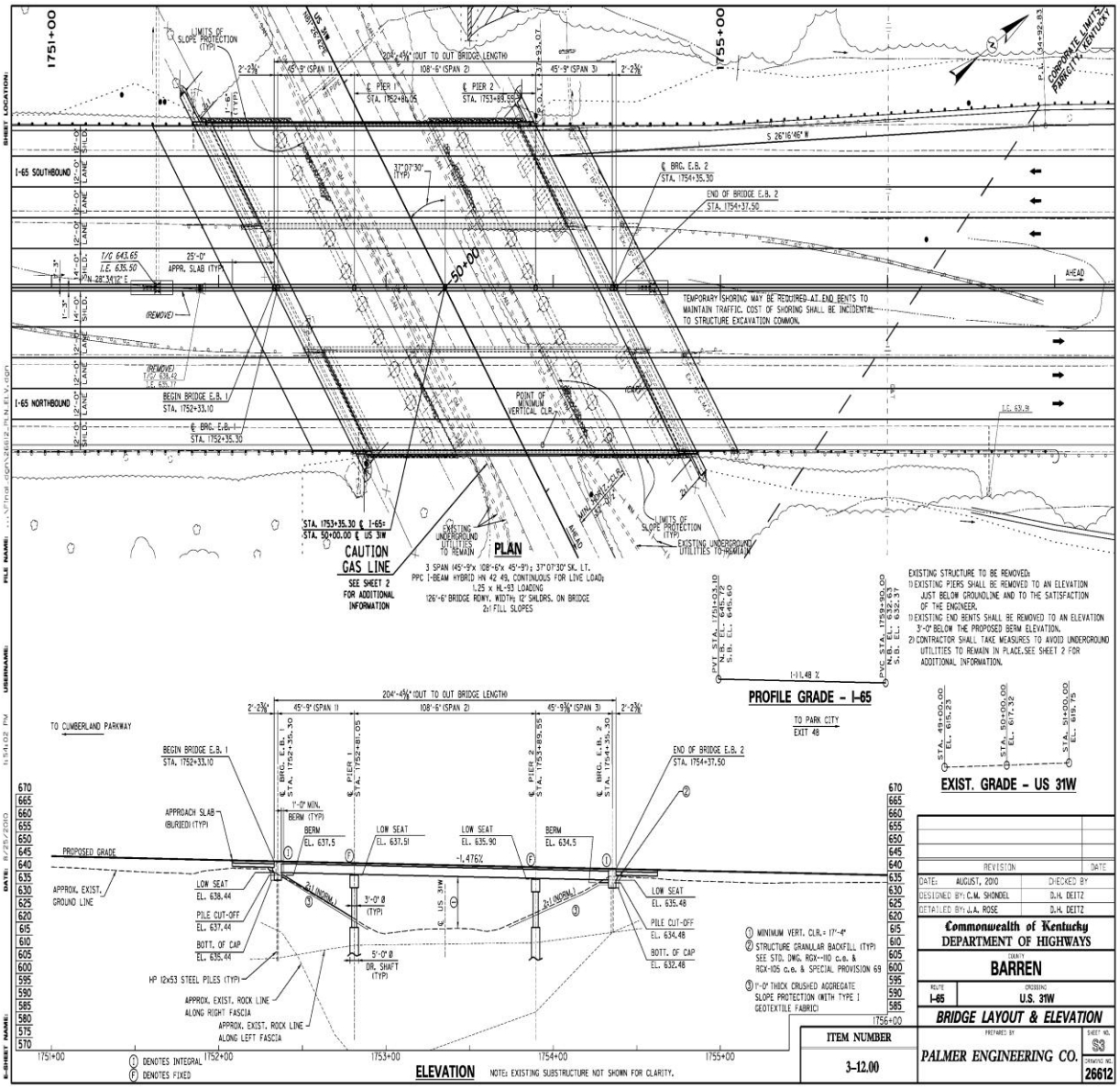
$VEcost := VEcost - 2 \cdot 8318 \cdot (45 - 25)$ Deduct cost difference between MSE & modular

VII. DEVELOPMENT PHASE

F. US 31 W GRADE SEPARATION SOUTH STRUCTURE

Original Design

The Original Design alternative for the Barren County I-65 Bridge over US 31W is to replace the entire structure with a 3-span Precast Prestressed Concrete (PPC) I-Beam bridge. The cost for this total replacement is estimated to be $3,407,382.



ORIGINAL DESIGN

VII. DEVELOPMENT PHASE

F. US 31 W GRADE SEPARATION

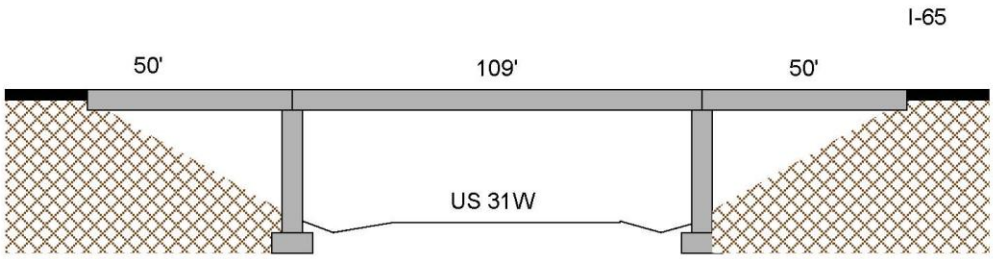
VE Alternative 8

The VE Alternative proposes to build the bridge Original Design but to shorten the bridges by the elimination of the two end spans and replacing them with:

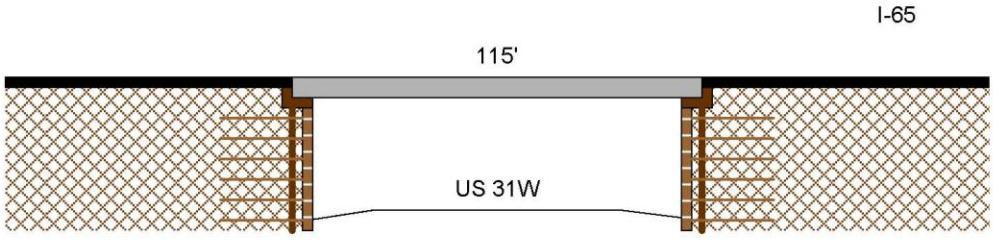
Option 1. Mechanically Stabilized Earth (MSE) Walls. The cost to replace the end spans with MSE abutments is estimated to be $2,759,534.

Option 2. Modular Block Walls. The cost to replace the end spans with Modular Block abutments is estimated to be $2,546,220.

Using either option, two piers on drilled shafts and approx. 85’ of span for the 129.5’ wide superstructure (85 X 129.5 = 11,0008 SF) are eliminated. The single span is supported by integral end bents which are supported by sleeved piles through the MSE or Modular Block Wall backfill which retains the roadway embankment.



ORIGINAL DESIGN



Reduced Span Length with MSE or Modular Block Walls

I-65 OVER US31W SOUTH GRADE SEPARATION (MSE WALL ABUTMENTS)
VE ALTERNATIVE 8, OPTION 1
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$2,726,996		$2,123,476
ADDITIONAL PAVEMENT	SY	$37.44			1,338.0	$50,095
ADDITIONAL EMBANKMENT	CY	$7.00			4,460.0	$31,220
ADDITIONAL GUARD RAIL	LF	$20.00			186.0	$3,720
SUBTOTAL				**$2,726,996**		**$2,208,511**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$134,986		$109,321
TRAFFIC CONTROL/MOT			10.0%	$272,700		$220,851
CONTINGENCY			10.0%	$272,700		$220,851
GRAND TOTAL				**$3,407,382**		**$2,759,534**

POSSIBLE SAVINGS: $647,847

I-65 OVER US31W SOUTH GRADE SEPARATION
(MODULAR WALL ABUTMENTS)
VE ALTERNATIVE 8, OPTION 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$2,726,996		$1,952,756
ADDITIONAL PAVEMENT	SY	$37.44			1,338.0	$50,095
ADDITIONAL EMBANKMENT	CY	$7.00			4,460.0	$31,220
ADDITIONAL GUARD RAIL	LF	$20.00			186.0	$3,720
SUBTOTAL				**$2,726,996**		**$2,037,791**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$134,986		$100,871
TRAFFIC CONTROL/MOT			10.0%	$272,700		$203,779
CONTINGENCY			10.0%	$272,700		$203,779
GRAND TOTAL				**$3,407,382**		**$2,546,220**

POSSIBLE SAVINGS: $861,162

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 8

F. I-65 over US31W South Crossing - MSE Abutment Alternate

$origcost := 272699$ from Stage I Final Plans

$VEcost := origcost + 2 \cdot 4268 ft^2 \cdot \frac{45}{ft^2}$ add estimated MSE wall area at $45/SF

$VEcost := VEcost - 32419$ eliminate drilled shaft items from SIF Plans for 2 piers eliminated

$VEcost := VEcost - \left(26468 ft^2 - 119 ft \cdot 129.5 ft\right) \cdot \frac{60}{ft^2}$ deduct eliminated span area at $60/SF for superstructure

Compute Alt 1B - Cost with Modular Block Abutments
estimate cost of Modular Block installed at $25/SF

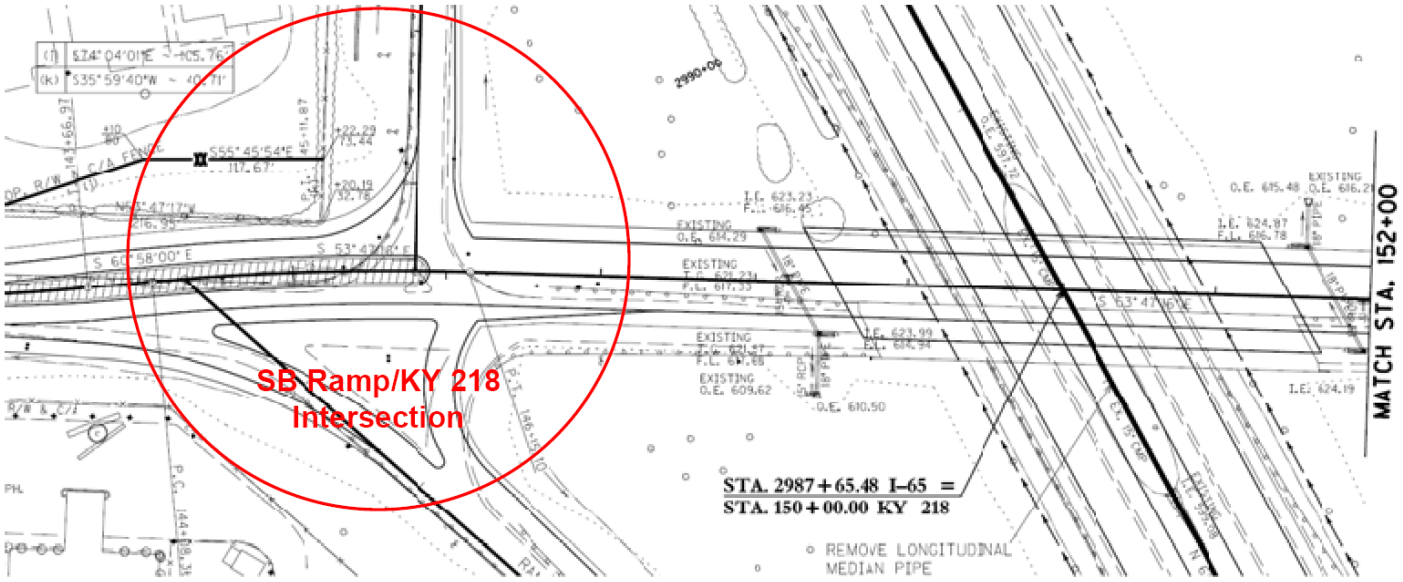
$VEcost := VEcost - 2 \cdot 4268 \cdot (45 - 25)$ Deduct cost difference between MSE & modular

VII. DEVELOPMENT PHASE

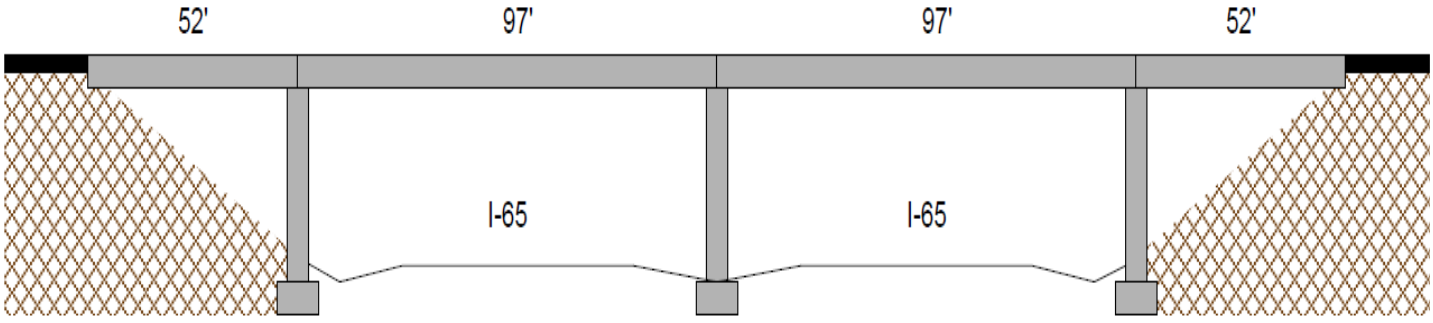
G. KY 218 INTERCHANGE

Original Design

The interchange has been designed as a conventional diamond interchange. The proposed bridge is 71’ wide, containing two through lanes, turning lane, and wide shoulders. There are two proposals: one is a four- span bridge (52’-97’-97’-52’), the other a two-span bridge (149’-149’).



ORIGINAL DESIGN KY 218 INTERCHANGE CONFIGURATION



ORIGINAL DESIGN KY 218 BRIDGE OVER I-65 SPAN CONFIGURATION

VII. DEVELOPMENT PHASE

G. KY 218 INTERCHANGE

VE Alternative 9

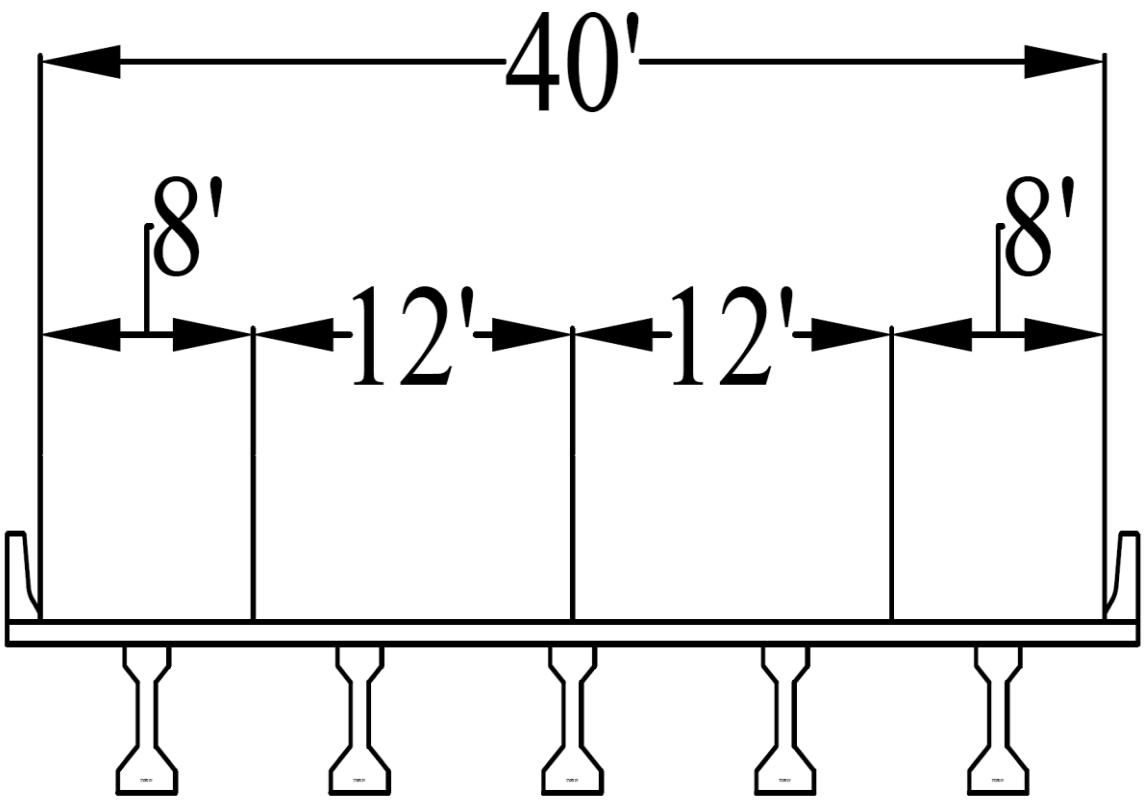
Option 1: Roundabout Intersections and Narrow Bridge

The recommendation is to reconfigure the interchange to a diamond interchange with roundabouts at the ramp terminals. By implementing this alternative, the cost is lower than the proposed alternative with very good traffic operations and spare capacity for future growth. Also, the use of roundabouts allows for safer operations due to low, consistent operating speeds through the intersections and a reduced number of conflict points.

