Bridge Replacement SR 43/US 378 at Savannah River

Project Number: BR000-0001-00(370)

P.I. No.: 0001370

Lincoln County

Value Engineering Study Report

90% Design Complete Stage

March 2009

Design Consultant

GDOT

Value Engineering Consultant

an ARCADIS company

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Ms. Lisa L. Myers
Design Review Engineering Manager/VE Coordinator
GA DOT - Engineering Services
One Georgia Center – 5th Floor
Atlanta, Georgia 30308

Date:
March 18, 2009

Contact:
Howard Greenfield

Phone:
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Email:
hgreenfield@lza.com

Our ref:
LZ083342

Re: Project No.BRF00-00001-00(370), Cobb, P.I. No.: 0001370
SR 43/US 378 Bridge Replacement Over the Savannah River
Value Engineering Study Report

Dear Ms. Myers:

Lewis & Zimmerman Associates, Inc. is pleased to submit two hard copies and one electronic copy of the referenced value engineering study report that took place on March 3 – 6, 2009. The objective of the VE effort was to identify opportunities to reduce costs and enhance the value of the project.

This VE workshop identified and developed several ideas which provide opportunities to improve the value of the project to GDOT. Of particular interest are those alternatives related to the roadway design, the 1330-ft long bridge, and right-of-way requirements as detailed in the Study Results Section of this report.

We thank you for your assistance during the course of the VE team's work. Please do not hesitate to call upon us if you or any of the reviewers have any questions regarding the information presented in this report.

Sincerely yours,

LZA, an ARCADIS company

Howard B. Greenfield, PE, CVS
Vice President
Attachment

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EXECUTIVE SUMMARY

INTRODUCTION

This value engineering (VE) study report summarizes the events and results of the VE study conducted by Lewis & Zimmerman Associates, Inc. (LZA) for the Georgia Department of Transportation (GDOT). The subject of the study was the Bridge Replacement SR 43/US 378 at Savannah River Project, BR000-0001-00(370), P.I. # 0001370, Lincoln County being designed by GDOT. The study was performed March 3 – 6, 2009 in the GDOT Central Office, Atlanta, GA using the 90% design complete documents as the basis of the study.

Comprising the VE team were a highway design engineer, a bridge engineer, a cost/construction specialist and a Certified Value Engineering team leader from LZA. The team used the following six-phase VE Job Plan to guide its deliberations.

- Information Gathering Phase
- Function Identification and Analysis Phase
- Creative Idea Generation Phase
- Evaluation/Judgment Phase
- Alternative Development Phase
- Presentation of Results Phase

PROJECT DESCRIPTION

This project replaces the existing two-lane bridge that has deteriorated to the point where it requires replacement. The new bridge alignment will be east of the existing bridge to avoid construction adjacent to a buried telephone cable line to the west of the existing bridge. The new bridge structure will be 1,680 ft long and 47 ft 3 in wide and will have the following features:

- 10-ft-wide shoulders and 12-ft-wide travel lanes in each direction
- 7-3/8 in thick cast-in-place concrete deck
- 74-in-deep precast concrete bulb tee bridge girders spaced at 8 ft 3 in on center and spanning 140 ft
- Concrete bridge deck barriers
- Cast-in-place concrete hammerhead piers to support the bridge deck
- Spread footings on a concrete seal sitting on rock for the foundation which will be constructed in 70 ft of water
- Cast-in-place concrete stub abutments supported on piles at each end
- New embankments at each end of the bridge constructed of rock fill
- 30 ft long concrete approach slabs at each end
- Demolition of the existing bridge

The new bridge will be tied into the existing highway at both ends and a road going down to an existing parking area of the south end of the bridge will be replaced. The bridge will be constructed on land owned by the U.S. Corps of Engineers, but will necessitate an increase in the right-of-way.

The estimated cost of the project is $14.2 million and it is expected to be bid in August 2009.

CONCERNS AND OBJECTIVES

The bridge is to be constructed in deep water, requiring the use of a barge to set all the materials in place. The rock foundation is about 70 feet below the water level, with water and some soil deposits composing the material on top of the rock. This requires the installation of cofferdams to construct the proposed foundations. Given these conditions, the VE team performed its own cost estimate for the bridge and determined that the cost of the project will exceed $24 million, a significant increase over its current estimated cost.

GDOT desires to design projects that meet its functional requirements in a cost-effective manner. To assist in achieving this goal, it engaged this VE study. The specific objective of the VE team was to identify individual opportunities for saving costs and enhancing functionality that the GDOT design and project management teams can evaluate and implement into the design.

RESULTS OF THE STUDY

The VE team generated six alternatives that could save project costs and one design suggestion that provides a means for accepting some of the alternatives without risking a schedule change. All of the alternatives are summarized on the following Summary of Potential Cost Savings table and detailed in the Study Results section of the report. Note that each alternative was developed independently so that some are mutually exclusive or interrelated and the total potential cost savings will have to be determined once implementation decisions are made. The narrative below consolidates the team's findings.

The bridge foundations are the most expensive part of the project. Alt. No. BF-1 suggests changing from a spread footing sitting on top of a deep concrete seal constructed within a cofferdam to two, 8-ft-diameter drilled piers. The drilled piers would be socked 25 ft into the rock to achieve a fixed condition at the top of rock and an intermediate strut would installed about half way between the top of rock and cap beam to create a moment frame. This type of pier bent will be faster and easier to construct and it avoids having to construct cofferdams. Cost savings of approximately $3 million can be achieved with this approach.

Another means for reducing construction in the water is to lengthen the distance between pier bents as shown in Alt. No. BF-7. In this instance, the bents are spaced at 240 ft apart in lieu of 140 ft apart and precast concrete, post-tensioned beams with drop-in sections are used to span between the bents in lieu of bulb tees. This saves costs but introduces a new construction type into the area.

Lesser cost savings can be attained by reducing the width of the shoulders from 10 ft to 8 ft which will allow one line of the bridge girders to be eliminated as well as some of the deck area. This is demonstrated in Alt. No. BD-2 and brings the bridge into conformance with GDOT's current bridge width policy.

Because of the short time frame between the VE study and the proposed bidding of the project, Alt. No. C-1 suggests that the project be contracted for using a design-build project delivery system. In this approach, the current bridge drawings can be used as an example of an acceptable design, but the contractors are free to submit alternatives. Criteria can be created to limit the number of piers to the current maximum to avoid any changes to river hydraulics. Fewer piers have the advantage of reducing the obstacles for boat users and improving the river hydraulics.

There is also the potential the potential to bid the project as is and allow the contractors to submit alternative foundation designs to save costs.

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT **S.R. 43/U.S. 378 BRIDGE REPLACEMENT OVER THE SAVANNAH RIVER**

Georgia Department of Transportation

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	PRESENT WORTH OF COST SAVINGS: RECURRING COST SAVINGS	PRESENT WORTH OF COST SAVINGS: TOTAL PW LCC SAVINGS
BRIDGE DECK						
BD-1	Use ll-ft-wide lanes on the bridge in lieu of 12-ft-wide lanes and reduce the width of the bridge	$2,018,347	$1,925,382	$92,965		$92,965
BD-2	Use 8-ft-wide shoulders in lieu of 10-ft-wide shoulders, narrow the bridge deck and eliminate one bridge girder	$4,367,995	$3,978,110	$389,885		$389,885
BRIDGE FOUNDATIONS						
BF-1	Use drilled piers in lieu of spread footings on a concrete seal	$11,452,555	$8,408,557	$3,043,998		$3,043,998
BF-2	Eliminate one span of the bridge and use longer beams spaced 152 ft apart in lieu of 140 apart	$16,026,091	$15,869,870	$156,221		$156,221
BF-7	Use concrete post-tensioned beams with drop-in sections spanning 240 ft and reduce the number of piers from 11 to 6	$16,129,962	$15,650,182	$479,780		$479,780
EMBANKMENT						
E-1	Reduce the limits of the rock embankment	$259,511	$0	$259,511		$259,511
CONTRACTING						
C-1	Procure the project using a design-build contract in lieu of a design-bid-build	DESIGN SUGGESTION				

STUDY RESULTS

INTRODUCTION

The results are the major feature of this value engineering study since they portray the benefits that can be realized by GDOT and the users. The results will directly affect the project's design and require coordination amongst the GDOT project team to determine the disposition of each alternative.

During the VE workshop, many ideas for potential value enhancement were conceived and evaluated by the team for technical merit, applicability to the project, implementability considering the project's status, and the ability to meet GDOT's project value objectives. Research performed on those ideas considered to have the potential to enhance the value of the project resulted in the development of individual alternatives identifying specific changes to the project as a whole, or individual elements that comprise the project. For each alternative developed, the following information is provided:

- A summary of the original design,
- A description of the proposed change to the project,
- Sketches and design calculations, if appropriate,
- A capital cost comparison and life cycle discounted present worth cost comparison of the alternative and original design (where appropriate),
- An evaluation of the advantages and disadvantages of the alternative, and
- A brief narrative to compare the original design and the proposed change and provide a rationale for implementing the change into the project.

The capital cost comparisons used unit quantities contained in the project cost estimate prepared by the designers, whenever possible. If prices were not available, cost databases from GDOT and team members were consulted.

Each alternative developed is identified with an alternative number (Alt. No.) that can be tracked through the value engineering process, thus facilitating referencing among the Creative Idea Listing and Evaluation worksheets, the alternatives, and the Summary of VE Alternatives table. The Alt. No. contains one of the following letter prefixes indicating the project element being addressed:

- Bridge Deck = BD
- Bridge Foundations = BF
- Embankment = E
- Contracting = C

Summaries of the alternatives are provided on the Summary of VE Alternatives table.

KEY ISSUES

This project is scheduled for bid in August 2009, and thus the plans are about 90% complete. In reviewing the project's cost estimate, the VE team determined it to be very low considering that the bridge is to be constructed over 60 to 70 feet of water. This requires deep cofferdams to construct the foundation and a thick concrete seal seated three feet into the rock. Thus the project cost will increase from $14.2 million to $24.2 million.

STUDY OBJECTIVES

This project will be funded with Stimulus Funds being doled out by the U.S. Government to the states because of the current economic situation. The increase in project cost could result in the project's priority being reduced or funds taken from another project to fund this one. To reduce the effect of the cost increase, GDOT engaged this VE study to identify specific opportunities to save project costs.

RESULTS OF THE STUDY

The VE team generated six alternatives that could save project costs and one design suggestion that provides a means for accepting some of the alternatives without risking a schedule change. All of the alternatives are detailed this section of the report. The narrative below consolidates the team's findings.

The bridge foundations are the most expensive part of the project. Alt. No. BF-1 suggests changing from a spread footing sitting on top of a deep concrete seal constructed within a cofferdam to two, 8-ft-diameter drilled piers. The drilled piers would be socked 25 ft into the rock to achieve a fixed condition at the top of rock and an intermediate strut would installed about half way between the top of rock and cap beam to create a moment frame. This type of pier bent will be faster and easier to construct and it avoids having to construct cofferdams. Cost savings of approximately $3 million can be achieved with this approach.

Another means for reducing construction in the water is to lengthen the distance between pier bents as shown in Alt. No. BF-7. In this instance, the bents are spaced at 240 ft apart in lieu of 140 ft apart and precast concrete, post-tensioned beams with drop-in sections are used to span between the bents in lieu of bulb tees. This saves costs but introduces a new construction type into the area.

Lesser cost savings can be attained by reducing the width of the shoulders from 10 ft to 8 ft which will allow one line of the bridge girders to be eliminated as well as some of the deck area. This is demonstrated in Alt. No. BD-2 and brings the bridge into conformance with GDOT's current bridge width policy.

Because of the short time frame between the VE study and the proposed bidding of the project, Alt. No. C-1 suggests that the project be contracted for using a design-build project delivery system. In this approach, the current bridge drawings can be used as an example of an acceptable design, but the contractors are free to submit alternatives. Criteria can be created to limit the number of piers to

the current maximum to avoid any changes to river hydraulics. Fewer piers have the advantage of reducing the obstacles for boat users and improving the river hydraulics.

There is also the potential the potential to bid the project as is and allow the contractors to submit alternative foundation designs to save costs.

In reviewing the alternatives, note that some are mutually exclusive or interrelated. Therefore, the total potential cost savings achievable will be dependent upon the combination of ideas selected for implementation.

EVALUATION OF ALTERNATIVES AND DESIGN SUGGESTIONS

When reviewing the study results, each part of an alternative or design suggestion should be considered on its own merit. There may be a tendency to disregard an alternative because of a concern about one part of it. Each area within an alternative or design suggestion that is acceptable should be considered for use in the final design, even if the entire alternative or design suggestion is not implemented. Variations of these alternatives and design suggestions by GDOT or the design team are encouraged.

All alternatives and design suggestions were developed independently of each other to provide a broad range of options to consider for implementation. Therefore, some are mutually exclusive, so acceptance of one may preclude the acceptance of another. In addition, some of the alternatives may be interrelated, so acceptance of one or more may not yield the total of the cost savings shown for each alternative. Design suggestions could also be interrelated, thus precluding a part of one or more suggestions from being implemented if another design suggestion is also implemented.

All alternatives should be carefully reviewed in order to select the combination of ideas with the greatest beneficial impact on the project. Once this has been accomplished, the total cost savings resulting from the VE study can be calculated based on implementing a revised, all-inclusive design solution.

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT **S.R. 43/U.S. 378 BRIDGE REPLACEMENT OVER THE SAVANNAH RIVER**

Georgia Department of Transportation

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	PRESENT WORTH OF COST SAVINGS: RECURRING COST SAVINGS	PRESENT WORTH OF COST SAVINGS: TOTAL PW LCC SAVINGS
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BF-7	Use concrete post-tensioned beams with drop-in sections spanning 240 ft and reduce the number of piers from 11 to 6	$16,129,962	$15,650,182	$479,780		$479,780
EMBANKMENT						
E-1	Reduce the limits of the rock embankment	$259,511	$0	$259,511		$259,511
CONTRACTING						
C-1	Procure the project using a design-build contract in lieu of a design-bid-build	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 43/US 378 Project No. BRF00-00001-00(370), P.I. 0001370**
Lincoln County, Georgia

ALTERNATIVE NO.: **BD-1**

DESCRIPTION: **ON BRIDGE DECK USE 11-FT-WIDE LANES IN LIEU OF 12-FT-WIDE LANES**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (Sketch attached)

The proposed section includes two 12-ft-wide travel lanes with 10 ft rural shoulders, 2 ft of which are paved in the roadway portion. The total bridge width is 44 ft, which includes two 12-ft-wide travel lanes and also has two 10 ft shoulders.

ALTERNATIVE: (Sketch attached)

The travel lanes through the projects limits could each be reduced by 1 ft.