Cost savings are realized through narrowing the bridge deck width. By implementing roundabouts the deck width is reduced by eliminating the need for turning lanes. The bridge width may also be reduced by using 12' travel lanes and six to eight foot shoulders. There is also maintenance cost savings during the life of the bridge by having a smaller deck area.

ROUNDABOUT INTERSECTION NEAR A DIAMOND INTERCHANGE

VE Alternative 9



REDUCED BRIDGE WIDTH

Option 2: Roundabout Intersections, Narrow Bridge, Shortened Bridge

This keeps the same interchange and lane configurations as in Option 1, but provides for a two-span bridge, rather than four. This reduces the total bridge length by 98' (298' versus 200'). This is achieved using either a Mechanically Stabilized Earth (MSE) or Modular Block Vertical Wall abutment.

VII. DEVELOPMENT PHASE

G. KY 218 INTERCHANGE

VE Alternative 9

OUTPUT

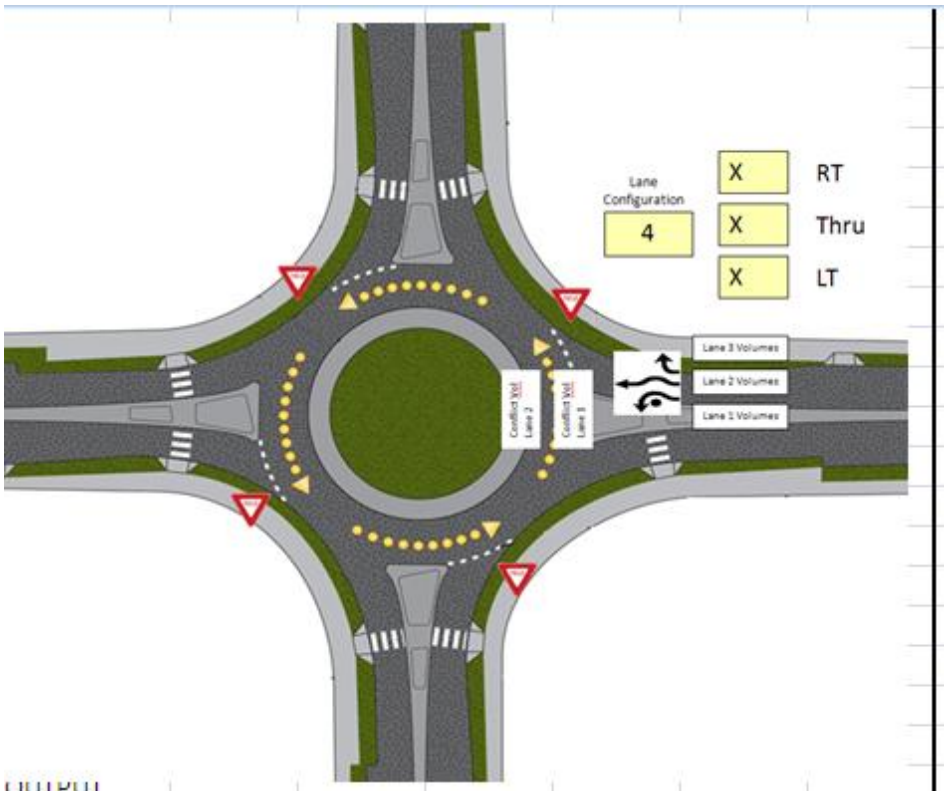
Approach	Lane	Volume	Capacity	V/C	Delay (s)	Queue
Eastbound	1	770	925.1658	0.832283	5.079352	25
	2	0	925.1658	0	3.891195	0
	3	0	925.1658	0	3.891195	0
Westbound	1	450	1130	0.39823	3.317544	25
	2	0	1130	0	3.185841	0
	3	0	1130	0	3.185841	0
Northbound	1	0	658.5055	0	5.466925	0
	2	0	658.5055	0	5.466925	0
	3	0	658.5055	0	5.466925	0
Southbound	1	420	720.5198	0.582912	5.431811	25
	2	0	720.5198	0	4.996393	0
	3	0	720.5198	0	4.996393	0

SB RAMP/KY 218

VII. DEVELOPMENT PHASE

G. KY 218 INTERCHANGE

VE Alternative 9



OUTPUT

Approach	Lane	Volume	Capacity	V/C	Delay (s)	Queue
Eastbound	1	540	1130	0.477876	3.36794	25
	2	0	1130	0	3.185841	0
	3	0	1130	0	3.185841	0
Westbound	1	260	620.1571	0.419249	6.066634	25
	2	0	620.1571	0	5.80498	0
	3	0	620.1571	0	5.80498	0
Northbound	1	360	658.5055	0.546692	5.878168	25
	2	0	658.5055	0	5.466925	0
	3	0	658.5055	0	5.466925	0
Southbound	1	0	720.5198	0	4.996393	0
	2	0	720.5198	0	4.996393	0
	3	0	720.5198	0	4.996393	0

NB RAMP/KY218

ROUNDABOUT TRAFFIC ANALYSIS USING KYTC SPREADSHEET

KY 218 INTERCHANGE ROUNDABOUT (4-SPAN)
VE ALTERNATIVE 9, OPTION 1
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	21513.0	$1,828,605	13029.0	$1,107,465
ADDITIONAL PAVEMENT	SY	$37.44	0.0	$0	3769.9	$141,130
PEDESTRIAN SAFETY FENCE	LF	$247.00	0.0	$0	0.0	$0
ROADWAY EXCAVATION	CY	$7.00	0.0	$0	5600.0	$39,200
MSE	SF	$45.00	0.0	$0	0.0	$0
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	0.0	$0
SUBTOTAL				**$1,828,605**		**$1,287,795**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$90,516		$63,746
TRAFFIC CONTROL/MOT			10.0%	$182,861		$128,780
CONTINGENCY			10.0%	$182,861		$128,780
GRAND TOTAL				**$2,284,842**		**$1,609,100**

POSSIBLE SAVINGS: $675,742

KY 218 INTERCHANGE ROUNDABOUT (2-SPAN)
VE ALTERNATIVE 9, OPTION 2
COST COMPARISON SHEET

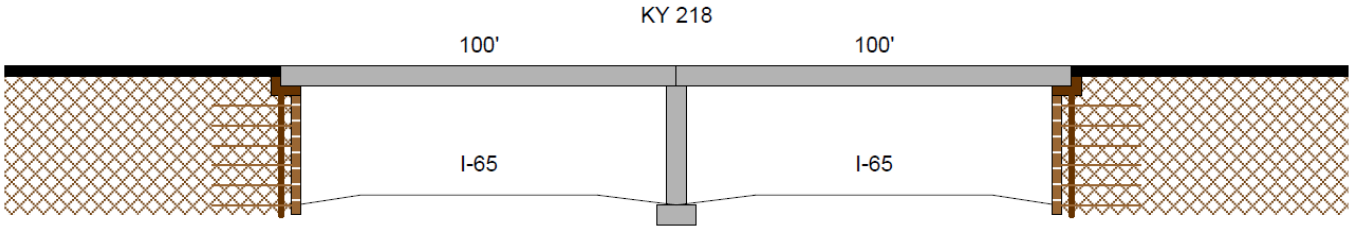
DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	21513.0	$1,828,605	8342.0	$709,070
ADDITIONAL PAVEMENT	SY	$37.44		$0	3769.9	$141,130
PEDESTRIAN SAFETY FENCE	LF	$247.00	0.0	$0	0.0	$0
ROADWAY EXCAVATION	CY	$7.00		$0	5600.0	$39,200
MSE	SF	$45.00		$0	0.0	$0
ADDITIONAL GUARD RAIL	LF	$20.00		$0	0.0	$0
SUBTOTAL				**$1,828,605**		**$889,400**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$90,516		$44,025
TRAFFIC CONTROL/MOT			10.0%	$182,861		$88,940
CONTINGENCY			10.0%	$182,861		$88,940
GRAND TOTAL				**$2,284,842**		**$1,111,305**

POSSIBLE SAVINGS: $1,173,537

G. KY 218 INTERCHANGE: Roundabout Intersections & Narrow Bridge

VE Alternative 10

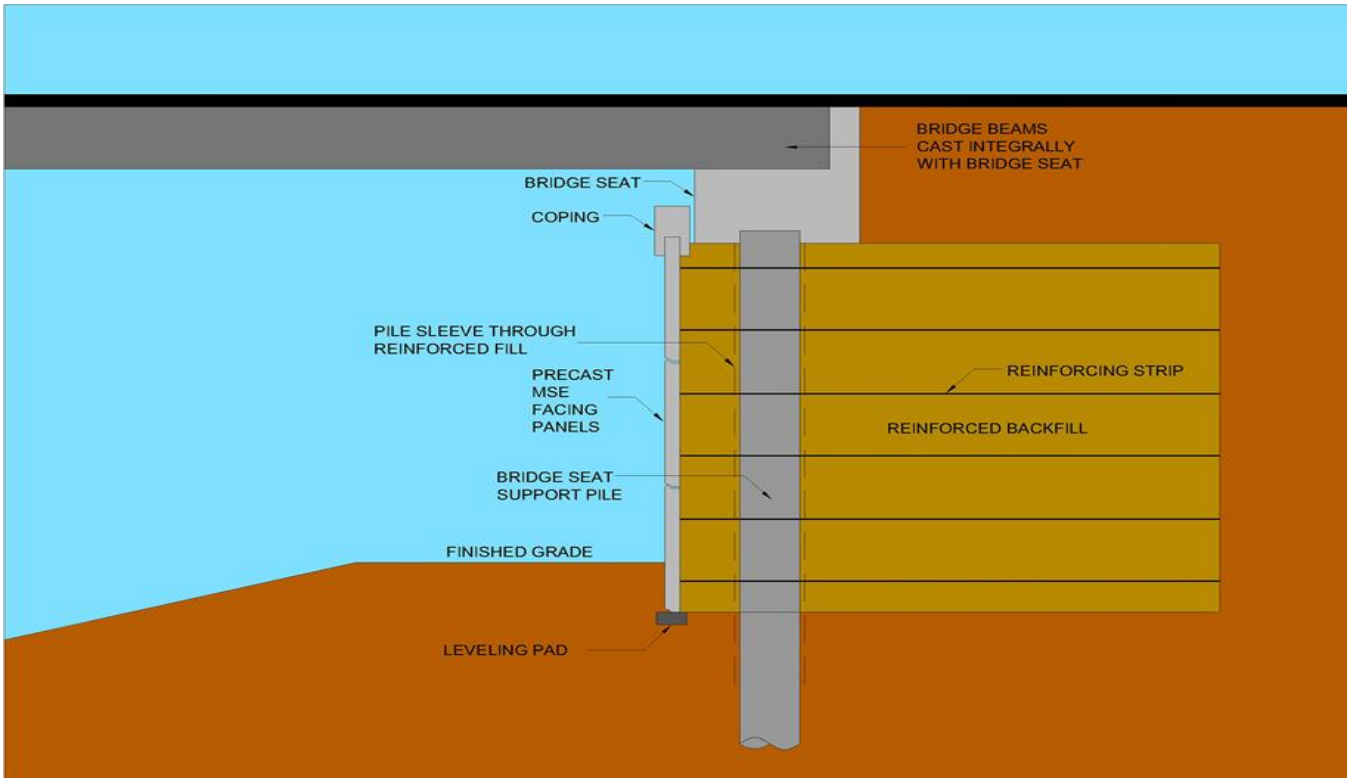
The VE Team evaluated constructing the KY 218 over I-65 Bridge as a two-span structure using Mechanically Stabilized Earth (MSE) Walls.



Reduced Span Length with MSE or Modular Block Walls

VE ALTERNATIVE 10, I-65 BRIDGE OVER KY 218 SPAN CONFIGURATION

Either metal straps or Geogrid mats that extend from the wall into the earth fill a distance of 70% of the height of the wall will reinforce the earth. Using reinforced earth and panels reduces the length of the structure which saves on bridge construction and maintenance costs. With a smaller deck, there is less area that could freeze during cold weather.



DETAILS OF MSE WALL CONSTRUCTION

VII. DEVELOPMENT PHASE

G. KY 218 INTERCHANGE: Roundabout Intersections & Narrow Bridge

VE Alternative 10

Option 1: Construct the walls using precast concrete panels.

The MSE Panels that form the wall serve only to contain the earth at the edges of the reinforcement and provide some aesthetics.

CONSTRUCTION OF MSE WALL

Option 2: Construct the walls with modular blocks.

The construction of the Modular Block Walls is completed with manual labor and requires little or no support or special equipment while being constructed. The Modular Blocks that form the walls serve only to contain the earth at the edges of the reinforcement and provide some aesthetics.

MODULAR BLOCK WALL UNDER CONSTRUCTION

VII. DEVELOPMENT PHASE

G. KY 218 INTERCHANGE: Roundabout Intersections & Narrow Bridge

VE Alternative 10

VE ALTERNATIVE WITH MODULAR BLOCK WALLS

KY 218 INTERCHANGE DIAMOND (2-SPAN) MSE ABUTMENT
VE ALTERNATIVE 10, OPTION 1
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	21,513.0	$1,828,605	13,774.0	$1,170,790
ADDITIONAL PAVEMENT	SY	$37.44	0.0	$0	1,450.7	$54,307
PEDESTRIAN SAFETY FENCE	LF	$247.00	0.0	$0	0.0	$0
ROADWAY EXCAVATION	CY	$7.00	0.0	$0	4,391.1	$30,738
MSE	SF	$45.00	0.0	$0	4,560.0	$205,200
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	204.0	$4,080
SUBTOTAL				**$1,828,605**		**$1,465,115**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$90,516		$72,523
TRAFFIC CONTROL/MOT			10.0%	$182,861		$146,511
CONTINGENCY			10.0%	$182,861		$146,511
GRAND TOTAL				**$2,284,842**		**$1,830,661**

POSSIBLE SAVINGS: $454,181

KY 218 INTERCHANGE DIAMOND (2-SPAN) MODULAR BLOCK ABUTMENT
VE ALTERNATIVE 10, OPTION 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	21,513.0	$1,828,605	13,774.0	$1,170,790
ADDITIONAL PAVEMENT	SY	$37.44	0.0	$0	1,450.7	$54,307
PEDESTRIAN SAFETY FENCE	LF	$247.00	606.0	$149,682	0.0	$0
ROADWAY EXCAVATION	CY	$7.00	0.0	$0	4,391.1	$30,738
MODULAR BLOCK	SF	$25.00	0.0	$0	4,560.0	$114,000
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	204.0	$4,080
SUBTOTAL				**$1,978,287**		**$1,373,915**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$97,925		$68,009
TRAFFIC CONTROL/MOT			10.0%	$197,829		$137,391
CONTINGENCY			10.0%	$197,829		$137,391
GRAND TOTAL				**$2,471,870**		**$1,716,707**

POSSIBLE SAVINGS: $755,163

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 9 & VE 10

CROSS ROAD PAVEMENT

	RATE	TN	PRICE	COST
1.5 CL3 ASPHALT SURFACE 0.5D PG64-22	165	0.083	$ 69.75	$ 5.75
3" ASPHALT BASE 1.0D PG76-22	330	0.165	$ 52.57	$ 8.67
7.25" CL3 ASPHALT BASE 1.0D PG64-22	797.5	0.399	$ 48.62	$ 19.39
6" CRUSHED STONE BASE	450	0.225	$ 16.09	$ 3.62
Pavement per SY				**$ 37.44**