ADVANTAGES:

- Cost savings on asphalt and concrete

DISADVANTAGES:

- Transitioning from 12-ft-wide on the remaining existing roadway

DISCUSSION:

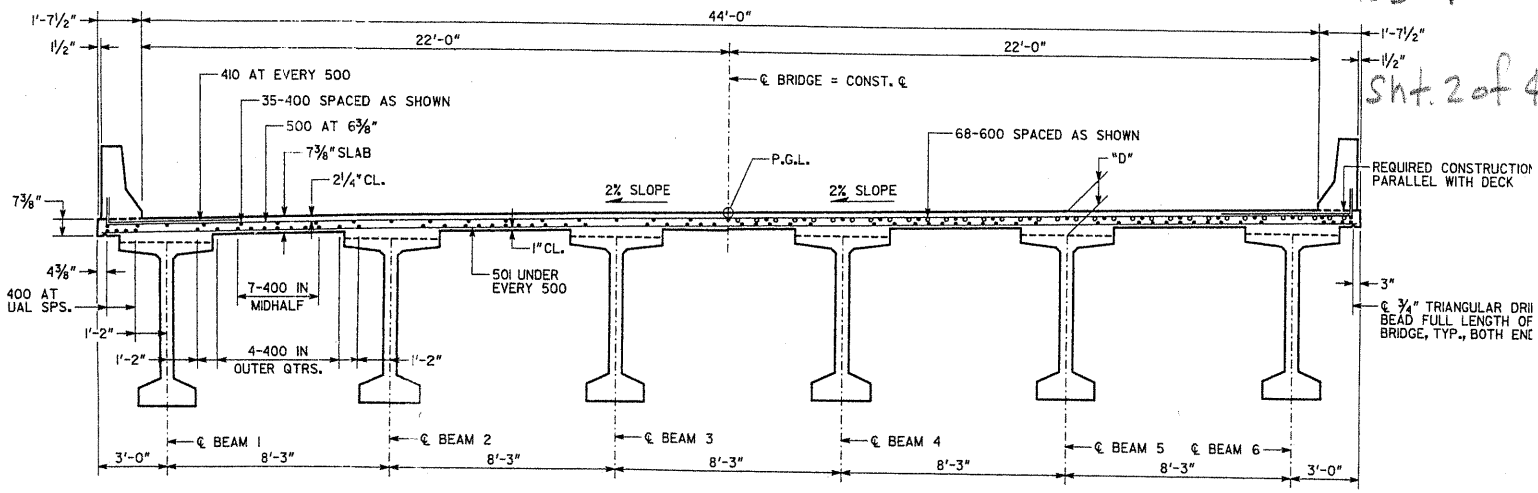
The lanes can be reduced by 1 ft each because it will save on costs. Additionally, the vehicles per day (vpd) counts are small and prove that the volumes are not high at any given time. Lastly, although the truck percentage is significant by retaining the 10 ft shoulders, this should ease the concern of side-swiping if there is one.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 2,018,348	—	$ 2,018,348
ALTERNATIVE	$ 1,925,381	—	$ 1,925,381
SAVINGS	$ 92,967	—	$ 92,967

Proposed

ALT. NO. BD-1

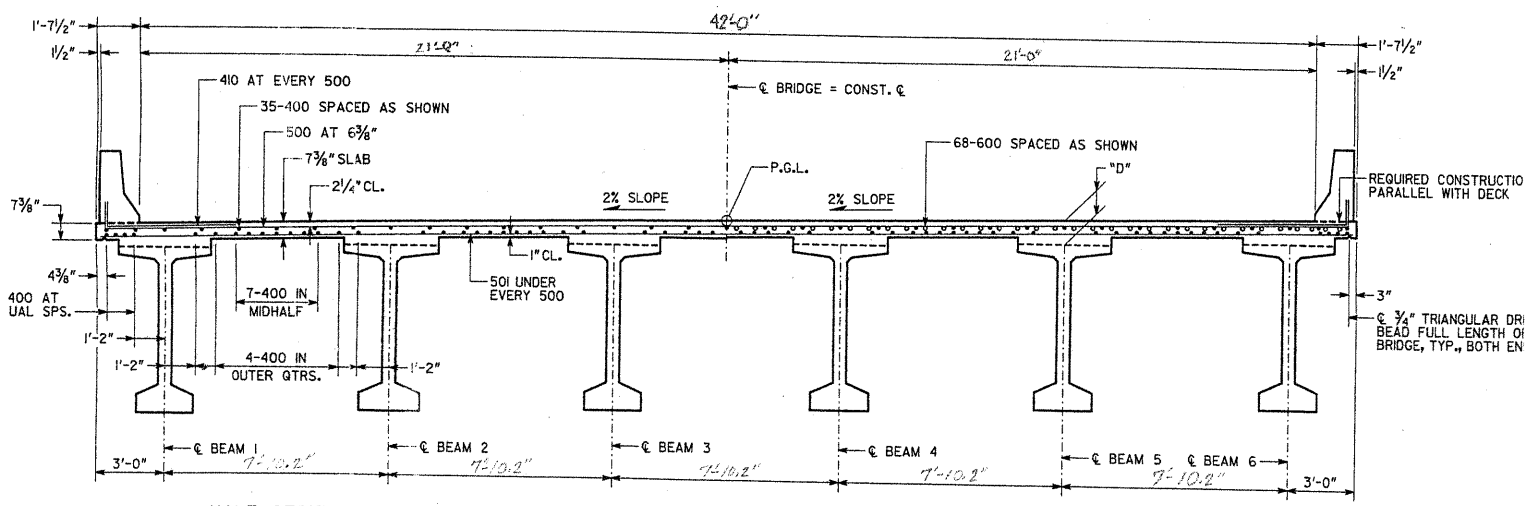
Sht. 2 of 4



HALF SECTION THRU SLAB AT MIDSPAN

HALF SECTION THRU SLAB AT INTERMEDIATE BENTS

Alternative



HALF SECTION THRU SLAB AT MIDSPAN

HALF SECTION THRU SLAB AT INTERMEDIATE BENTS

Alternative No.: BD-1

CALCULATIONS

PROJECT: **SR 43/US 378 PROJECT NO. BRF00-00001-00(370)**
Lincoln County, Georgia

ALTERNATIVE NO.: BD-1

On bridge deck use 11' lanes in lieu of 12' lanes

SHEET NO.: 3 of 4

Asphalt Paving (2110')
Sta. 413+00 to Sta. 423+90 (1090')
Sta. 441+30 to Sta. 451+50 (1020')

Concrete (1740') → (1680' plus 30' approach slab) 7 3/8
Sta. 423+90 to Sta. 441+30

Asphalt: (2110')(42') = 88620 sf
$\frac{88620}{9}$ = 9847 sy

$73.60/sy (9847 sy) = $724,740
(see other attachments)

Paving Section: Base: $\frac{12" \times 110"}{2000}$ = .66 × $18.20 = $12.00/sy
25mm: $\frac{4" \times 110"}{2000 lbs}$ = .44 × $62.20 = $13.7 sy
19mm $\frac{3" \times 110}{2000}$ = .33 × $67.27 = 11.10 sy
9.5mm: $\frac{1.5" \times 110}{2000}$ = .17 × $72.56 = 6.00 sy
$42.80/sy

Concrete: (1680')(42')(7 3/8" / 12" = .615') = 43365 cf
DECK
$\frac{43365}{27}$ = 1606 cy
deck (≥ 7 90 kv)

(1606 cy)($790/cy) = $1,268,740

SLAB (60')(42') = 2520 sf
$\frac{2520}{9}$ = 280 sy
(280 sy)($15.80/sy) = $4,386

COST WORKSHEET

PROJECT: **BRIDGE REPLACEMENT**
S.R. 43/U.S. 378 OVER THE SAVANNAH RIVER
Georgia Department of Transportation

ALTERNATIVE NO. **BD-1**
SHEET NO. **4 of 4**

CONSTRUCTION ITEM		ORIGINAL ESTMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Paving	SY	10,316	42.80	441,525	9,847	42.80	421,452
Superstructure Concrete (Decking)	CY	1,684	790.00	1,330,360	1,606	790.00	1,268,740
Concrete Approach Slab	SY	293	158.52	46,446	280	158.52	44,386
Sub-total				1,818,331			1,734,577
Mark-up at 11.00%				200,016			190,803
TOTAL				2,018,348			1,925,381

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 43/US 378 Project No. BRF00-00001-00(370), P.I. 0001370**
Lincoln County, Georgia

ALTERNATIVE NO.: **BD-2**

DESCRIPTION: **REDUCE THE SHOULDER WIDTH FROM 10 FT TO 8 FT, NARROW THE BRIDGE DECK AND ELIMINATE ONE BRIDGE GIRDER**

SHEET NO.: **1 of 6**

ORIGINAL DESIGN: (Sketch attached)

The proposed design includes two 10-ft-wide shoulders along the bridge deck and in the roadway portion.

ALTERNATIVE: (Sketch attached)

Instead of designing 10-ft-wide shoulders, use 8-ft-wide shoulders along the deck as well as the roadway. By doing this, only five of the six beams is needed.

ADVANTAGES:

- Reduces cost of asphalt and concrete
- Eliminates a beam
- Saves construction time

DISADVANTAGES:

- Redesign is required

DISCUSSION:

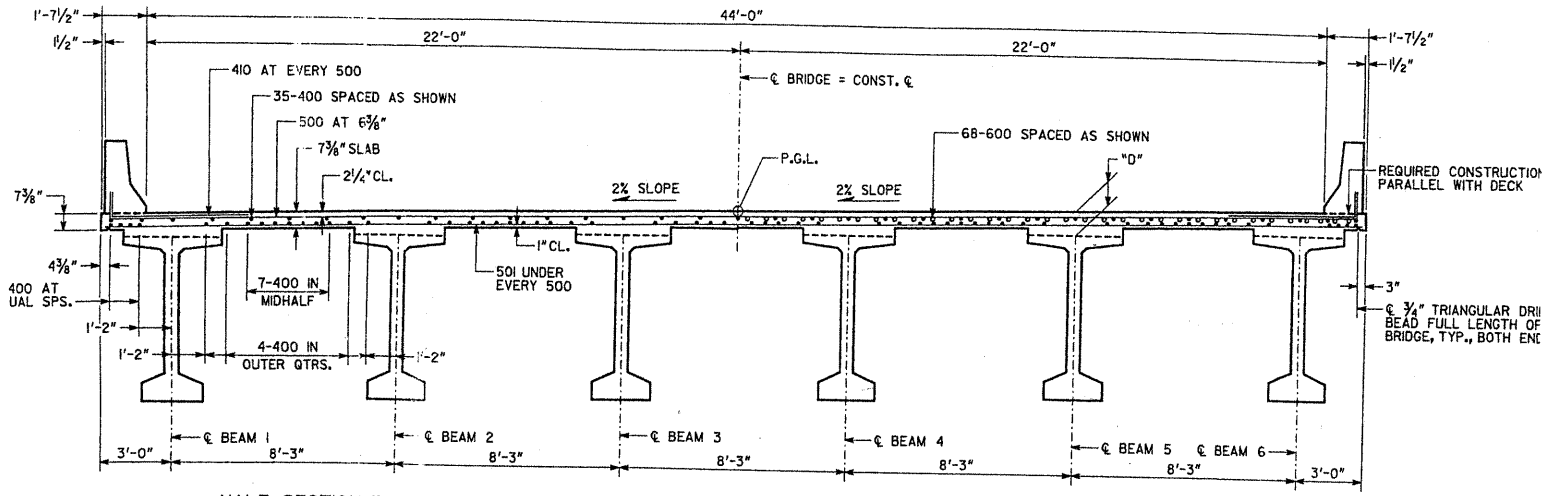
By reducing the 10 ft shoulder width to 8 ft, this allows for the elimination of a beam as well. This results in cost savings of asphalt, concrete and an entire beam. The span widths will have to be adjusted accordingly.

The GDOT policies and procedures recommend this.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 4,367,996	—	$ 4,367,996
ALTERNATIVE	$ 3,978,110	—	$ 3,978,110
SAVINGS	$ 389,886	—	$ 389,886

ALT. NO.
BD-2
Sht. 2 of 6

Proposed

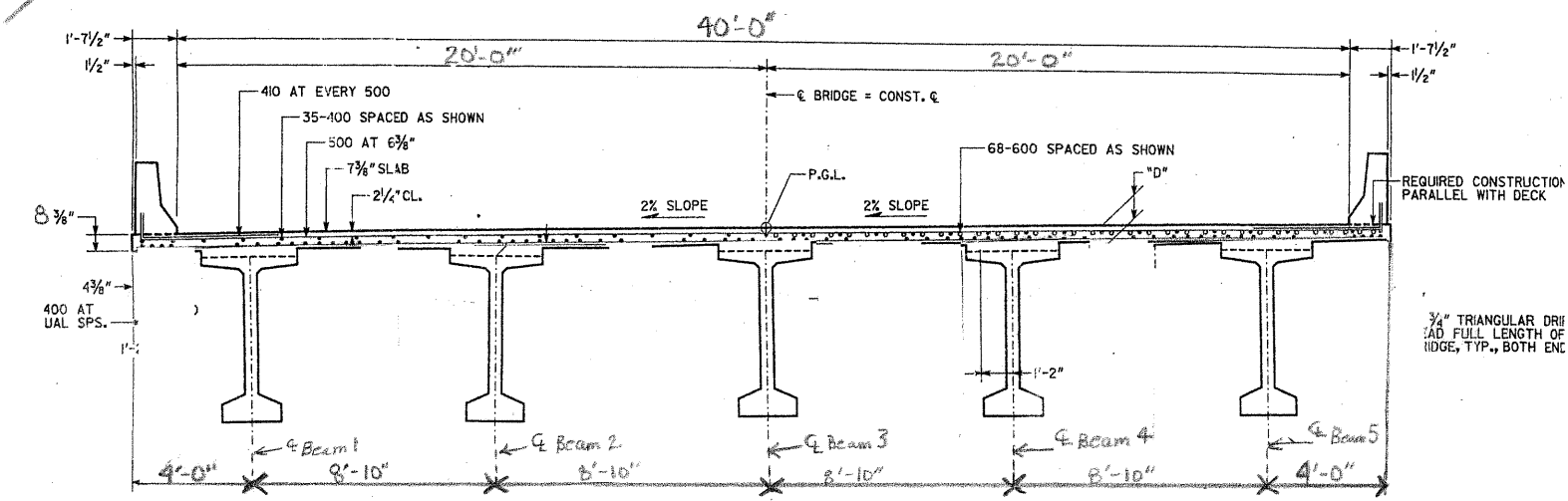


HALF SECTION THRU SLAB AT MIDSPAN

HALF SECTION THRU SLAB AT INTERMEDIATE BENTS

AS DESIGNED

Alternative



ALTERNATIVE

PROJECT: **SR 43/US 378 PROJECT NO. BRF00-00001-00(370)**
Lincoln County, Georgia

ALTERNATIVE NO.: BD-2

Reduce shoulder width from 10'+8'

SHEET NO.: 3 of 6

Asphalt Paving (2110')
Sta. 413+00 to Sta. 423+90 (1090')
Sta. 441+30 to Sta. 451+50 (1020')

Concrete (1740')
Sta. 423+90 to Sta. 441+30 (includes two 30' approach slabs)

Asphalt:
(2110')(40') = 84400 sf
84400 / 9 = 9378 sy
($73.60/sy)(9378 sy) = $690,221

Beam:
(1680')($210/m) = $352,800

Concrete:

SLAB
(60')(40') = 2400 sf
2400 / 9 = 267 sy
($158.52)(267 sy) = $42,325

DECK
(1680')(40')(8 3/8" = .70) = 47040 cf
47040 / 27 = 1742 cy
(1742 cy)($790/cy) = $1,376,180

4 of 6

Policies & Procedures

POLICIES & PROCEDURES

Policies : Geometric Design Guide for Bridges on Highways Having State Route Numbers, Other Than Interstate

Cancel

Subject	Geometric Design Guide for Bridges on Highways Having State Route Numbers, Other Than Interstate	**Subject No.**	4265-10
Section	Widths	**Division**	Pre-Construction
Office	Bridge and Structural Design	**Contact**	
Date Last Reviewed	3/3/2008	**Procedures**	N/A

Details

Geometric design standards shall be in accordance with the AASHTO publication "A Policy on Geometric Design of Highways & Streets," Collector Roads and Streets, 2004, p. 426.