ROUNDABOUT PAVEMENT

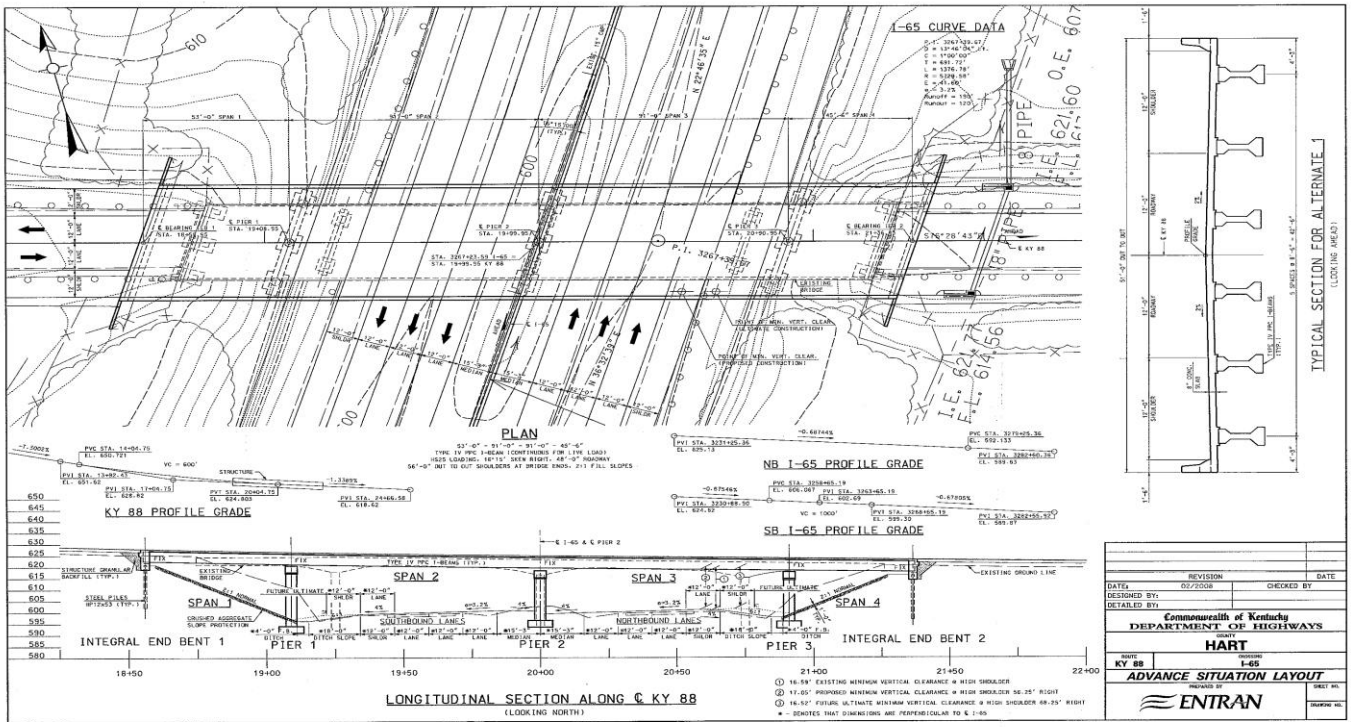
75	17671.46	
105	34636.06	
	16964.6	SF
	1885	SY

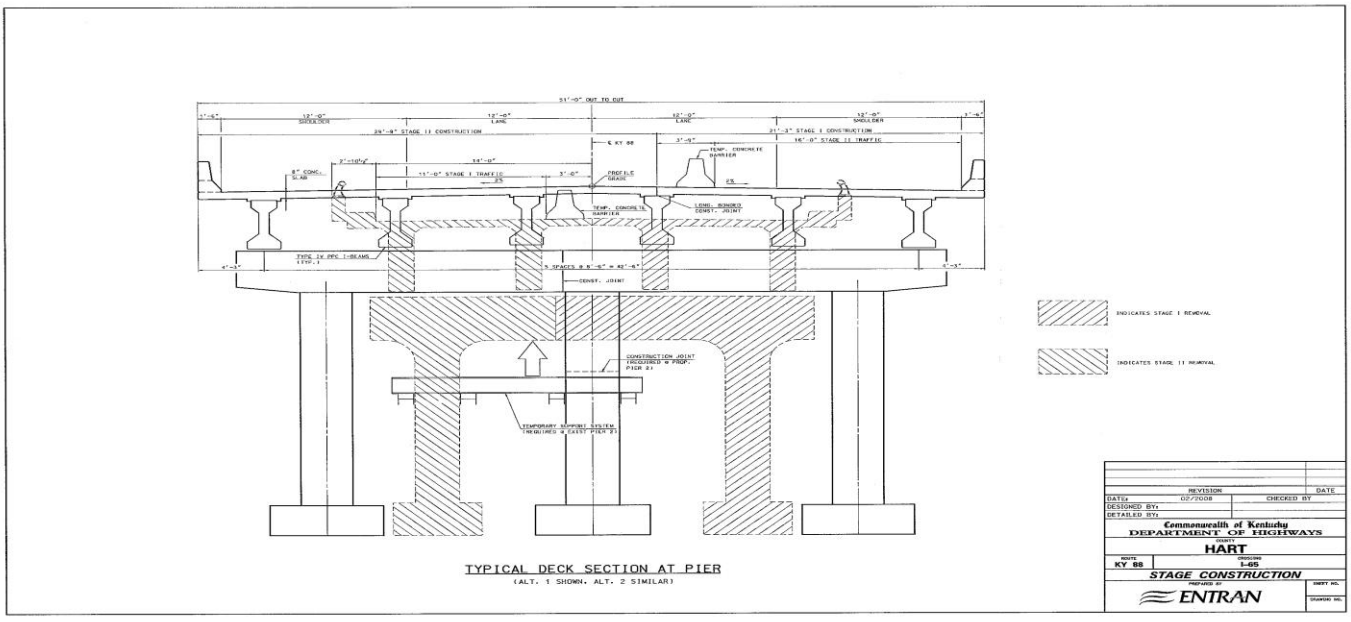
VII. DEVELOPMENT PHASE

H. KY 88 GRADE SEPARATION

Original Design

The Original Design KY 88 Bridge over I-65 is to replace the existing structure with a 4-span Precast Prestressed Concrete (PPC) I-Beam bridge. The bridge would carry 2~ 12' lanes and 12' shoulders.





VII. DEVELOPMENT PHASE

H. KY 88 GRADE SEPARATION

VE Alternative 11

The VE Alternative for this structure is that the existing superstructure will be raised by jacking at the piers and bents to achieve a minimum of 16'-6" vertical clearance. The superstructure deck will also be widened to provide 12' lanes with minimum 3' shoulders. This alternate permits maximum use of the existing structure which is in good to fair condition.

KY88 OVER I-65 (RAISING EXIST SUPERSTR)
VE ALTERNATIVE 11
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$958,825		$441,250
SUBTOTAL				**$958,825**		**$441,250**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$47,462		$21,842
TRAFFIC CONTROL/MOT			10.0%	$95,883		$44,125
CONTINGENCY			10.0%	$95,883		$44,125
GRAND TOTAL				**$1,198,052**		**$551,342**

POSSIBLE SAVINGS: $646,710

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 11

PROJECT

JACK EXISTING BRIDGE/REPLACE AT 35 YEARS

75 Year Life Cycle Cost Comparison

Enter the Interest Rate = 5%

		ORIGINAL DESIGN		VE ALT 11	
Year		Total	Present Worth	Total	Worth
0	INITIAL COST	$1,198,052	-$1,198,052	$551,342	-$551,342
1	ANNUAL MAINT	$2,500	-$2,381	$5,000	-$4,762
2	ANNUAL MAINT	$2,500	-$2,268	$5,000	-$4,535
3	ANNUAL MAINT	$2,500	-$2,160	$5,000	-$4,319
4	ANNUAL MAINT	$2,500	-$2,057	$5,000	-$4,114
5	ANNUAL MAINT	$2,500	-$1,959	$5,000	-$3,918
6	ANNUAL MAINT	$2,500	-$1,866	$5,000	-$3,731
7	ANNUAL MAINT	$2,500	-$1,777	$5,000	-$3,553
8	ANNUAL MAINT	$2,500	-$1,692	$5,000	-$3,384
9	ANNUAL MAINT	$2,500	-$1,612	$5,000	-$3,223
10	ANNUAL MAINT	$2,500	-$1,535	$5,000	-$3,070
11	ANNUAL MAINT	$2,500	-$1,462	$5,000	-$2,923
12	ANNUAL MAINT	$2,500	-$1,392	$5,000	-$2,784
13	ANNUAL MAINT	$2,500	-$1,326	$5,000	-$2,652
14	ANNUAL MAINT	$2,500	-$1,263	$5,000	-$2,525
15	ANNUAL MAINT	$2,500	-$1,203	$5,000	-$2,405
16	ANNUAL MAINT	$2,500	-$1,145	$5,000	-$2,291
17	ANNUAL MAINT	$2,500	-$1,091	$5,000	-$2,181
18	ANNUAL MAINT	$2,500	-$1,039	$5,000	-$2,078
19	ANNUAL MAINT	$2,500	-$989	$5,000	-$1,979
20	ANNUAL MAINT	$2,500	-$942	$5,000	-$1,884
21	ANNUAL MAINT	$2,500	-$897	$5,000	-$1,795
22	ANNUAL MAINT	$2,500	-$855	$5,000	-$1,709
23	ANNUAL MAINT	$2,500	-$814	$5,000	-$1,628
24	ANNUAL MAINT	$2,500	-$775	$5,000	-$1,550
25	ANNUAL MAINT	$2,500	-$738	$5,000	-$1,477
26	ANNUAL MAINT	$2,500	-$703	$5,000	-$1,406
27	ANNUAL MAINT	$2,500	-$670	$5,000	-$1,339
28	ANNUAL MAINT	$2,500	-$638	$5,000	-$1,275
29	ANNUAL MAINT	$2,500	-$607	$5,000	-$1,215
30	ANNUAL MAINT	$2,500	-$578	$5,000	-$1,157
31	ANNUAL MAINT	$2,500	-$551	$5,000	-$1,102
32	ANNUAL MAINT	$2,500	-$525	$5,000	-$1,049
33	ANNUAL MAINT	$2,500	-$500	$5,000	-$999
34	ANNUAL MAINT	$2,500	-$476	$5,000	-$952

Year		Total	Present Worth	Total	Worth
35	REPLACE BRIDGE	$2,500	-$453	$1,198,052	-$217,195
36	ANNUAL MAINT	$2,500	-$432	$2,500	-$432
37	ANNUAL MAINT	$2,500	-$411	$2,500	-$411
38	ANNUAL MAINT	$2,500	-$392	$2,500	-$392
39	ANNUAL MAINT	$2,500	-$373	$2,500	-$373
40	ANNUAL MAINT	$2,500	-$355	$2,500	-$355
41	ANNUAL MAINT	$2,500	-$338	$2,500	-$338
42	ANNUAL MAINT	$2,500	-$322	$2,500	-$322
43	ANNUAL MAINT	$2,500	-$307	$2,500	-$307
44	ANNUAL MAINT	$2,500	-$292	$2,500	-$292
45	ANNUAL MAINT	$2,500	-$278	$2,500	-$278
46	ANNUAL MAINT	$2,500	-$265	$2,500	-$265
47	ANNUAL MAINT	$2,500	-$252	$2,500	-$252
48	ANNUAL MAINT	$2,500	-$240	$2,500	-$240
49	ANNUAL MAINT	$2,500	-$229	$2,500	-$229
50	ANNUAL MAINT	$2,500	-$218	$2,500	-$218
51	ANNUAL MAINT	$2,500	-$208	$2,500	-$208
52	ANNUAL MAINT	$2,500	-$198	$2,500	-$198
53	ANNUAL MAINT	$2,500	-$188	$2,500	-$188
54	ANNUAL MAINT	$2,500	-$179	$2,500	-$179
55	ANNUAL MAINT	$2,500	-$171	$2,500	-$171
56	ANNUAL MAINT	$2,500	-$163	$2,500	-$163
57	ANNUAL MAINT	$2,500	-$155	$2,500	-$155
58	ANNUAL MAINT	$2,500	-$148	$2,500	-$148
59	ANNUAL MAINT	$2,500	-$141	$2,500	-$141
60	ANNUAL MAINT	$2,500	-$134	$2,500	-$134
61	ANNUAL MAINT	$2,500	-$127	$2,500	-$127
62	ANNUAL MAINT	$2,500	-$121	$2,500	-$121
63	ANNUAL MAINT	$2,500	-$116	$2,500	-$116
64	ANNUAL MAINT	$2,500	-$110	$2,500	-$110
65	ANNUAL MAINT	$2,500	-$105	$2,500	-$105
66	ANNUAL MAINT	$2,500	-$100	$2,500	-$100
67	ANNUAL MAINT	$2,500	-$95	$2,500	-$95
68	ANNUAL MAINT	$2,500	-$91	$2,500	-$91
69	ANNUAL MAINT	$2,500	-$86	$2,500	-$86
70	ANNUAL MAINT	$2,500	-$82	$2,500	-$82
71	ANNUAL MAINT	$2,500	-$78	$2,500	-$78
72	ANNUAL MAINT	$2,500	-$75	$2,500	-$75
73	ANNUAL MAINT	$2,500	-$71	$2,500	-$71
74	ANNUAL MAINT	$2,500	-$68	$2,500	-$68
75	ANNUAL MAINT	$2,500	-$64	$2,500	-$64
75	SALVAGE	$0	$0	$638,961	-$16,454
			-$1,246,764		**-$873,733**

Life Cycle Cost Savings **$373,032**

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 11

H. KY88 over I-65 - Raise Bridge ALT

$VEcost := 25000$ Estimate Cost for Jacking Bridge approx. 12"

$VEcost := VEcost + 25 \cdot 90$ add cost of Concrete to extend Abut & Pier seats at $900/CY conc and $1.10/lb reinf

$VEcost := VEcost + 4000 \cdot 1.1$

$VEcost := VEcost + 510 \cdot 10$ add 510 LF of Type 3 Barrier at $100/LF

$VEcost := VEcost + 95 \cdot 51$ add 95 CY Class AA conc in extended overhangs at $510/CY

$VEcost := VEcost + 22000 \cdot 1.1$ add 22000lbs epoxy coated reinf in overhangs at $1.15/lb

$VEcost := VEcost + 66 \cdot 40$ add 66LF replace exp joint at $400/LF

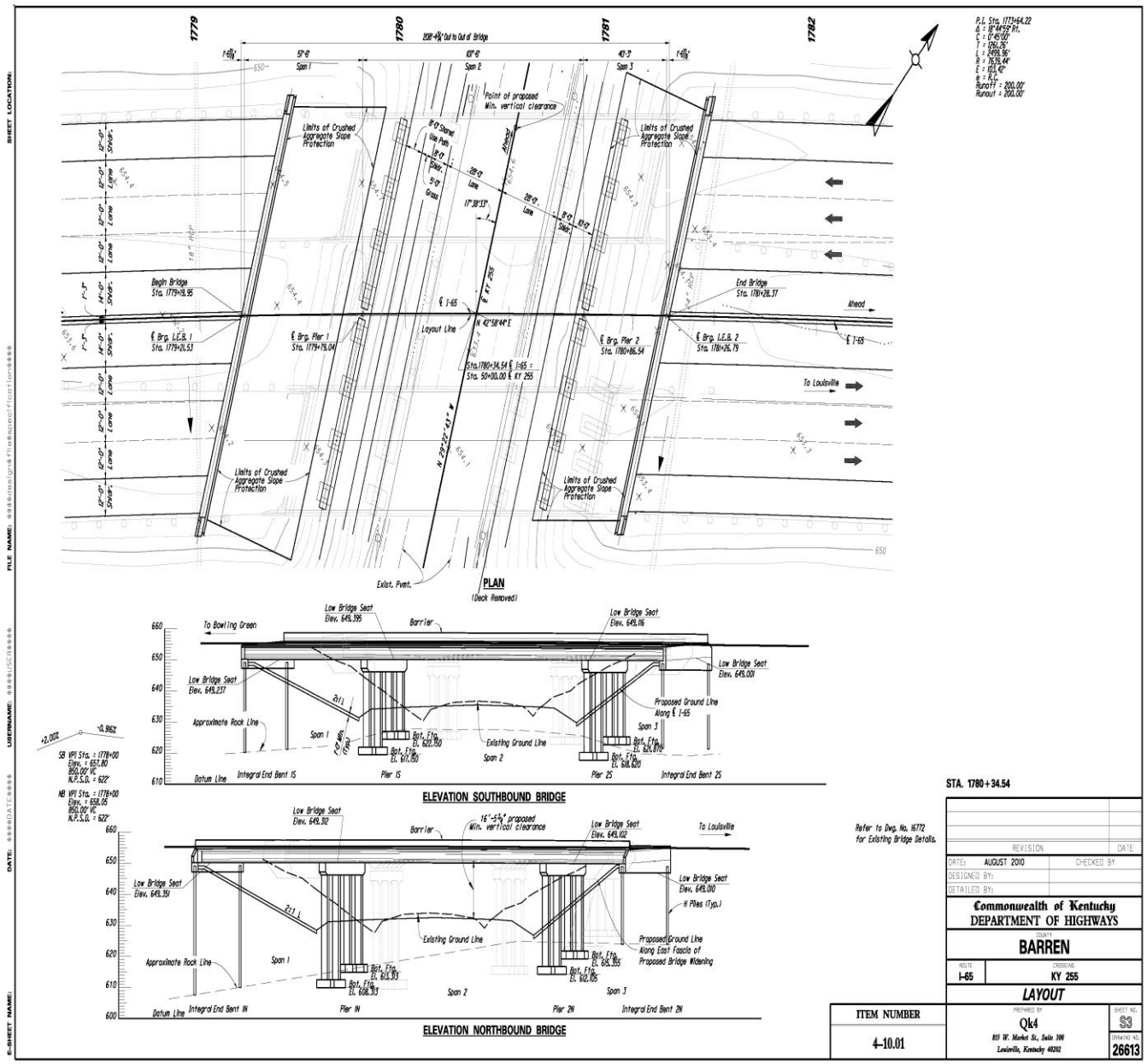
$VEcost := VEcost + 66 \cdot 20$ add 66LF replace Armored Edge at $200/LF

VII. DEVELOPMENT PHASE

I. KY 255 INTERCHANGE BRIDGE

Original Design

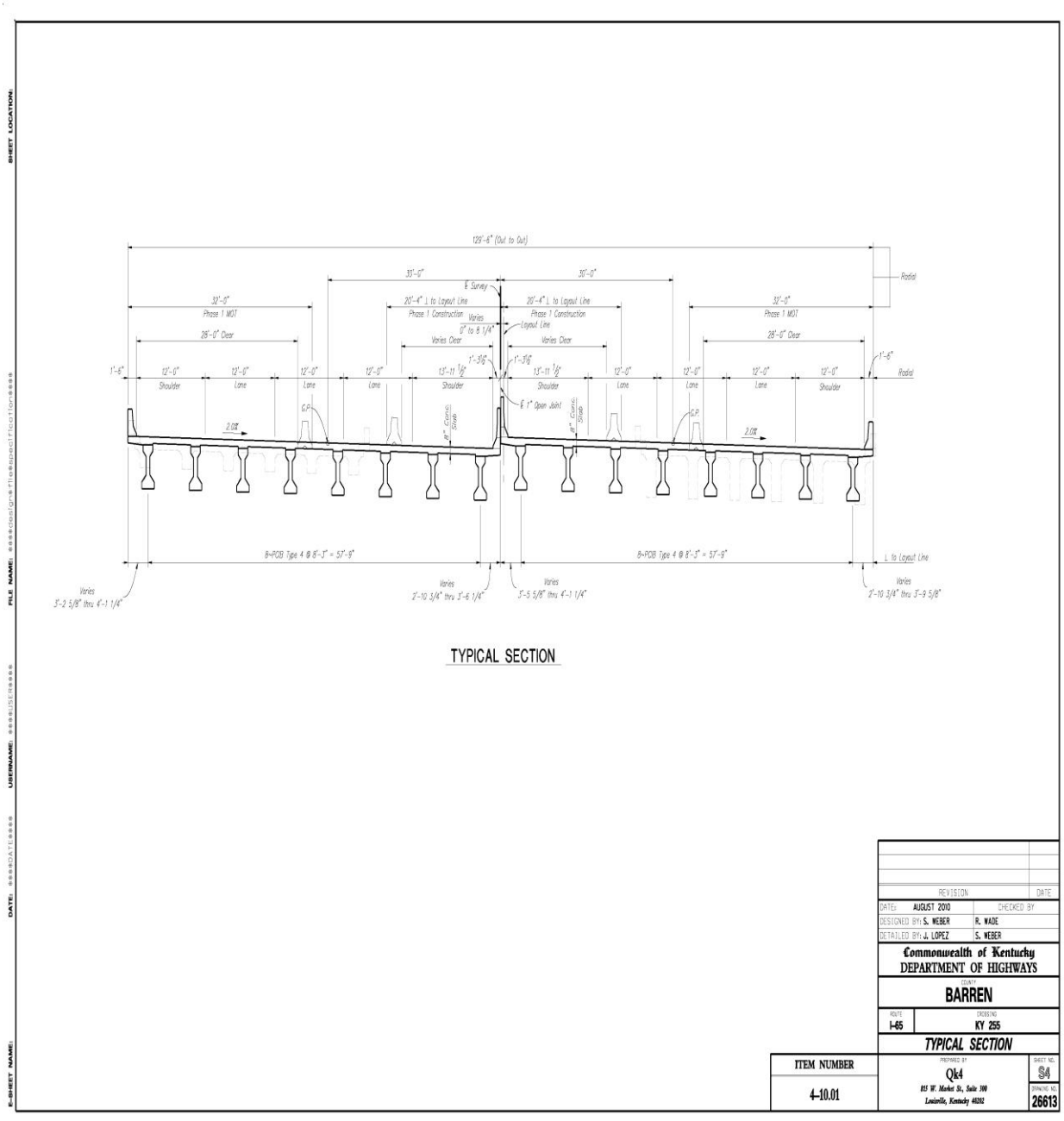
The Original Design I-65 bridge over KY 255 is to build a new 129'-6" wide 3-span Precast Prestressed Concrete (PPC) I-Beam structure to cross KY 255 including 8' sidewalks and an 8' shared use path on one side of KY 255.



VII. DEVELOPMENT PHASE

I. KY 255 INTERCHANGE BRIDGE

Original Design



TYPICAL SECTION

REVISION	DATE
DATE: AUGUST 2010	CHECKED BY
DESIGNED BY: S. WEBER	R. WADE
DETAILED BY: J. LOPEZ	S. WEBER

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: BARREN

ROUTE: I-65 | CROSSING: KY 255

TYPICAL SECTION

ITEM NUMBER: 4-10.01

PREPARED BY: Qk4
815 W. Market St., Suite 300
Louisville, Kentucky 40202

SHEET NO.: S4

DRAWING NO.: 26613

E-SHEET NAME: DATE: USERNAME: FILE NAME: SHEET LOCATION:

VII. DEVELOPMENT PHASE

I. KY 255 INTERCHANGE BRIDGE

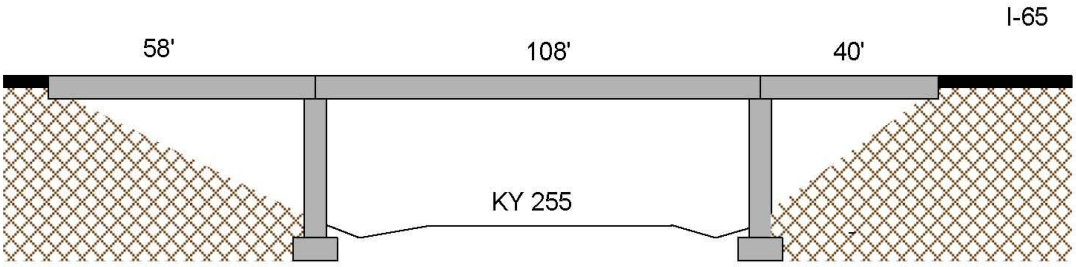
VE Alternative 12

The VE Alternative proposes to build the bridge at the proposed 129'-6" width but shortens the structure by eliminating the two end spans (approx. 92' total) and replacing them with:

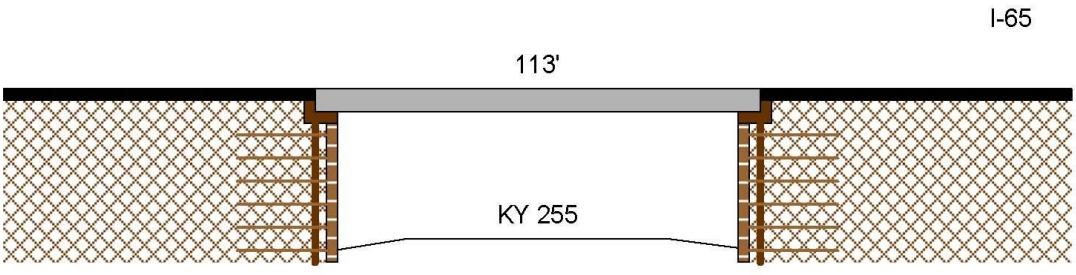
Option 1. Mechanically Stabilized Earth (MSE) Walls. The cost to replace the end spans with MSE abutments is estimated to be $2,572,277.

Option 2. Modular Block Walls. The cost to replace the end spans with Modular Block abutments is estimated to be $2,319,378.

Eliminating the end spans was done to improve economics without sacrificing functionality.



ORIGINAL DESIGN



Reduced Span Length with MSE or Modular Block Walls

I-65 OVER KY255 (MSE WALL ABUTMENTS)
VE ALTERNATIVE 12, OPTION 1
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$2,236,845		$1,974,297
ADDITIONAL PAVEMENT	SY	$37.44			1,327.0	$49,683
ADDITIONAL EMBANKMENT	CY	$7.00			4,425.0	$30,975
ADDITIONAL GUARD RAIL	LF	$20.00			184.5	$3,690
SUBTOTAL				**$2,236,845**		**$2,058,645**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$110,724		$101,903
TRAFFIC CONTROL/MOT			10.0%	$223,685		$205,864
CONTINGENCY			10.0%	$223,685		$205,864
GRAND TOTAL				**$2,794,938**		**$2,572,277**

POSSIBLE SAVINGS: $222,661

I-65 OVER KY255 (MODULAR WALL ABUTMENTS)
VE ALTERNATIVE 12, OPTION 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$2,236,845		$1,771,897
ADDITIONAL PAVEMENT	SY	$37.44			1327.0	$49,683
ADDITIONAL EMBANKMENT	CY	$7.00			4425.0	$30,975
ADDITIONAL GUARD RAIL	LF	$20.00			184.5	$3,690
SUBTOTAL				**$2,236,845**		**$1,856,245**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$110,724		$91,884
TRAFFIC CONTROL/MOT			10.0%	$223,685		$185,624
CONTINGENCY			10.0%	$223,685		$185,624
GRAND TOTAL				**$2,794,938**		**$2,319,378**

POSSIBLE SAVINGS: $475,560

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 12

I. I-65 over KY255 - MSE Abutment Alternate

$origcost := 223684$ from Stage I Final Plans

$VEcost := origcost + 2 \cdot 5060\,ft^2 \cdot \frac{45}{ft^2}$ add estimated MSE wall area at $45/SF

$VEcost := VEcost - \left(26987.8\,ft^2 - 116\,ft \cdot 129.5\,ft\right) \cdot \frac{60}{ft^2}$ deduct eliminated span area at $60/SF for superstructure

Compute Alt 1B - Cost with Modular Block Abutments
estimate cost of Modular Block installed at $25/SF

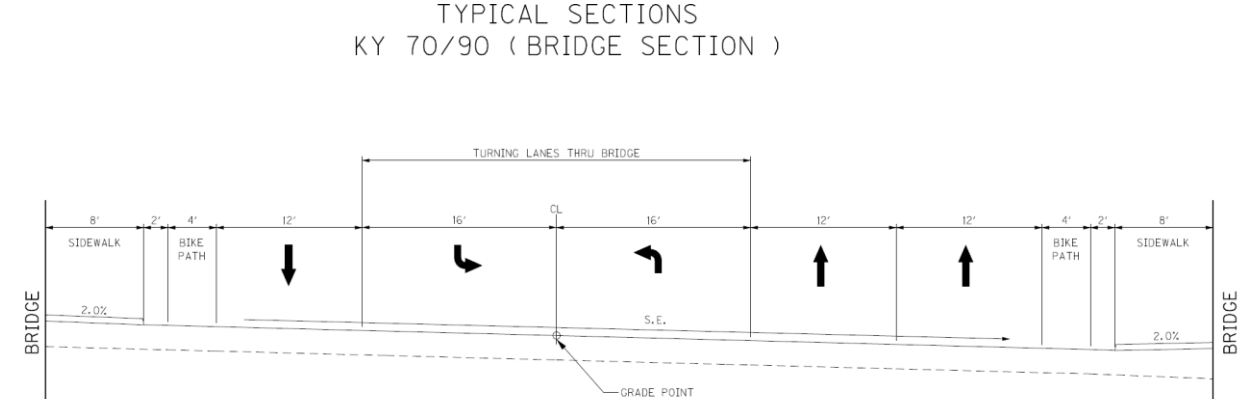
$VEcost := VEcost - 2 \cdot 5060 \cdot (45 - 25)$ Deduct cost difference between MSE & modular

VII. DEVELOPMENT PHASE

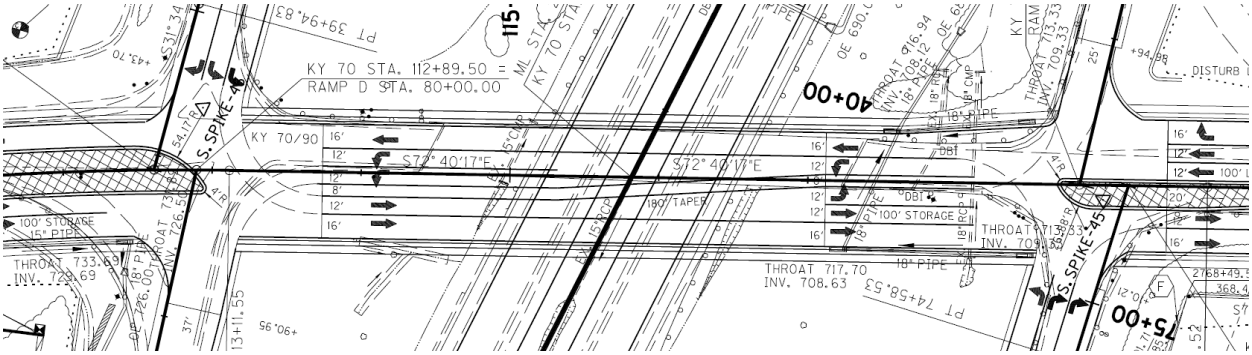
J. KY 70/KY 90 INTERCHANGE

Original Design

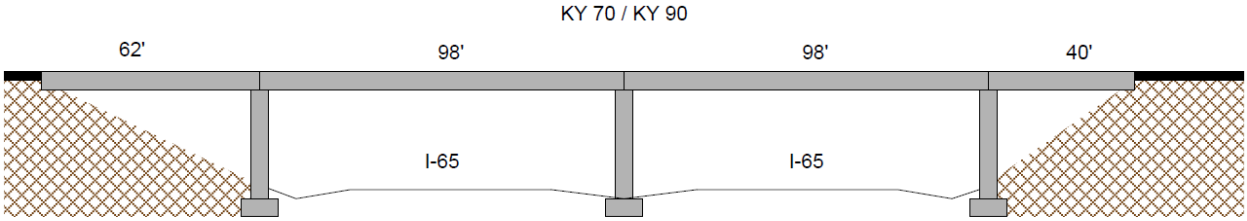
The interchange has been designed as a conventional diamond interchange. The proposed bridge is 96’ wide, containing three through lanes, turning lanes, two bicycle lanes and two sidewalks. There is a pedestrian fence on both sides of the bridge adjacent to the sidewalk. The through lanes are designed to accommodate an unbalanced traffic situation. There are four bridge spans (62’-98’-98’-40’).