I. Minimum Bridge Widths

A. **Rural section (2 lanes without curb**

Speed Design: All Speeds
Design YearADT: 0 - 399
Bridge WidthClear Distance: TW + 4 ft + 4 ft (TW + 1.2 m + 1.2 m)
Design* Live Loading: HS-20 (MS-18)

Speed Design: All Speeds
Design YearADT: 400 - 2000
Bridge WidthClear Distance: TW + 6 ft + 6 ft (TW + 1.8 m + 1.8 ,)
Design* Live Loading: HS-20 (MS-18)

Speed Design: All Speeds
Design YearADT: Over 2000
Bridge WidthClear Distance: TW + 8ft + 8 ft (TW + 2.4 m + 2.4 m)
Design* Live Loading: HS-20 (MS-18)

B. **Multilane rural (undivided -- 4 or more lanes)**
TW + 16 feet (4.8 m) | 8 feet (2.4 m) shoulders right and left

C. Multilane rural (divided)
TW + 12 feet (3.6 m) | 4 feet (1.2 m) inside shoulders + 8 feet (2.4 m) outside shoulders

D. Urban sections (with curb)
The minimum clear width for all new or reconstructed bridges shall be the curb to curb width of the approaches except that the minimum curb to curb width for two-lane, two-way bridges shall be TW + 4 ft (1.2 m) unless an exception is obtained from the Chief Engineer. Sidewalks shall be provided on bridges where curb and gutter is provided on the approach roadway. Minimum sidewalk width on bridges shall be 5.5 ft (1.7 m).

II. Vertical ClearanceVertical clearance shall be a minimum of 16.5 ft (5.1 m) on all State Route highway separations except that 17.5 ft (5.4 m) may be a minimum where the overpass structure design is such that future jacking to increase clearance is not feasible. A minimum vertical clearance of 14.5 ft (4.4 m) is permissible for Rural Secondary or Urban System facilities where a suitable bypass is available for high vehicles.

III. Bridge WideningsWhen an existing bridge is to be widened, its structural capacity will be accepted if the live load capacity is HS20-44 (MS-18) or greater. If the structural capacity is less than HS 20-44 (MS-18) and the bridge is to be retained, then a design variance will be obtained from the Chief Engineer.

IV. Design VariancesWhen a project is implemented using Federal Funds and the structural capacity and/or width characteristics do not meet the above criteria, a design variance request will be submitted to the Chief Engineer for approval.

COST WORKSHEET

PROJECT: **BRIDGE REPLACEMENT**
S.R. 43/U.S. 378 OVER THE SAVANNAH RIVER
Georgia Department of Transportation

ALTERNATIVE NO. **BD-2**
SHEET NO. **6 of 6**

CONSTRUCTION ITEM		ORIGINAL ESTMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Ashpalt Paving	SY	10,316	42.80	441,525	9,378	42.80	401,378
Concrete Approach Slab	SY	293	158.52	46,446	267	158.52	42,325
Superstructure Concrete	CY	1,684	790.00	1,330,360	1,742	790.00	1,376,180
PSC Beams	LF	10,080	210.00	2,116,800	8,400	210.00	1,764,000
Sub-total				3,935,131			3,583,883
Mark-up at 11.00%				432,864			394,227
TOTAL				4,367,996			3,978,110

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 43/US 378 Project No. BRF00-00001-00(370), P.I. 0001370**
Lincoln County, Georgia

ALTERNATIVE NO.: **BF-1**

DESCRIPTION: **USE DRILLED SHAFTS IN LIEU OF COLUMNS ON SPREAD FOOTINGS TO SUPPORT THE BRIDGE DECK**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN:

The original design has 11 hammer head piers on spread footings in deep water (70 ft). A coffer dam with a 25-ft-thick concrete seal will have to be constructed at each pier to erect the pier.

ALTERNATIVE: (Sketch attached)

Replace the hammer head piers on spread footings with a two-column drilled shaft pier.

ADVANTAGES:

- Eliminates costly coffer dam and dewatering
- Eliminates large footing
- Faster to install

DISADVANTAGES:

- Drilled shafts need to go 25 ft into rock
- Redesign required using sophisticated computer software

DISCUSSION:

Drilled shafts will eliminate the large footing and the costly coffer dam. Construction time will decrease with the drilled shaft construction because the contractor will not need to assemble the coffer dam and dewater. Based on a bridge in Florida, it appears that 9-ft-diameter shafts with a strut at about mid-height will be sufficient to carry the loads, making it a very economical solution. An option would be to allow the contractor to submit an alternate design for the foundation during the bid period.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 11,452,555	—	$ 11,452,555
ALTERNATIVE	$ 8,408,557	—	$ 8,408,557
SAVINGS	$ 3,043,998	—	$ 3,043,998

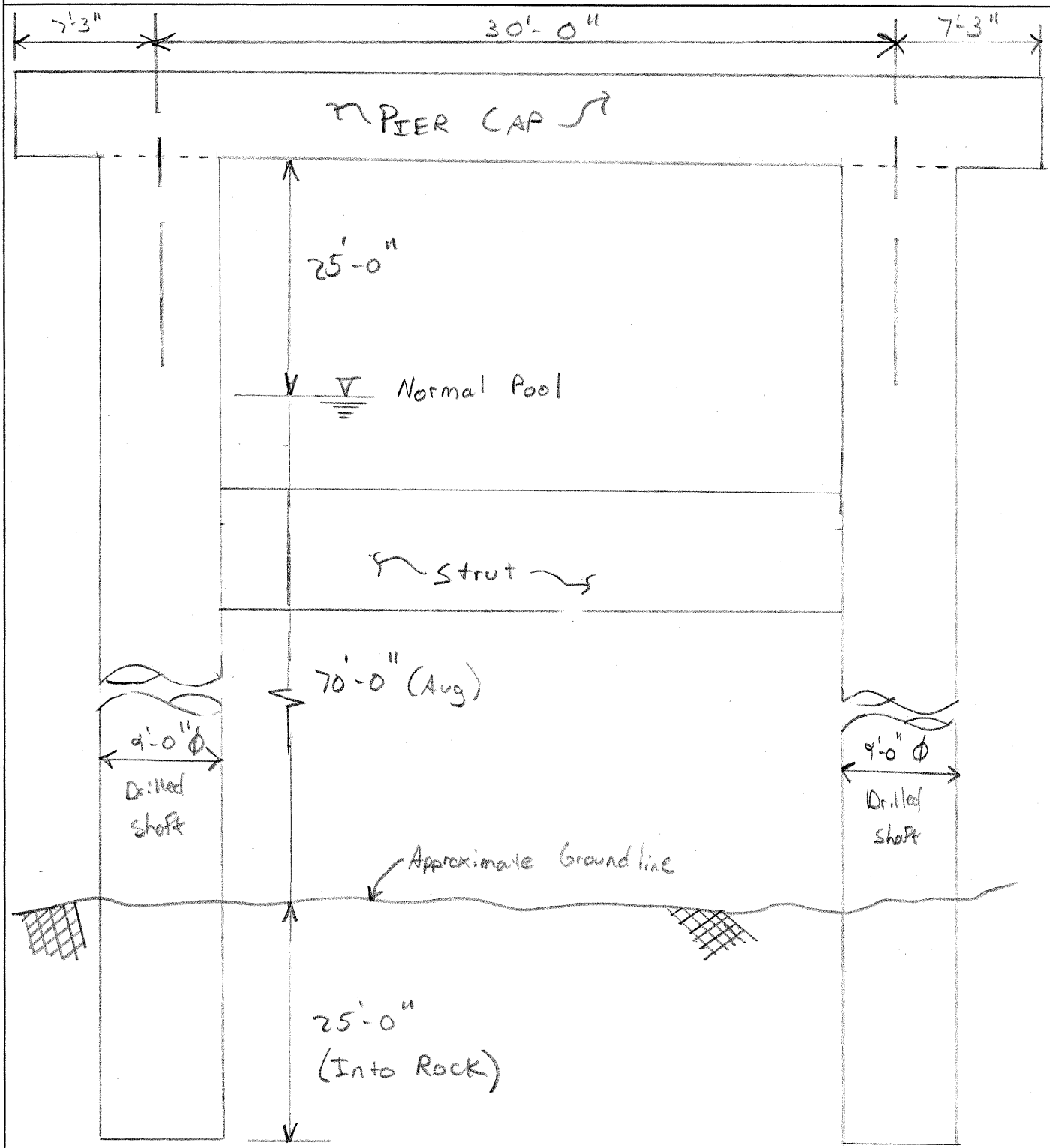
SKETCH

PROJECT: **SR 43/US 378 Project No. BRF00-00001-00(370), P.I. 0001370**
Lincoln County, Georgia

ALTERNATIVE NO.: BF-1

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☑ BOTH ☐

SHEET NO.: 2 of 4



PROJECT: **SR 43/US 378 PROJECT NO. BRF00-00001-00(370)**
Lincoln County, Georgia

ALTERNATIVE NO.: BF-1

SHEET NO.: 3 of 4

Discussion (Con't)

An option would be to allow the contractor to submit an alternate design for the foundation during the bid period.

COST WORKSHEET

PROJECT: **BRIDGE REPLACEMENT**

S.R. 43/U.S. 378 OVER THE SAVANNAH RIVER

Georgia Department of Transportation

ALTERNATIVE NO. **BF-1**

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Round Casing 9-ft Dia. X 70 ft high	LF				1,540	1,800.00	2,772,000
with concrete and rebar							
Rock Excavation	CY				1,296	110.00	142,560
Concrete in Rock	CY				1,296	600.00	777,600
Concrete Above Water Line	CY				1,296	1,100.00	1,425,600
Struts	CY				538	2,000.00	1,076,000
Cap	CY				635	1,100.00	698,500
Column Concrete	CY	2,353	1,100.00	2,588,300			
Footing Concrete	CY	1,353	800.00	1,082,400			
Seal Concrete	CY	8,515	300.00	2,554,500			
Rock Excavation	CY	1,022	110.00	112,420			
Soil Excavation	CY	7,493	40.00	299,720			
Coffer Dam	EA	11	250,000	2,750,000			
Sub-total				9,387,340			6,892,260
Mark-up at 22.00%				2,065,215			1,516,297
TOTAL				11,452,555			8,408,557

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 43/US 378 Project No. BRF00-00001-00(370), P.I. 0001370**
Lincoln County, Georgia

ALTERNATIVE NO.: **BF-2**

DESCRIPTION: **ELIMINATE ONE SPAN AND USE LONGER BEAMS SPACED 152 FT APART**

SHEET NO.: **1 of 3**

ORIGINAL DESIGN: (sketch attached)

The original design has 12 ft spans at 140 ft spacing with 11 piers and two abutments are designed for the bridge.

ALTERNATIVE: (sketch attached)

Use 11 spans spaced at 152 ft with 10 piers and two abutments. Adjust the bridge girder spacing to 8 ft between beams and 3 ft 6 5/8 in overhangs.

ADVANTAGES:

- Cost savings in erection of piers

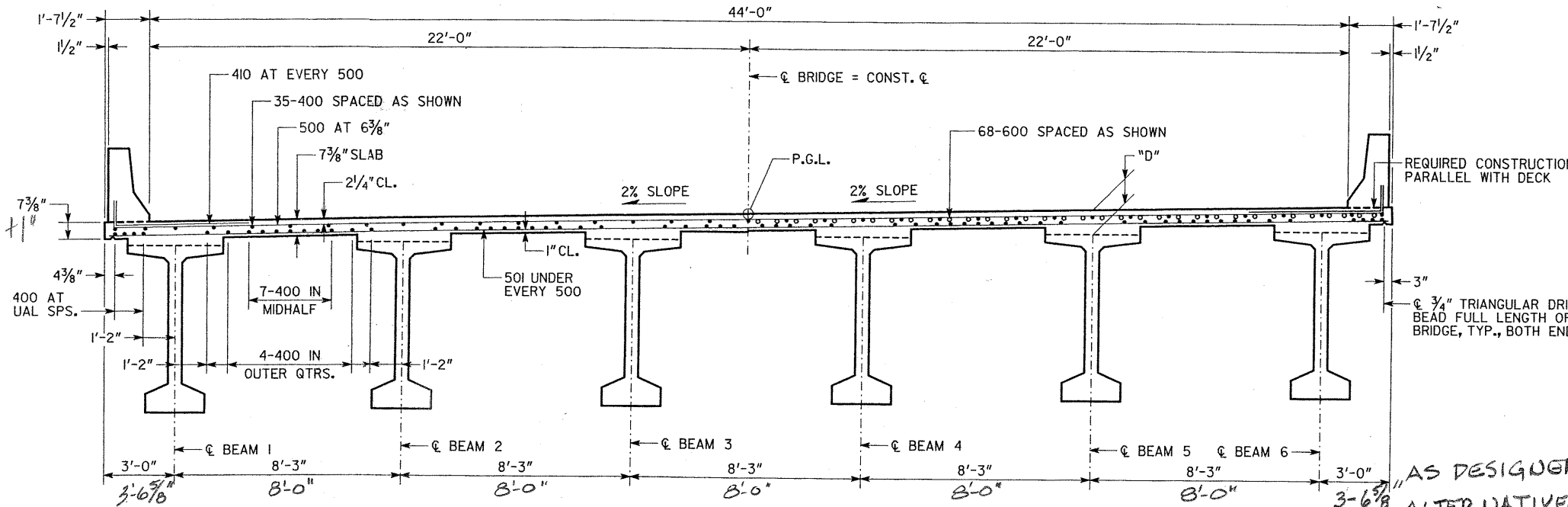
DISADVANTAGES:

- Redesign is required

DISCUSSION:

By eliminating one span and increasing the length of the spans, cost savings will occur. This elimination will result in one less pier as well as the use and construction of a coffer dam.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 16,026,091	—	$ 16,026,091
ALTERNATIVE	$ 15,869,870	—	$ 15,869,870
SAVINGS	$ 156,221	—	$ 156,221



HALF SECTION THRU SLAB AT MIDSPAN

HALF SECTION THRU SLAB AT INTERMEDIATE BENTS

"AS DESIGNED"
ALTERNATIVE

ALT. NO. BF-2
Sht. 2 of 3

COST WORKSHEET

PROJECT: **BRIDGE REPLACEMENT**

S.R. 43/U.S. 378 OVER THE SAVANNAH RIVER

Georgia Department of Transportation

ALTERNATIVE NO. **BF-2**

SHEET NO. 3 of 3

CONSTRUCTION ITEM		ORIGINAL ESTMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Column Concrete	CY	2,353	1,100.00	2,588,300	2,139	1,150.00	2,459,850
Footing Concrete	CY	1,353	800.00	1,082,400	1,353	800.00	1,082,400
Seal Concrete	CY	8,515	300.00	2,554,500	8,515	300.00	2,554,500
Rock Excavation	CY	1,022	110.00	112,420	1,022	110.00	112,420
Soil Excavation	CY	7,493	40.00	299,720	7,493	40.00	299,720
Coffer Dam	EA	11	250,000	2,750,000	10	270,000	2,700,000
Deck Concrete	CY	2,720	600.00	1,632,000	2,720	600.00	1,632,000
74" Precast Concrete Beams	LF	10,080	210.00	2,116,800	10,080	215.00	2,167,200
Sub-total				13,136,140			13,008,090
Mark-up at	**22.00%**			2,889,951			2,861,780
TOTAL				16,026,091			15,869,870

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 43/US 378 Project No. BRF00-00001-00(370), P.I. 0001370**
Lincoln County, Georgia

ALTERNATIVE NO.: **BF-7**

DESCRIPTION: **POST-TENSIONED CONCRETE GIRDERS WITH DROP-IN SECTION FOR LONGER SPANS**

SHEET NO.: **1 of 3**

ORIGINAL DESIGN:

The original design uses 12 ft spans at 140 ft spacing for a total bridge length of 1,680 ft. The bridge deck is supported on 6 74-in-deep precast concrete bulb tee sections.

ALTERNATIVE: (sketch attached)

Use seven approximately 240 ft spans for a total bridge length of 1,680 ft. Use give post-tensioned concrete girders with a drop-in section to support the bridge deck over the 240 ft spans.