ORIGINAL DESIGN KY 70/KY 90 BRIDGE TYPICAL SECTION



ORIGINAL DESIGN KY 70/KY 90 INTERCHANGE LAYOUT

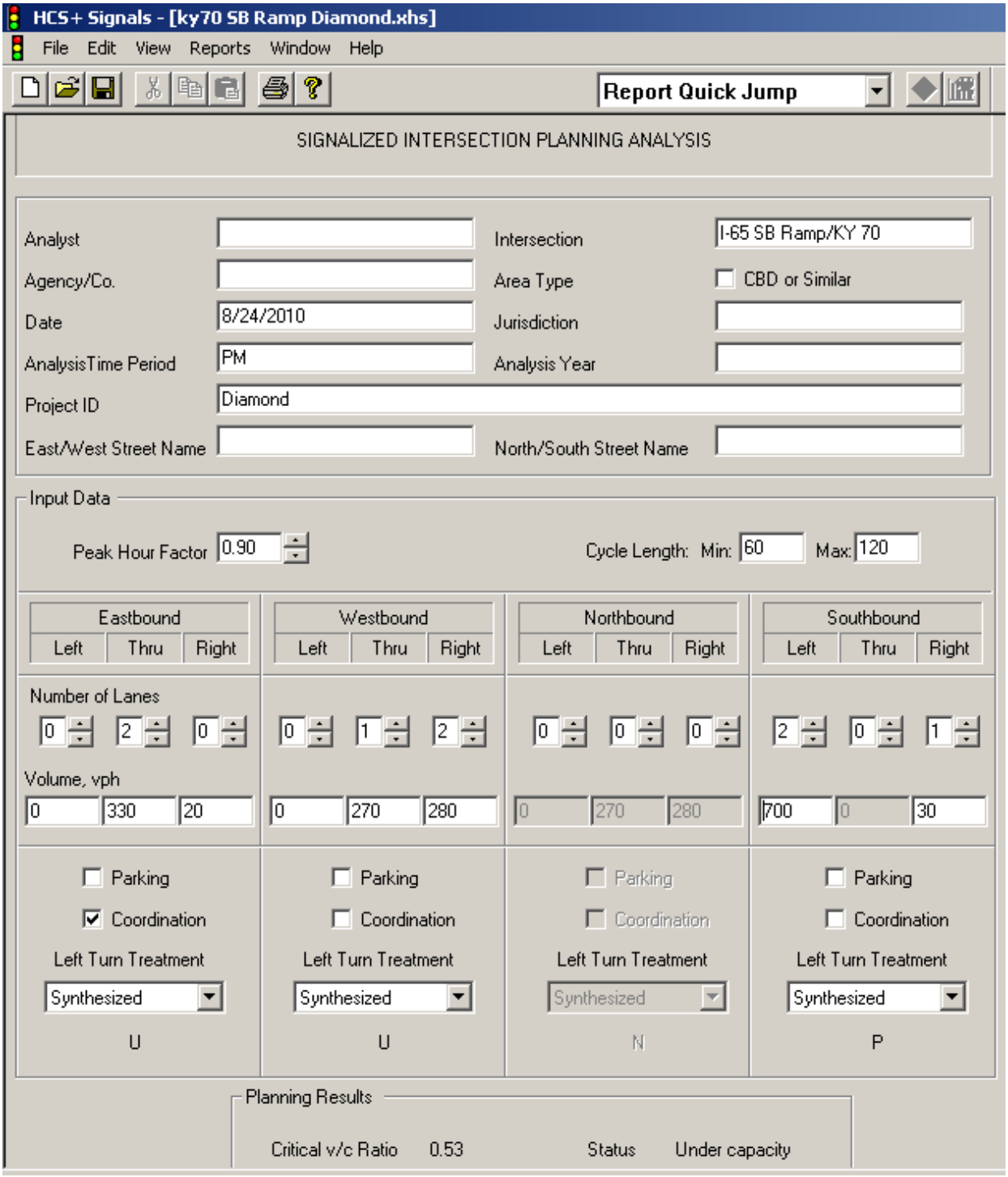


ORIGINAL DESIGN KY 70/KY 90 BRIDGE SPAN CONFIGURATION

VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE

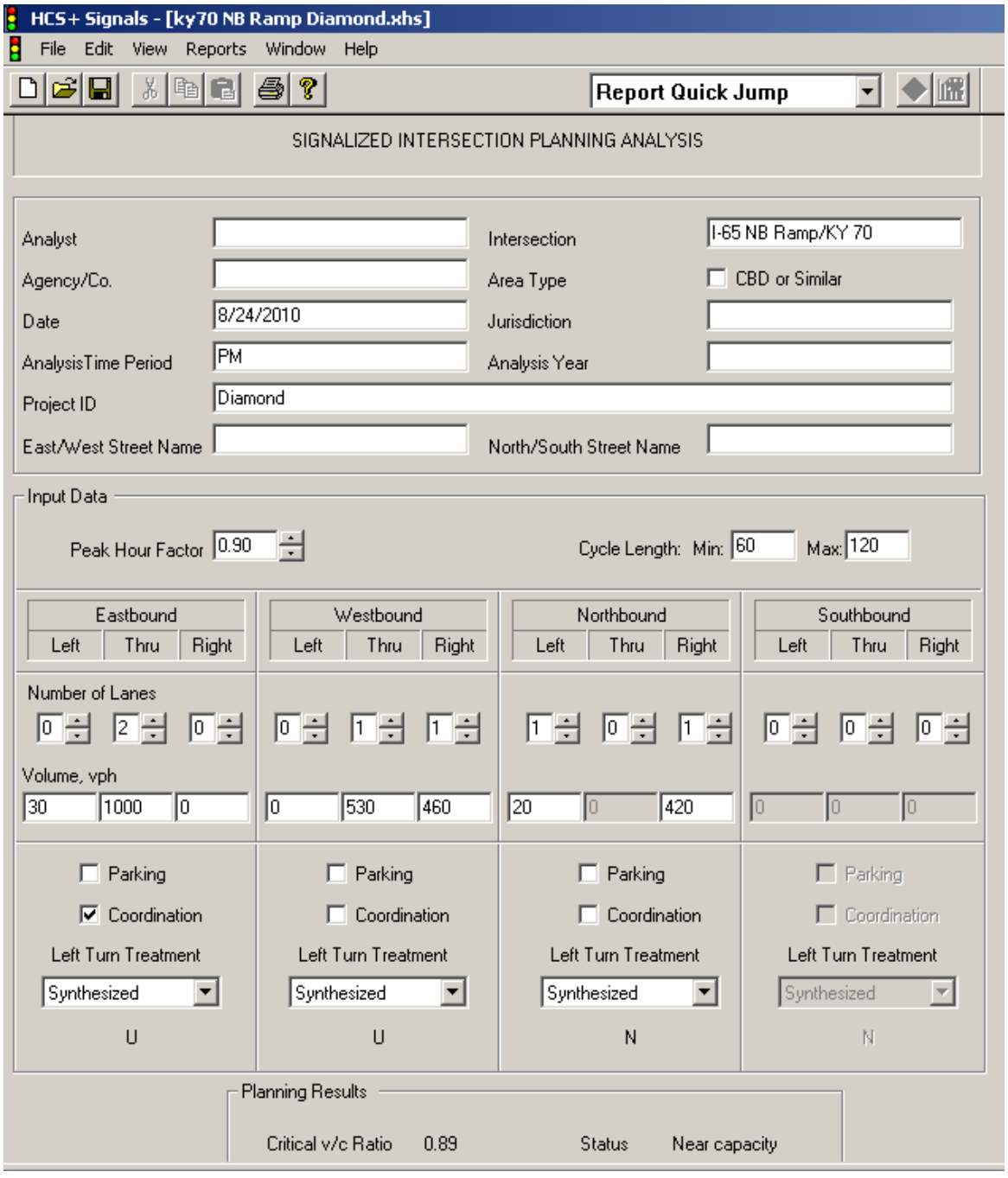
Original Design



VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE

Original Design



TRAFFIC OPERATIONS for the ORIGINAL DESIGN ALTERNATIVE.

VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE

VE Alternative 13

Option 1: Diverging Diamond Interchange

The recommendation is to reconfigure the interchange to a diverging diamond interchange (DDI). By implementing this alternative, the cost is lower than the proposed alternative and has comparable or better traffic operations.

VE ALTERNATIVE 13, KY 70/KY 90 DIVERGING DIAMOND INTERCHANGE

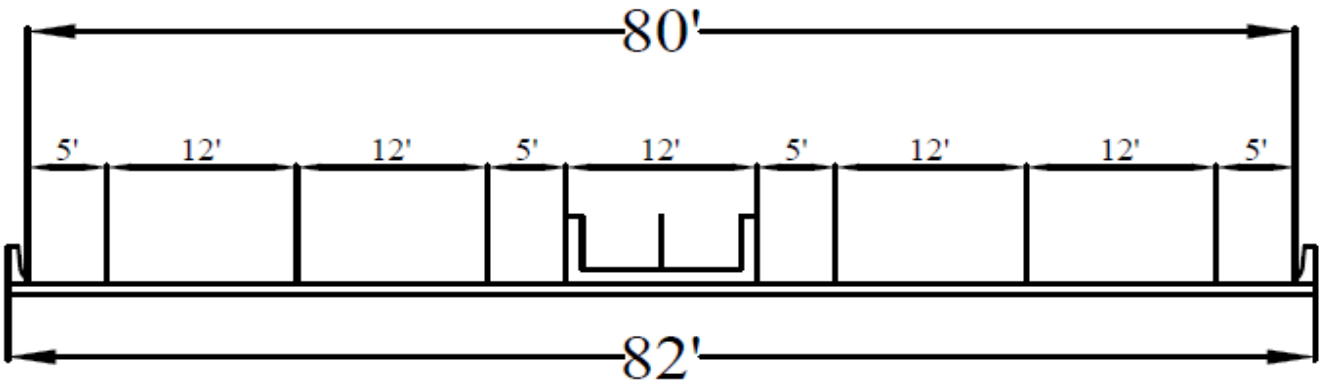
Cost savings are realized through narrowing the bridge deck width. The necessary bridge width is only 80', compared to 96', an initial savings of 17%. By moving the pedestrian traffic to the median on the bridge, the need for pedestrian fencing is eliminated. There is also a cost savings during the life cycle of the bridge by having a smaller deck area.

There are two travel lanes in each direction across the bridge. A single lane enters the bridge area from the west and then aligns next to the lane that turns from the southbound ramp. Pedestrian accommodations are combined into a single walkway on the center (median) of the bridge. Bike lanes remain to the right of the traffic.

VII. DEVELOPMENT PHASE

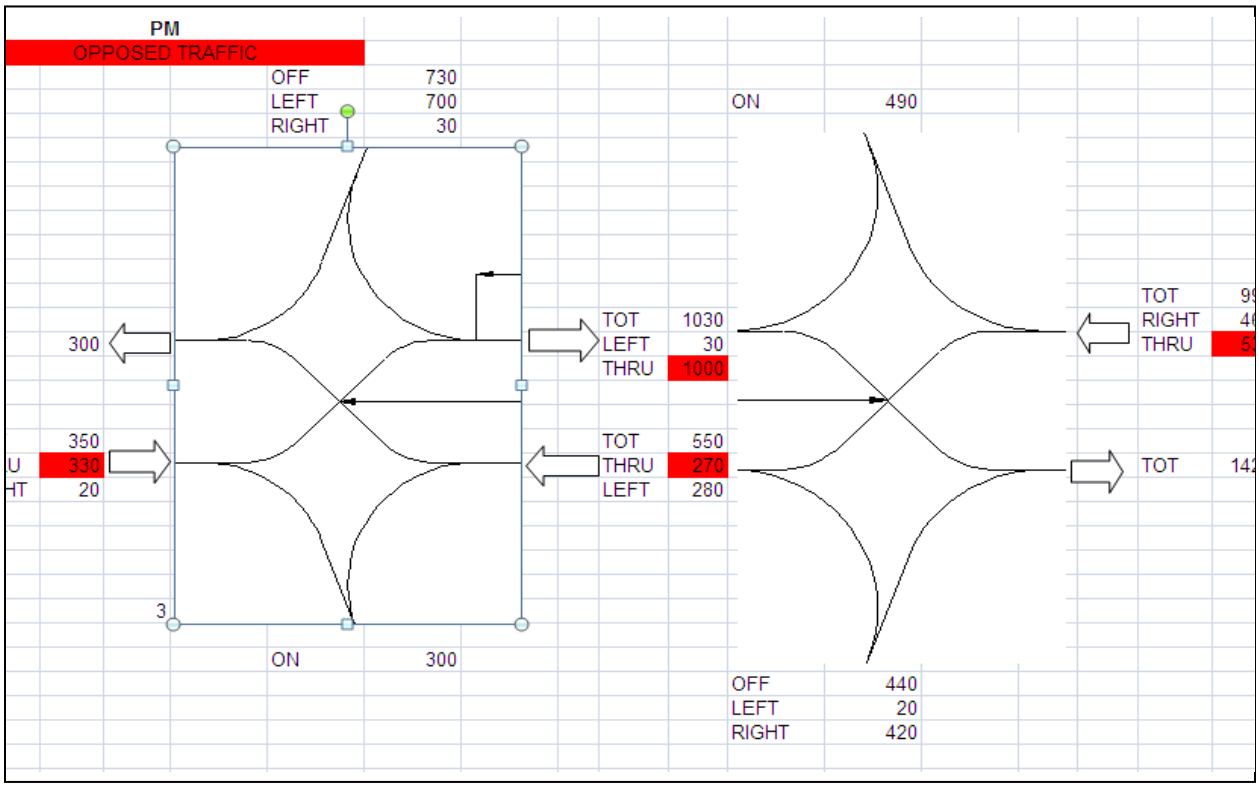
J. KY 70/KY 90 INTERCHANGE

VE Alternative 13



Option 2: Diverging Diamond Interchange with Shortened Bridge

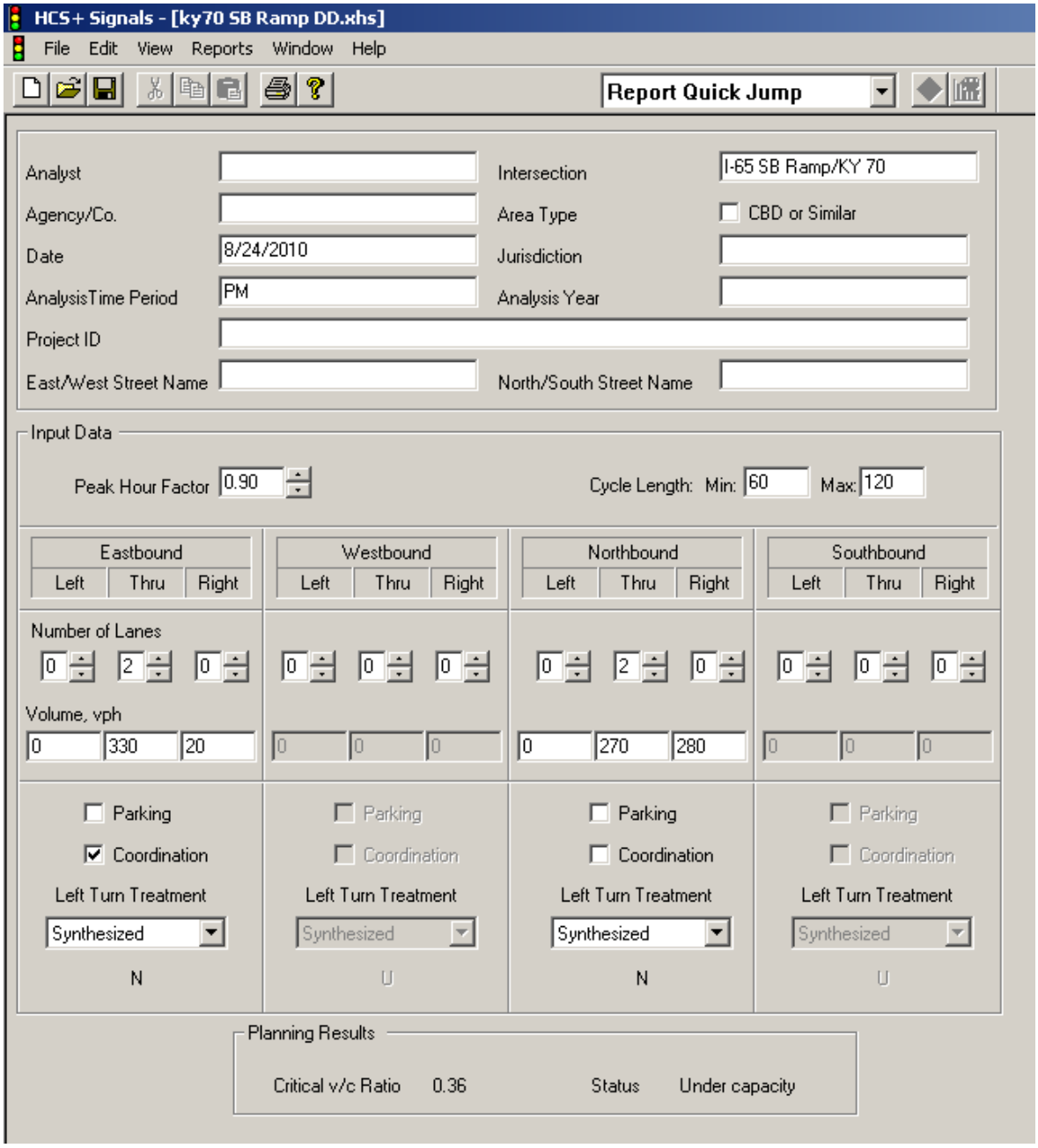
This option keeps the same interchange and lane configurations as in Option 1, but provides for a two-span bridge, rather than four. This reduces the total bridge length by 96' (298' versus 202'). This is achieved using either a Mechanically Stabilized Earth (MSE) Precast Prestressed Concrete (PPC) panels or a Modular Block Vertical Wall abutment.



VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE

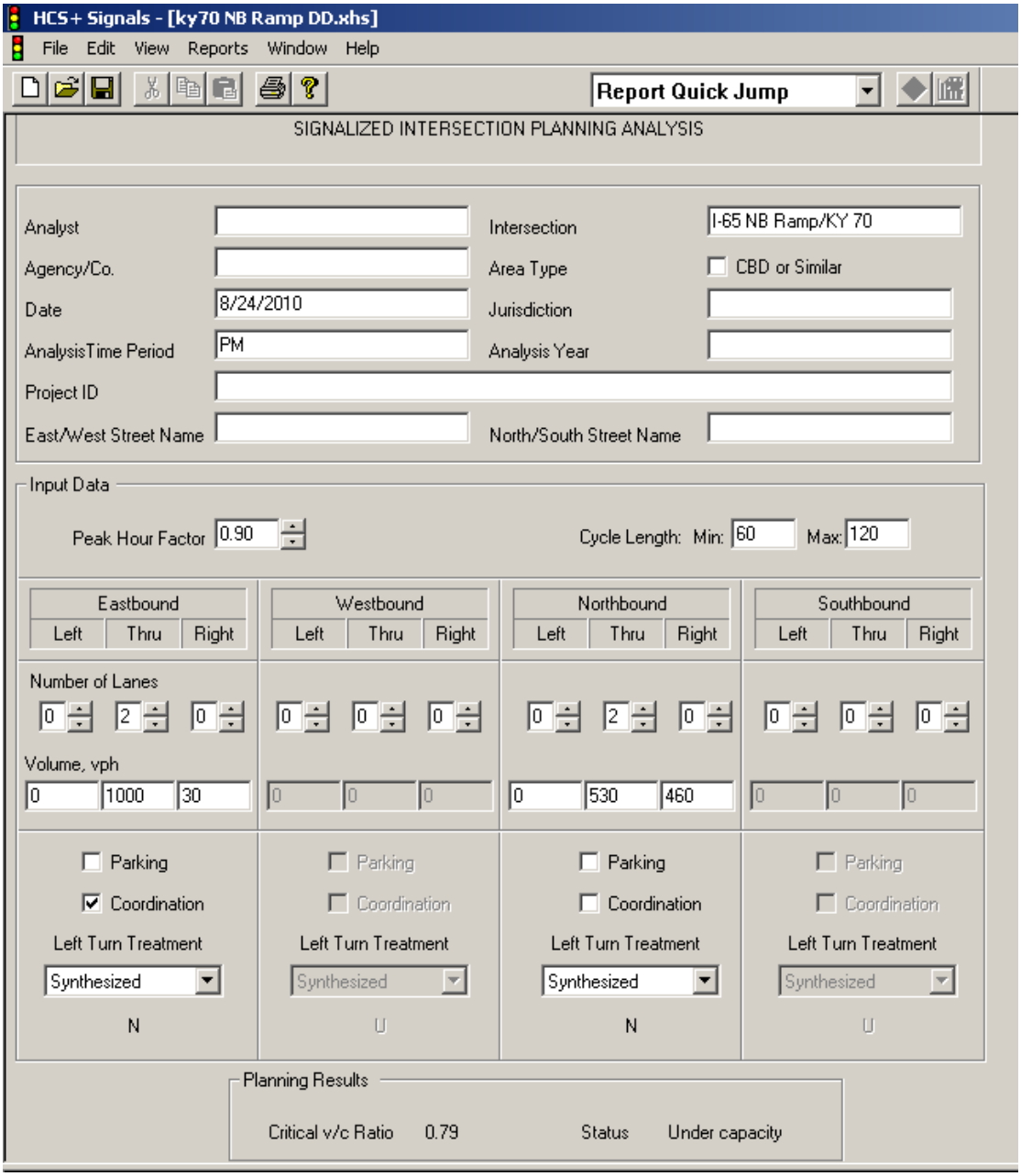
VE Alternative 13



VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE

VE Alternative 13



Note: ***The 700vph for the SB ramp left-turn have a dedicated receiving lane and therefore were not included in the signal analysis.***

KY 70/KY 90 DIVERGING DIAMOND INTERCHANGE
(4-SPAN) VE ALTERNATIVE 13, OPTION 1
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	28,608.0	$2,431,680	23,840.0	$2,026,400
ADDITIONAL PAVEMENT	SY	$37.44	0.0	$0	0.0	$0
PEDESTRIAN SAFETY FENCE	LF	$247.00	596.0	$147,212	0.0	$0
ROADWAY EXCAVATION	CY	$7.00	0.0	$0	0.0	$0
MODULAR BLOCK WALL	SF	$25.00	0.0	$0	0.0	$0
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	0.0	$0
SUBTOTAL				**$2,578,892**		**$2,026,400**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$127,655		$100,307
TRAFFIC CONTROL/MOT			10.0%	$257,889		$202,640
CONTINGENCY			10.0%	$257,889		$202,640
GRAND TOTAL				**$3,222,326**		**$2,531,987**

POSSIBLE SAVINGS: $690,339

KY 70/KY 90 DIVERGING DIAMOND INTERCHANGE
(2-SPAN) VERTICAL ABUTMENT VE ALTERNATIVE 13, OPTION 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	28,608.0	$2,431,680	16,160.0	$1,373,600
ADDITIONAL PAVEMENT	SY	$37.44	0.0	$0	725.3	$27,154
PEDESTRIAN SAFETY FENCE	LF	$247.00	596.0	$147,212	0.0	$0
ROADWAY EXCAVATION	CY	$7.00	0.0	$0	4,306.7	$30,147
MODULAR BLOCK WALL	SF	$25.00	0.0	$0	4,560.0	$114,000
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	204.0	$4,080
SUBTOTAL				**$2,578,892**		**$1,548,980**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$127,655		$76,675
TRAFFIC CONTROL/MOT			10.0%	$257,889		$154,898
CONTINGENCY			10.0%	$257,889		$154,898
GRAND TOTAL				**$3,222,326**		**$1,935,451**

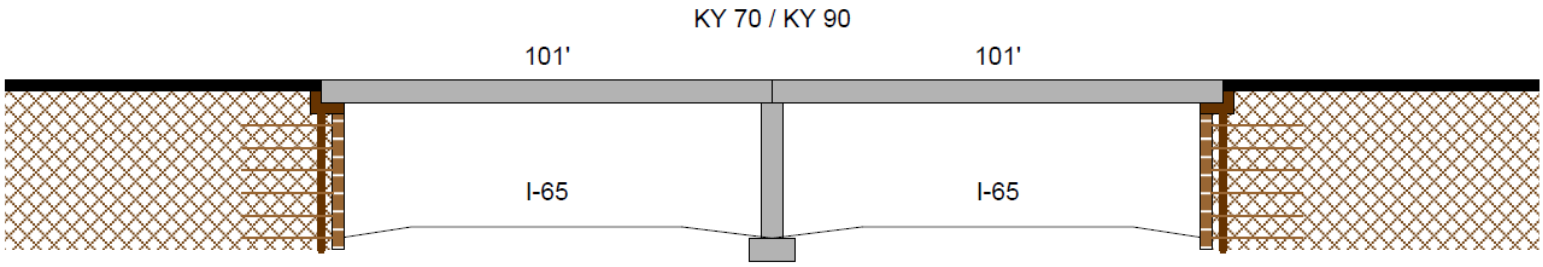
POSSIBLE SAVINGS: $1,286,875

VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE

VE Alternative 14

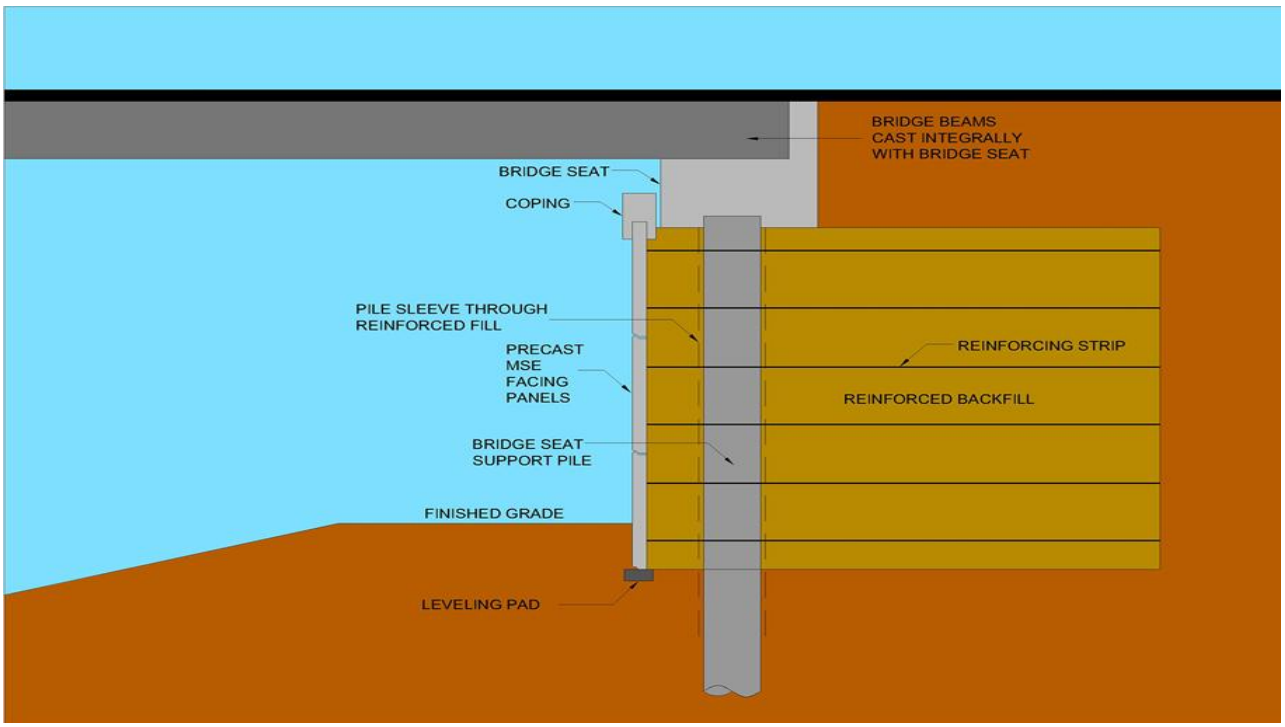
The VE Team evaluated constructing the KY 70/KY 90 over I-65 Bridge as a two-span structure using Mechanically Stabilized Earth (MSE) Walls as shown below.



Reduced Span Length with MSE or Modular Block Walls

VE ALTERNATIVE 14, I-65 BRIDGE OVER KY 70/KY 90 SPAN CONFIGURATION

Either metal straps or Geogrid mats that extend from the wall into the earth fill a distance of 70% of the height of the wall will reinforce the earth. Using reinforced earth and panels reduces the length of the structure which saves on bridge construction and maintenance costs. With a smaller deck, there is less area that could freeze during cold weather.



DETAILS OF MSE WALL CONSTRUCTION

VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE

VE Alternative 14

Option 1: Construct the walls using precast concrete panels.

The MSE Panels that form the wall serve only to contain the earth at the edges of the reinforcement and provide some aesthetics.

CONSTRUCTION OF MSE WALL

Option 2: Construct the walls with modular blocks.

The construction of the Modular Block Walls is completed with manual labor and requires little or no support or special equipment while being constructed. The Modular Blocks that form the walls serve only to contain the earth at the edges of the reinforcement and provide some aesthetics.

MODULAR BLOCK WALL UNDER CONSTRUCTION

VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE:

VE Alternative 14

VE ALTERNATIVE WITH MODULAR BLOCK WALLS

KY 70/KY 90 INTERCHANGE DIAMOND (2-SPAN) MSE ABUTMENT
VE ALTERNATIVE 14, OPTION 1
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	28,608.0	$2,431,680	19,392.0	$1,648,320
ADDITIONAL PAVEMENT	SY	$37.44	0.0	$0	725.3	$27,154
PEDESTRIAN SAFETY FENCE	LF	$247.00	596.0	$147,212	392.0	$96,824
ROADWAY EXCAVATION	CY	$7.00	0.0	$0	4,306.7	$30,147
MSE	SF	$45.00	0.0	$0	4,560.0	$205,200
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	204.0	$4,080
SUBTOTAL				**$2,578,892**		**$2,011,724**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$127,655		$99,580
TRAFFIC CONTROL/MOT			10.0%	$257,889		$201,172
CONTINGENCY			10.0%	$257,889		$201,172
GRAND TOTAL				**$3,222,326**		**$2,513,649**

POSSIBLE SAVINGS: $708,676

KY 70/KY 90 INTERCHANGE DIAMOND (2-SPAN) MODULAR BLOCK ABUTMENT
VE ALTERNATIVE 14, OPTION 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	SF	$85.00	28,608.0	$2,431,680	19,392.0	$1,648,320
ADDITIONAL PAVEMENT	SY	$37.44	0.0	$0	725.3	$27,154
PEDESTRIAN SAFETY FENCE	LF	$247.00	596.0	$147,212	392.0	$96,824
ROADWAY EXCAVATION	CY	$7.00	0.0	$0	4,306.7	$30,147
MODULAR BLOCK WALL	SF	$25.00	0.0	$0	4,560.0	$114,000
ADDITIONAL GUARD RAIL	LF	$20.00	0.0	$0	204.0	$4,080
SUBTOTAL				**$2,578,892**		**$1,920,524**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$127,655		$95,066
TRAFFIC CONTROL/MOT			10.0%	$257,889		$192,052
CONTINGENCY			10.0%	$257,889		$192,052
GRAND TOTAL				**$3,222,326**		**$2,399,695**

POSSIBLE SAVINGS: $822,631

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 13 & 14

KY70 PAVEMENT

	RATE	TN	PRICE	COST
1.5 CL3 ASPHALT SURFACE 0.5D PG64-22	165	0.083	$ 69.75	$ 5.75
3" ASPHALT BASE 1.0D PG76-22	330	0.165	$ 52.57	$ 8.67
7.25" CL3 ASPHALT BASE 1.0D PG64-22	797.5	0.399	$ 48.62	$ 19.39
6" CRUSHED STONE BASE	450	0.225	$ 16.09	$ 3.62
Pavement per SY				**$ 37.44**

I-65 PAVEMENT

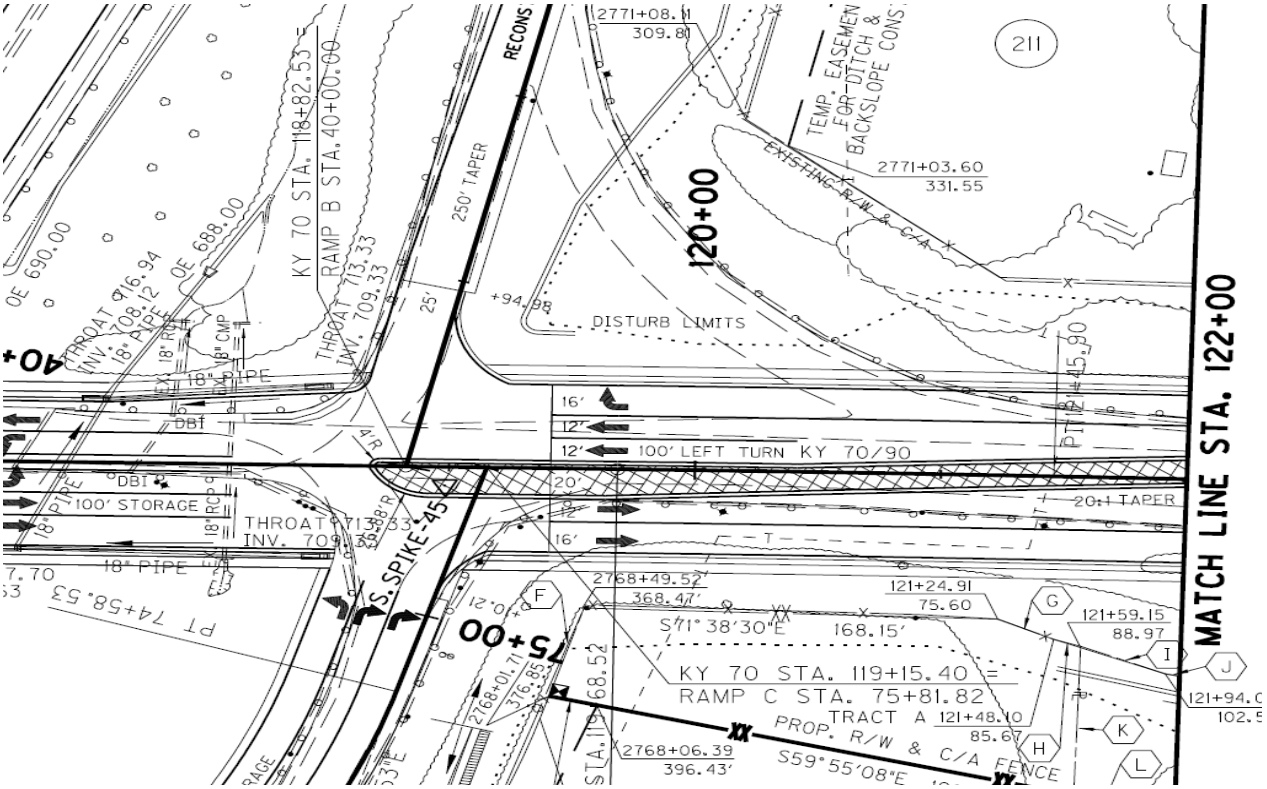
	RATE	TN	PRICE	COST
1.5 CL4 ASPHALT SURFACE 0.5A PG76-22	165	0.083	$69.79	$5.76
3.5" CL4 ASPHALT BASE 1.0D PG76-22	385	0.193	$55.00	$10.59
9" CL4 ASPHALT BASE 1.0D PG76-22	990	0.495	$60.66	$30.03
DRAINAGE BLANKET	1100	0.550	$33.10	$18.21
ASPHALT CURING SEAL	1.6	0.001	$451.91	$0.36
6" DGA	450	0.225	$14.53	$3.27
Pavement per SY				**$68.21**

VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE ROADWAY

Original Design

The KY 90 design is to widen to four lanes plus a center turning lane from the interchange to station 139+17, east of the interchange. From there, the road tapers down to a two lane section at station 145+72.