ADVANTAGES:

- Eliminates five piers
- Reduces construction time
- Saves cost
- Reduces hydraulic impediments in the lake

DISADVANTAGES:

- Redesign is required

DISCUSSION:

The long-span post-tensioned concrete girders will eliminate five piers and coffer dams and decrease the construction time, thus saving costs. This is a common construction method used in states bordering Georgia.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 16,129,962	—	$ 16,129,962
ALTERNATIVE	$ 15,650,182	—	$ 15,650,182
SAVINGS	$ 479,780	—	$ 479,780

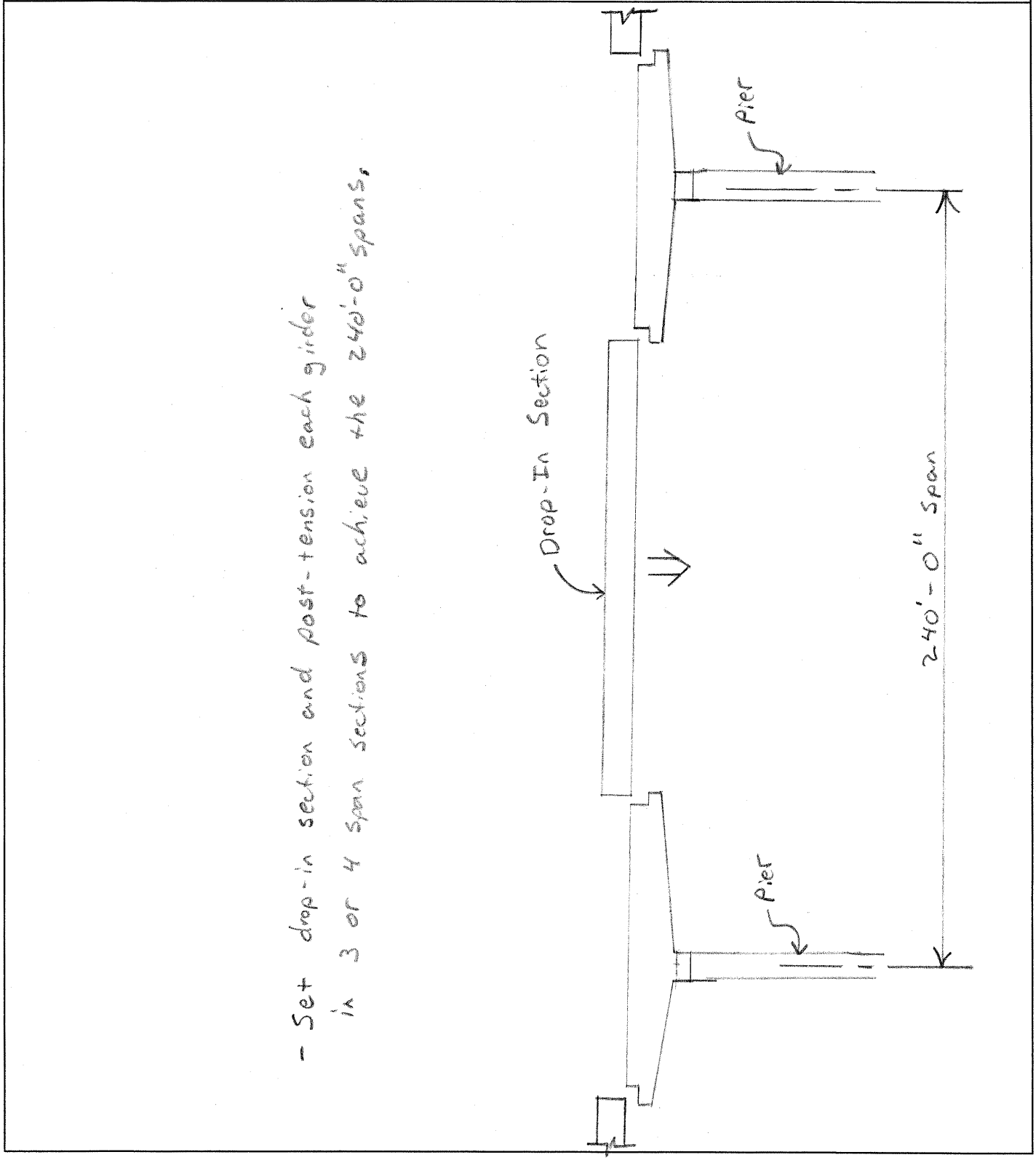
SKETCH

PROJECT: **SR 43/US 378 Project No. BRF00-00001-00(370), P.I. 0001370**
Lincoln County, Georgia

ALTERNATIVE NO.: BF-7

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☑ BOTH ☐

SHEET NO.: 2 of 3



COST WORKSHEET

PROJECT: **BRIDGE REPLACEMENT**

S.R. 43/U.S. 378 OVER THE SAVANNAH RIVER

Georgia Department of Transportation

ALTERNATIVE NO. **BF-7**

SHEET NO. of

CONSTRUCTION ITEM		ORIGINAL ESTMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Deck Concrete	CY	2,720	600.00	1,632,000	2,742	600.00	1,645,200
74" Precast Concrete Beams	LF	10,080	210.00	2,116,800			
Column Concrete	CY	2,353	1,100.00	2,588,300	1,555	1,100.00	1,710,500
Footing Concrete	CY	1,353	800.00	1,082,400	1,479	800.00	1,183,200
Seal Concrete	CY	8,515	300.00	2,554,500	7,733	300.00	2,319,900
Rock Excavation	CY	1,022	110.00	112,420	967	110.00	106,370
Soil Excavation	CY	7,493	40.00	299,720	6,767	40.00	270,680
Coffer Dam	EA	11	250,000	2,750,000	6	250,000	1,500,000
Post-tensioned Concrete Beams	LF				8,400	475.00	3,990,000
with drop-in section							
Abutment Piles	LF	990	86.00	85,140	1,188	86.00	102,168
Sub-total				13,221,280			12,828,018
Mark-up at 22.00%				2,908,682			2,822,164
TOTAL				16,129,962			15,650,182

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 43/US 378 Project No. BRF00-00001-00(370), P.I. 0001370**
Lincoln County, Georgia

ALTERNATIVE NO.: **E-2**

DESCRIPTION: **REDUCE LIMITS OF ROCK EMBANKMENT**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

Rock embankment extends approximately 40 ft beyond the riprap slope at the abutments.

ALTERNATIVE: (sketch attached)

Reduce the extent beyond the riprap to 10 ft.

ADVANTAGES:

- Reduce the quantity of rock embankment needed

DISADVANTAGES:

- None apparent

DISCUSSION:

Reduce the limits of rock embankment beyond the riprap slope at both abutments. This will reduce the overall cost of the project.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 259,211	—	$ 259,211
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 259,511	—	$ 259,511

SKETCH

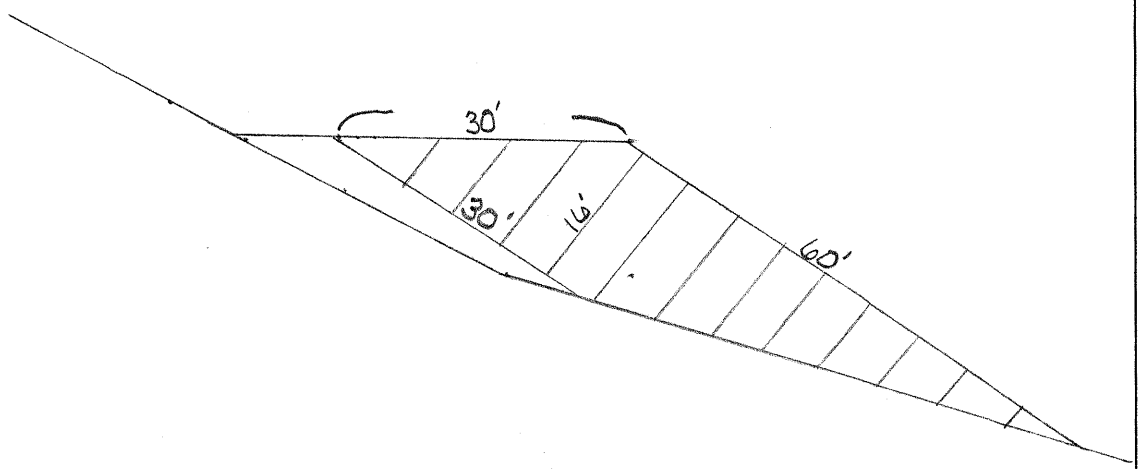
PROJECT: **SR 43/US 378 Project No. BRF00-00001-00(370), P.I. 0001370**
Lincoln County, Georgia