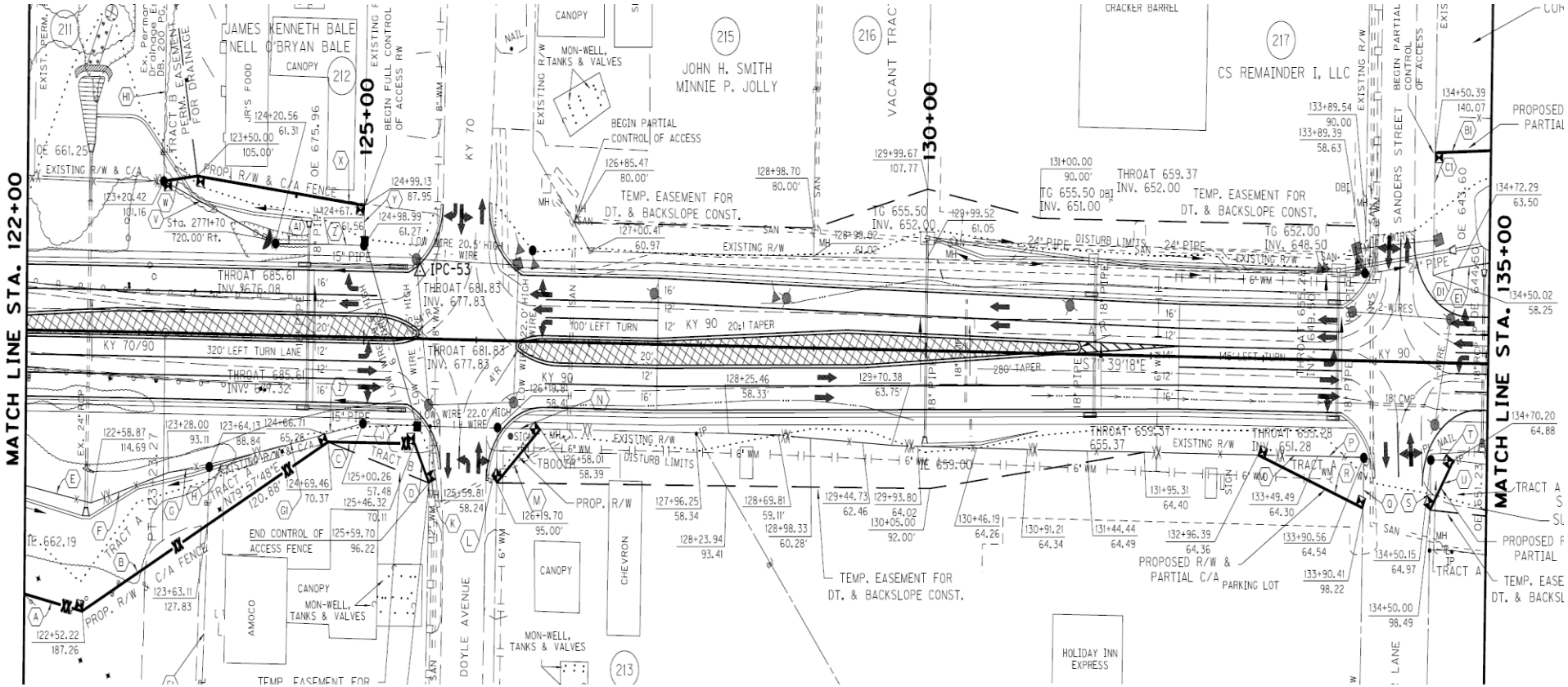


EB KY 70/KY 90 COMMERCIAL DEVELOPMENT

VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE ROADWAY

Original Design

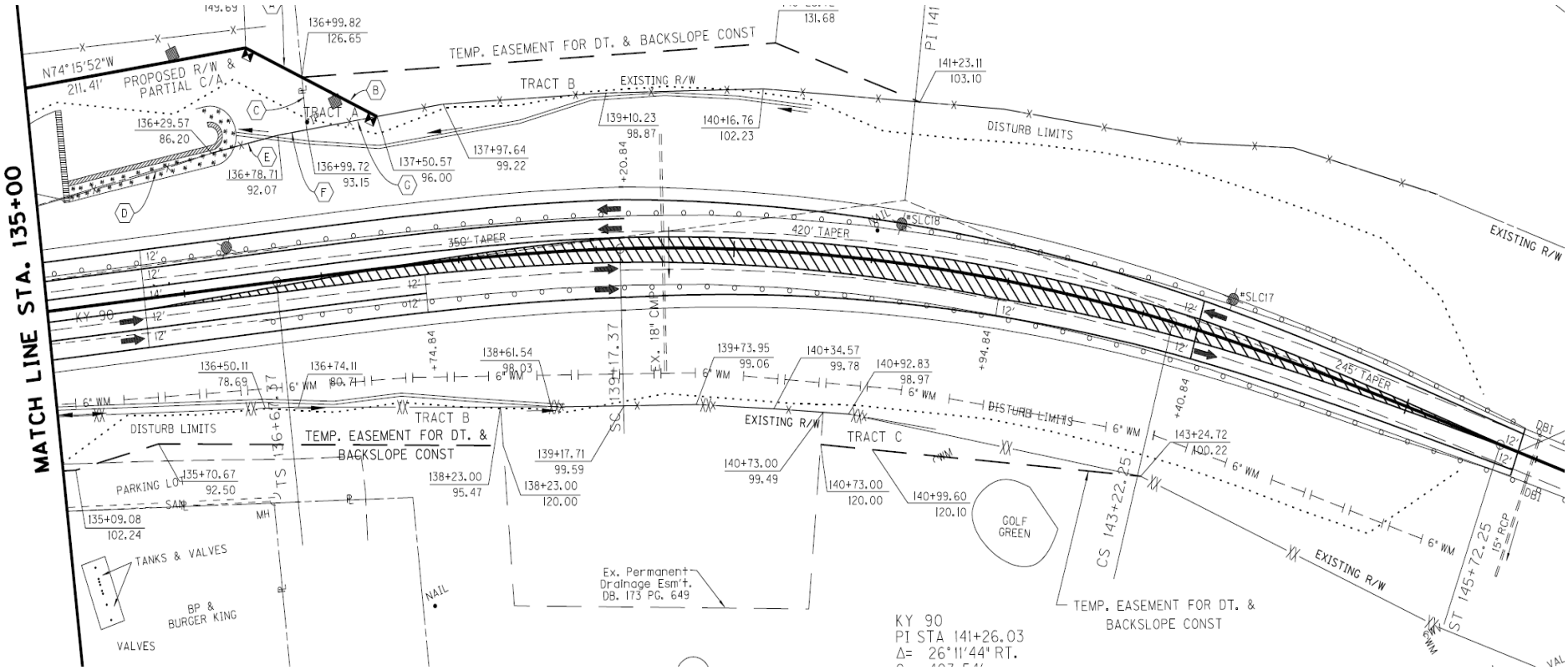


KY 70 and KY 90 EAST SIDE of INTERCHANGE

VII. DEVELOPMENT PHASE

J. KY 70/KY 90 INTERCHANGE ROADWAY

Original Design



KY 90 TAPER to TWO LANES

VII. DEVELOPMENT PHASE

J. KY 70 / KY 90 INTERCHANGE ROADWAY

VE Alternative 15

Reduce Roadway Width to Three Lanes

This alternative is to reduce the five-lane cross section to three lanes. Doing so will allow the project cost to be reduced while still safely meeting the traffic demand.

The original forecast project traffic growing from 11,800 vehicles per day (vpd) to 25,600 vpd in 2025. A reexamination of traffic counts in 2009, 10 years after the original counts, reveals that traffic has actually decreased to 10,118 vpd just east of the interchange ramps and 8,726 vpd near the project ending point. Therefore, it is safe to assume that the growth of traffic along this section of roadway will be much lower than originally anticipated. Assuming a healthy two percent growth rate, the volume would be approximately 16,600 vpd in 20 years. This moderate level appears to support the reduction to three lanes. A new traffic forecast and analysis is recommended at each of the intersections to confirm this.

In addition to reducing the number of lanes, it would also be beneficial to further address access control along both KY 90 and the side streets, especially in the vicinity of the intersections and interstate ramps. An access management plan for the Cave City interchange area and Memorandum Of Understanding (MOU) between KYTC and the Joint City-County Planning Commission of Barren County would help to maintain and improve future access as well as roadway mobility and safety.To assist with access management, a roundabout at the intersections of KY 90/Doyle Avenue and KY 90/Sanders Street may be beneficial for traffic flow and safety.

KY70/90 TYPICAL SECTION: REDUCE TO THREE LANES
VE ALTERNATIVE 15
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
CROSS ROAD TYPICAL SECTION	SY	$37.34	15,459.0	$577,239	11,968.0	$446,885
SUBTOTAL				**$577,239**		**$446,885**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		4.5%		$28,573		$22,121
TRAFFIC CONTROL/MOT		10.0%		$57,724		$44,689
CONTINGENCY		10.0%		$57,724		$44,689
GRAND TOTAL				**$721,260**		**$558,383**

POSSIBLE SAVINGS: $162,877

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 15

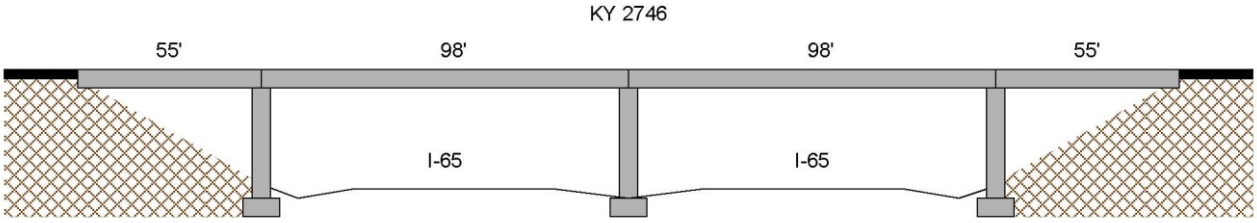
STA 11882	LENGTH FEET	WIDTH FEET	AREA SY	$/SY	COST	STA 11882	LENGTH FEET	WIDTH FEET	AREA SY	$/SY	COST
14126	2244	62	15459	$37.34	$577,227	14126	2244	48	11968	$37.34	$446,885
		SAVING	$130,341								

VII. DEVELOPMENT PHASE

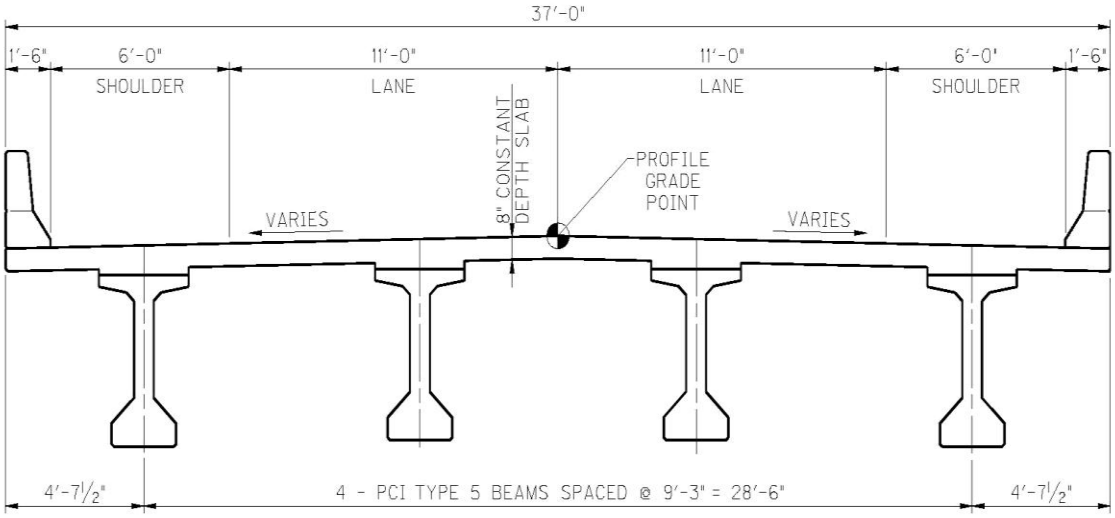
K. KY 2746 OVER I-65

Original Design

The Original Design crossing of I-65 by KY 2746 will be a 4-span Precast Prestressed Concrete (PPC) I-Beam bridge with 37’ out-to-out deck width.



As-Proposed



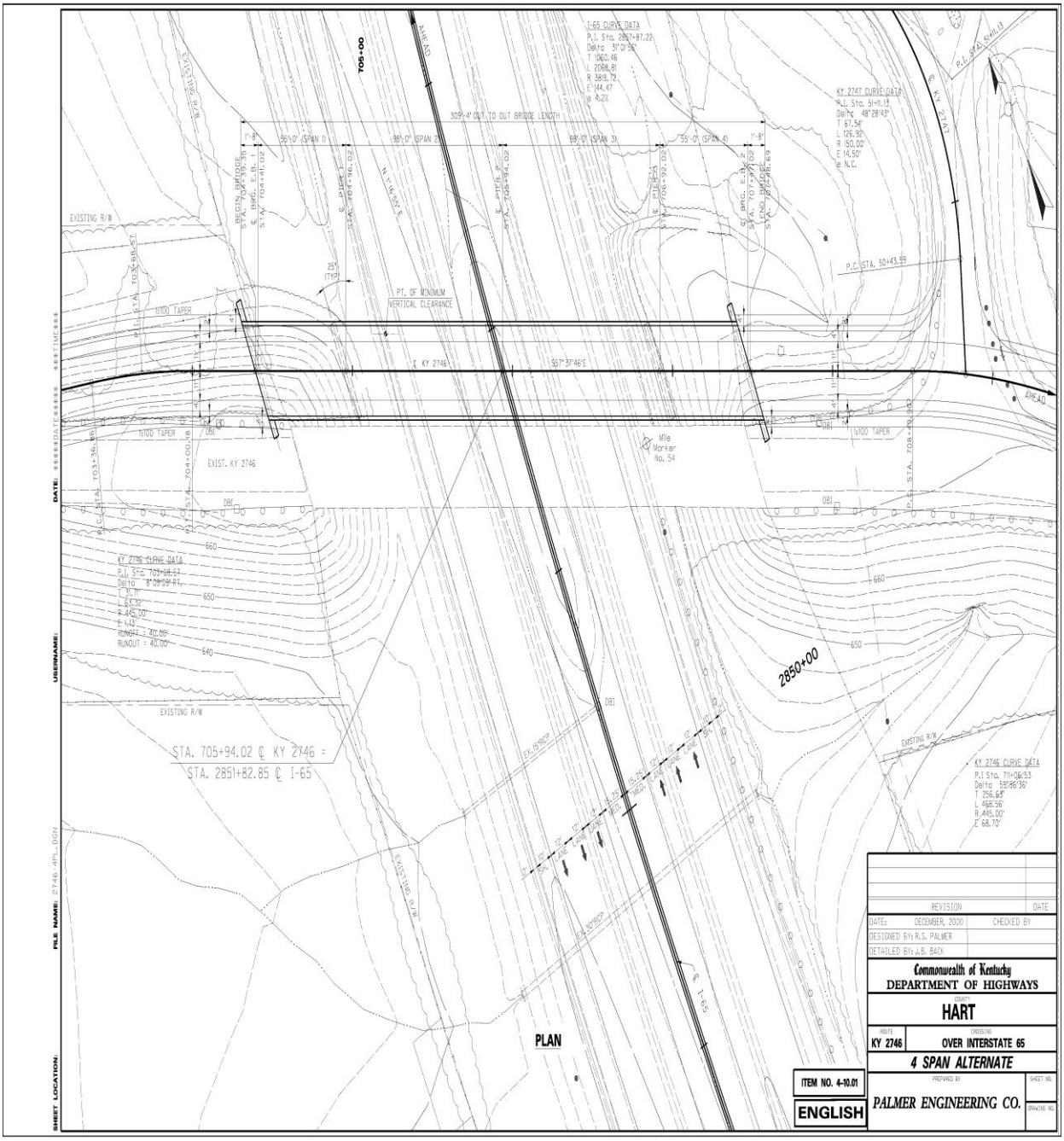
BRIDGE TYPICAL SECTION

(LOOKING AHEAD)

VII. DEVELOPMENT PHASE

K. KY 2746 OVER I-65

Original Design



PLAN VIEW OF ORIGINAL DESIGN ALTERNATE

VII. DEVELOPMENT PHASE

K. KY 2746 over I-65

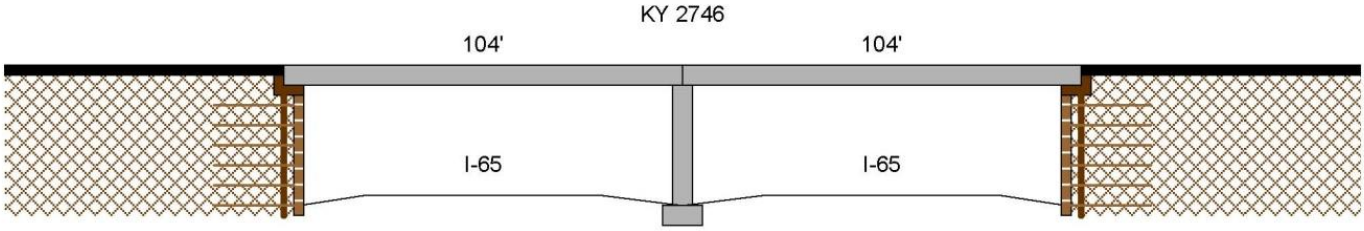
VE Alternative 16

The VE Alternative proposes to build the bridge at the proposed 31’ width but shortens the structure by eliminating the 2 end spans (approx. 98’ total) and replacing them with:

Option 1. Mechanically Stabilized Earth (MSE) Walls. The cost to replace the end spans with MSE abutments is estimated to be $1,273,753.

Option 2. Modular Block Walls. The cost to replace the end spans with Modular Block abutments is estimated to be $1,044,747.

Eliminating the end spans and replacing with MSE or Modular Block Wall abutments provides improved economy although for narrow structures, the economic impact is generally smaller than on the wider mainline bridges.



Reduced Span Length with MSE or Modular Block Walls

KY 2746 OVER I-65 (MSE WALL ABUTMENTS)
VE ALTERNATIVE 16, OPTION 1
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$1,083,900		$934,000
ADDITIONAL PAVEMENT	SY	$37.44			1,410.0	$52,790
ADDITIONAL EMBANKMENT	CY	$7.00			4,100.0	$28,700
ADDITIONAL GUARD RAIL	LF	$20.00			196.0	$3,920
SUBTOTAL				**$1,083,900**		**$1,019,410**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$53,653		$50,461
TRAFFIC CONTROL/MOT			10.0%	$108,390		$101,941
CONTINGENCY			10.0%	$108,390		$101,941
GRAND TOTAL				**$1,354,333**		**$1,273,753**

POSSIBLE SAVINGS: $80,580

KY 2746 OVER I-65 (MODULAR BLOCK WALL ABUTMENTS)
VE ALTERNATIVE 16, OPTION 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
BRIDGE	Each			$1,083,900		$750,722
ADDITIONAL PAVEMENT	SY	$37.44			1,410.0	$52,790
ADDITIONAL EMBANKMENT	CY	$7.00			4,100.0	$28,700
ADDITIONAL GUARD RAIL	LF	$20.00			196.0	$3,920
SUBTOTAL				**$1,083,900**		**$836,132**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$53,653		$41,389
TRAFFIC CONTROL/MOT			10.0%	$108,390		$83,613
CONTINGENCY			10.0%	$108,390		$83,613
GRAND TOTAL				**$1,354,333**		**$1,044,747**

POSSIBLE SAVINGS: $309,586

VII. DEVELOPMENT PHASE

COST COMPARISON SHEET BACK UP CALCULATIONS, VE 16

I. KY2746 over I-65 - MSE Abutment Alternate

$origcost := 108390$ from Adv Sit Folder Estimate with updated unit costs

$VEcost := origcost + 2 \cdot 4580ft^2 \cdot \frac{45}{ft^2}$ add estimated MSE wall area at $45/SF

$VEcost := VEcost - \left(11445ft^2 - 104ft \cdot 37ft\right) \cdot \frac{74}{ft^2}$ deduct eliminated span area at $74/SF for superstructure from updated ASF

Compute Alt 1B - Cost with Modular Block Abutments
estimate cost of Modular Block installed at $25/SF

$VEcost := VEcost - 2 \cdot 4580 \cdot (45 - 25)$ Deduct cost difference between MSE & modular

VIII. FINAL PRESENTATION ATTENDEE SHEET

I-65 WIDENING FROM NORTH OF CUMBERLAND PARKWAY INTERCHANGE TO NORTH OF MUNFORDVILLE INTERCHANGE

August 23-27, 2010

NAME	AFFILIATION	PHONE
Bill Ventry	VE Group, L.L.C.	850/627-3900
Rodney Little	KYTC Design-QAB	606/677-4016
Joseph C. Pyles	KYTC Structures Design	502/564-4560
Vicki Boldrick	KYTC-Highway Design	502/564-3280
Donald Smith	KYTC	502/564-4556
Duncan Silver	VE Group, L.L.C.	850/627-3900
Thomas Hartley	VE Group, L.L.C.	850/627-3900
Bob Lewis	KYTC	502/564-3730
Andre Johannes	KYTC	502/564-3280
Paul Looney	KYTC	502/564-3280
Richard Thomas	KYTC	502/564-3280
Jeff Jasper	KYTC	502/564-3280
Wheeler Nevels	KYTC	502/564-4556
Marshall Carrier	KYTC	502/564-3280
Vibert Forsythe	KYTC	502/564-4780

IX. VE PUNCH LIST

ITEM NOS. 3-12.00, 3-13.00, 3-14.00, 4-13.00, 4-14.00
DATE OF STUDY: 8/23-27/10

VE Alternative/ Option #	Description	VE Team Top Picks	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Tot. Present Worth Life Cycle Cost Savings	Remarks
Roadway/Earthwork/Pavement								
VE Alternative 1A	Revises the pavement design for the new pavement. Reduce the amount of drainage blanket for the asphalt pavement.	X		$9,586,474	$6,786,848	$2,799,627	$2,799,627	
VE Alternative 1B	Revises the pavement design for the new pavement. Reduce the amount of drainage blanket for the concrete pavement.			$14,914,247	$13,063,494	$1,850,753	$1,850,753	
VE Alternative 1C	Revises the pavement design for the new pavement. Use partial depth shoulders for the asphalt pavement.	X		$70,130,246	$68,078,168	$2,052,078	$2,052,078	
VE Alternative 1C	Revises the pavement design for the new pavement. Revise the pavement design for both the asphalt and concrete pavement.	X		$69,827,546	$67,842,421	$1,985,125	$1,985,125	
VE Alternative 2	Eliminates the rock cut throughout the project on the outside based on the latest traffic trends and relocating traffic lanes.	X		$12,014,250	$3,068,925	$8,945,325	$8,945,325	

DESIGN SUGGESTIONS

Design Suggestion No.	Description	Activity	Implemented Life Cycle Cost Savings	Remarks

VE Alternative/ Option #	Description	VE Team Top Picks	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Tot. Present Worth Life Cycle Cost Savings	Remarks
Interchanges/Ramps								
VE Alternative 5	Uses a roundabout at the terminus of the southbound “On” and “Off” ramps.	**X**		$3,609,356	$3,865,141	$255,786	$255,786	
VE Alternative 6	Shortens the bridges by eliminating the end spans and using walls. Option 1: Use Mechanically Stabilized Earth (MSE) Walls.			$3,609,356	$2,537,285	$1,072,070	$1,072,070	
VE Alternative 6	Shortens the bridges by eliminating the end spans and using walls. Option 2: Use Modular Block Walls.	**X**		$3,609,356	$2,337,365	$1,271,990	$1,271,990	
VE Alternative 9	Uses a diamond interchange with roundabouts. Option 1: Use the same bridge length as the Original Design bridge.			$2,284,842	$1,609,100	$675,742	$675,742	
VE Alternative 9	Uses a diamond interchange with roundabouts. Option 2: Shorten the bridge length.	**X**		$2,284,842	$1,111,305	$1,173,537	$1,173,537	
VE Alternative 10	Shortens the bridges by eliminating the end spans and using walls. Option 1: Use Mechanically Stabilized Earth (MSE) Walls.			$2,284,842	$1,830,661	$454,181	$454,181	
VE Alternative 10	Shortens the bridges by eliminating the end spans and using walls. Option 2: Use Modular Block Walls.			$2,284,842	$1,716,707	$568,135	$568,135	

VE Alternative/ Option #	Description	VE Team Top Picks	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Tot. Present Worth Life Cycle Cost Savings	Remarks
Interchanges/Ramps								
VE Alternative 13	Uses a diverging diamond interchange design. Option 1: Use the Original Design bridge length.			$3,222,326	$2,531,987	$690,339	$690,339	
VE Alternative 13	Uses a diverging diamond interchange design. Option 2: Shorten the bridge length.	**X**		$3,222,326	$1,935,451	$1,286,875	$1,286,875	
VE Alternative 14	Shortens the bridges by eliminating the end spans and using walls. Option 1: Use Mechanically Stabilized Earth (MSE) Walls.			$3,222,326	$2,513,649	$708,676	$708,676	
VE Alternative 14	Shortens the bridges by eliminating the end spans and using walls. Option 2: Use Modular Block Walls.			$3,222,326	$2,399,695	$822,631	$822,631	
VE Alternative 15	Revises the proposed typical section KY 70/KY 90.	**X**		$721,260	$558,383	$162,877	$162,877	

DESIGN SUGGESTIONS

Design Suggestion No.	Description	Activity	Implemented Life Cycle Cost Savings	Remarks

VE Alternative/ Option #	Description	VE Team Top Picks	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Tot. Present Worth Life Cycle Cost Savings	Remarks
Structures								
VE Alternative 3	Utilizes the existing steel bridge and constructs a new steel bridge in the median.			$12,977,080	$10,184,873	$2,792,206	$803,142	
VE Alternative 4	Uses a new concrete structure.	**X**		$12,977,080	$13,697,178	$<720,098>	$57,007	
VE Alternative 7	Shortens the bridges by eliminating the end spans and using walls. Option 1: Use Mechanically Stabilized Earth (MSE) Walls.			$4,982,166	$3,682,523	$1,299,643	$1,299,643	
VE Alternative 7	Shortens the bridges by eliminating the end spans and using walls. Option 2: Use Modular Block Walls.	**X**		$4,982,166	$3,266,790	$1,715,377	$1,715,377	
VE Alternative 8	Shortens the bridges by eliminating the end spans and using walls. Option 1: Use Mechanically Stabilized Earth (MSE) Walls.			$3,407,382	$2,759,534	$647,847	$647,847	
VE Alternative 8	Shortens the bridges by eliminating the end spans and using walls. Option 2: Use Modular Block Walls.	**X**		$3,407,382	$2,546,220	$861,162	$861,162	
VE Alternative 11	Utilizes the existing bridge by jacking and widening the bridge to obtain vertical clearance.	**X**		$1,198,052	$551,342	$646,710	$343,032	
VE Alternative 12	Shortens the bridges by eliminating the end spans and using walls. Option 2: Use Modular Block Walls.	**X**		$2,794,938	$2,319,378	$475,560	$475,560	
VE Alternative 12	Shortens the bridges by eliminating the end spans and using walls. Option 1: Use Mechanically Stabilized Earth (MSE) Walls.			$2,794,938	$2,572,277	$222,661	$222,661	

VE Alternative/ Option #	Description	VE Team Top Picks	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Tot. Present Worth Life Cycle Cost Savings	Remarks
Structures								
VE Alternative 16	Shortens the bridges by eliminating the end spans and using walls. Option 1: Use Mechanically Stabilized Earth (MSE) Walls.			$1,354,333	$1,273,753	$80,580	$80,580	
VE Alternative 16	Shortens the bridges by eliminating the end spans and using walls. Option 2: Use Modular Block Walls.	**X**		$1,354,333	$1,044,747	$309,586	$309,586	
DESIGN SUGGESTIONS								
Design Suggestion No.	**Description**	**Activity**	**Implemented** Life Cycle Cost Savings	**Remarks**				

VE Alternative/ Option #	Description	VE Team Top Picks	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Tot. Present Worth Life Cycle Cost Savings	Remarks
Other								
DESIGN SUGGESTIONS								
Design Suggestion No.	**Description**	**Activity**	**Implemented** Life Cycle Cost Savings	**Remarks**				

X. FHWA TABLES

	FHWA CATEGORIES					
	Safety	**Mobility**	**Operations**	**Environment**	**Innovative Construction**	**Other Features**
RECOMENDATIONS						
PAVEMENT AND BASE						
Recommendation 1: VE Alternative 1 revises the pavement design for the new pavement- **Option 1:** Reduce the amount of drainage blanket for the asphalt pavement.						**X**
Recommendation 1: VE Alternative 1 revises the pavement design for the new pavement- **Option 1:** Reduce the amount of drainage blanket for the asphalt concrete pavement.						**X**
Recommendation 1: VE Alternative 1 revises the pavement design for the new pavement- **Option 2:** Use partial depth shoulders for the asphalt pavement.						**X**
Recommendation 1: VE Alternative 1 revises the pavement design for the new pavement- **Option 3:** Revise the pavement design for both the asphalt and concrete pavement.						**X**
EARTHWORK (ROCK CUT)						
Recommendation 2: VE Alternative 2 eliminates the rock cut throughout the project on the outside based on the latest traffic trends and relocating traffic lanes.						**X**

	FHWA CATEGORIES					
	Safety	**Mobility**	**Operations**	**Environment**	**Innovative Construction**	**Other Features**
GREEN RIVER BRIDGE						
Recommendation 3: VE Alternative 3 utilizes the existing bridge and constructs a new bridge in the median.						**X**
Recommendation 3: VE Alternative 4 uses a concrete structure.						**X**
US 31 W INTERCHANGE						
Recommendation 4: VE Alternative 5 uses a roundabout at the terminus of the southbound "On" and "Off" ramps.	**X**	**X**	**X**		**X**	
Recommendation 4: Option 1: Use Mechanically Stabilized Earth (MSE) Walls.						**X**
Recommendation 4: Option 2: Use Modular Block Walls.						**X**
Recommendation 4: VE Alternative 6 uses the original interchange design but shortens the bridges using vertical walls to eliminate the end spans.						
Recommendation 4: Option 1: Use Mechanically Stabilized Earth (MSE) Walls.						**X**
Recommendation 4: Option 2: Use Modular Block Walls.						**X**
SOUTH CSX RAILROAD BRIDGE						
Recommendation 5: VE Alternative 7 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 1:** Use MSE Walls.						**X**
Recommendation 5: VE Alternative 7 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 2:** Use Modular Block Walls.						**X**
US 31 W GRADE SEPARATION BRIDGE						
Recommendation 6: VE Alternative 8 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 1:** Use MSE Walls.						**X**

	FHWA CATEGORIES					
	Safety	**Mobility**	**Operations**	**Environment**	**Innovative Construction**	**Other Features**
US 31 W GRADE SEPARATION BRIDGE *(continued)*						
Recommendation 6: VE Alternative 8 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 2:** Use Modular Block Walls.						**X**
KY 218 INTERCHANGE						
Recommendation 7: VE Alternative 9 uses a diamond interchange with roundabouts-- **Option 1:** Use the same bridge length as the Original Design bridge.	**X**	**X**	**X**		**X**	
Recommendation 7: VE Alternative 9 uses a diamond interchange with roundabouts-- **Option 2:** Shorten the bridge length.	**X**	**X**	**X**		**X**	
Recommendation 7: VE Alternative 10 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 1:** Use MSE Walls.						**X**
Recommendation 7: VE Alternative 10 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 2**: Use Modular Block Walls.						**X**
KY 88 GRADE SEPARATION BRIDGE						
Recommendation 8: VE Alternative 11 utilizes the existing bridge by widening and jacking the bridge to obtain vertical clearance.						**X**
KY 255 INTERCHANGE BRIDGE						
Recommendation 9: VE Alternative 12 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 1:** Use MSE Walls.						**X**

	FHWA CATEGORIES					
	Safety	**Mobility**	**Operations**	**Environment**	**Innovative Construction**	**Other Features**
KY 255 INTERCHANGE BRIDGE *(continued)*						
Recommendation 9: VE Alternative 12 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 2:** Use Modular Block Walls.						**X**
KY 70/KY 90 INTERCHANGE						
Recommendation 10: VE Alternative 13 uses a diverging diamond interchange design- **Option 1:** Use the Original Design bridge length.	**X**	**X**	**X**		**X**	
Recommendation 10: VE Alternative 13 uses a diverging diamond interchange design- **Option 2:** Shorten the bridge length.	**X**	**X**	**X**		**X**	
Recommendation 10: VE Alternative 14 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 1:** Use MSE Walls.						**X**
Recommendation 10: VE Alternative 14 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 2:** Use Modular Block Walls.						**X**
Recommendation 10: VE Alternative 15 revises the proposed typical section KY 70/KY 90.			**X**			
KY 2746 GRADE SEPARATION BRIDGE						
Recommendation 11: VE Alternative 16 shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 1:** Use MSE Walls.						**X**

	FHWA CATEGORIES					
	Safety	**Mobility**	**Operations**	**Environment**	**Innovative Construction**	**Other Features**
KY 2746 GRADE SEPARATION BRIDGE *(continued)*						
Recommendation 11: This VE Alternative shortens the bridges by eliminating the end spans and using walls by one of the following- **Option 2**: Use Modular Block Walls.						**X**
TOTAL	**5**	**5**	**6**		**5**	**24**