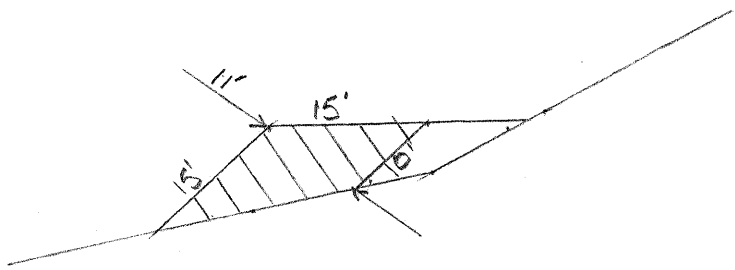
ALTERNATIVE NO.: E-2

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☐ BOTH ☑

SHEET NO.: 2 of 4

South Abutment





CALCULATIONS

PROJECT: **SR 43/US 378 PROJECT NO. BRF00-00001-00(370)**
Lincoln County, Georgia

ALTERNATIVE NO.: E-2

SHEET NO.: 3 of 4

South Abutment

16'(L) x 45'(H) x 100'(W) = 72,000CF

North Abutment

11' x 12.5' x 80 = 11,000 CF

83,000 CF x 160 lbs/CF ÷ 2000 lbs/TN = 6,640 TNs

COST WORKSHEET

PROJECT: **BRIDGE REPLACEMENT**
S.R. 43/U.S. 378 OVER THE SAVANNAH RIVER
Georgia Department of Transportation

ALTERNATIVE NO. **E-2**
SHEET NO. **4 of 4**

CONSTRUCTION ITEM		ORIGINAL ESTMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Rock Embankment	TN	6,640	35.21	233,794			
Sub-total				233,794			
Mark-up at	**11.00%**			25,717			
TOTAL				259,512			

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 43/US 378 Project No. BRF00-00001-00(370), P.I. 0001370**
Lincoln County, Georgia

ALTERNATIVE NO.: **C-1**

DESCRIPTION: **PROCURE THE PROJECT USING A DESIGN-BUILD CONTRACT IN LIEU OF DESIGN-BID-BUILD**

SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

This project is to be contracted for using the traditional design-bid-build approach.

ALTERNATIVE: (sketch attached)

Contract for the work using the design-build approach using the current GDOT bridge documents as an example of an acceptable design and allowing the contractor to select the number of piers, their spacing and the type of foundation.

ADVANTAGES:

- Will result in the most cost-effective project, thus saving costs.

DISADVANTAGES:

- Requires the development of the design-build contract
- Requires contractor to come up with a new design

DISCUSSION:

As designed, the bridge pier foundations will have to be constructed using coffer dams that will average 70 ft deep from the top of the water surface to the top of the rock. Constructing these coffer dams is costly and time consuming. By allowing the contractor the option of changing the type and number of foundations constructed, as permitted under design-build contracting, costs and time can be saved because the contractors will select their preferred methodology.

Options that may be considered are to eliminate one pier and use longer precast concrete beams, Alt. No. BF-2, use longer post-tensioned beams, Alt. No. BF-7, or change to two drilled shafts with a strut midway up the shaft, Alt. No. BF-1.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

PROJECT DESCRIPTION

The Bridge Replacement S.R. 43/U.S. 378 At Savannah River project, BR000-0001-00(370) Lincoln County, P.I. No. 0001370, replaces the existing two-lane bridge that has deteriorated to the point where it requires replacement. The new bridge alignment will be east of the existing bridge to avoid construction adjacent to a buried telephone cable line to the west of the existing bridge. The new bridge will be higher than the existing bridge to allow recreational boats to pass beneath it. The structure will be 1,680 ft long and 47 ft 3 in wide and will have the following features:

- 10-ft-wide shoulders and 12-ft-wide travel lanes in each direction
- 7-1/2 in thick cast-in-place concrete deck with a 3 ft overhang at the edges
- Cast-in-place concrete barriers at the edges of the deck
- 74-in-deep precast concrete bulb tee bridge girders spaced at 8 ft 3 in on center and spanning 140 ft
- Concrete bridge deck barriers
- Cast-in-place concrete hammerhead piers to support the bridge deck
- Spread footings on a concrete seal sitting on rock for the foundation which will be constructed in 70 ft of water
- New embankments at each end of the bridge constructed of rock fill
- 30 ft long concrete approach slabs at each end
- Demolition of the existing bridge

It is anticipated that the contractor will have to install steel cofferdams from the water surface to the solid rock and seat it in the rock. The cofferdams will have to be dewatered to install the footings on top of the seal concrete which can be tremied in.

The new bridge will be tied into the existing highway at both ends and a road down to an existing parking area of the south end of the bridge will be replaced. The bridge will be constructed on land owned by the U.S. Corps of Engineers and will necessitate an increase in the right-of-way.

The estimated cost of the project is $14.2 million and it is expected to be bid in August 2009.

A bridge plan and typical bent section follow.

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.	BR000-0001-00(370)		

BEGIN PROJECT
STA 413+00
SR 43/US 378
M.P. 17.630 GEORGIA

2
U.S. GOVERNMENT

415+00

EXIST R/W

N 46°23'28.7" E
U.S. ROUTE 378/STATE ROUTE 43
CONST C/L
PROP EOP
PROP EOP
PROP EOS
PROP EOS

SE-1
SE-2
SE-3
SE-4

REMOVE EXISTING CONCRETE PIPE

417+28
24.00' ASPH

PC 418+46.97

TYPE I GUARDRAIL ANCHORAGE
419+00.00

BEGIN ASPHALT CURB
419+12.00

CLARKS HILL LAKE

420+00

EXIST R/W

END ASPHALT CURB
423+94.71

OPEN WATER *1

425+00

EXIST R/W

SE-5

PT 425+44.02

SE-6

EXISTING BRIDGE
BEGIN STA 424+84

SEE SHEET 13-02
MATCH LINE STATION 426+00

414+00.00
100'

414+00.00
150'

S.R. 43
CONSTRUCTION CENTERLINE
KC8

Degree = 4°00'00.0" Delta = 27°52'55.5"
Radius = 1432.39 Length = 697.05
Tangent = 355.57 Length of Cord = 690.19
External = 43.47 S.E. Rate = 7.120%
PC Sta = 418+46.97 DB = N 46°23'28.7" E
North 1401882.93 East 587654.14
PI Sta = 422+02.54
North 1402128.18 East 587911.59
PT Sta = 425+44.02 DA = N 18°30'33.3" E
North 1402465.35 East 588024.47
Design Speed = 55 MPH
Runoff Length = 182'

TEMP EASM'T FOR THE CONST OF BMP'S

EXIST R/W

416+50.00
100'

S 43°36'31.3" E

SPLICE HAND HOLE

416+50.00
150'

PI 1+15.11

N 54°48'10.4" E

PT 1+71.21

PI 2+39.40

418+00.00
100'

418+00.00
100'

TYPE 12 GUARDRAIL ANCHORAGE
(STRAIGHT TYPE) 419+00.00

BEGIN ASPHALT CURB
419+12.00

CLARKS HILL LAKE

1
U.S. GOVERNMENT

EXIST EOP
OBLITERATE EXISTING PAVEMENT AND GRADE TO DRAIN
CURVE, KC8
EXIST EOP

EXIST R/W
BERM
TOE OF SLOPE
ROCK EMBANKMENT
REQD R/W

420+26.07
71.70'

PI 422+02.54

423+73.23
35.07'

BEGIN APPROACH SLAB STA. 423+90
END APPROACH SLAB STA. 424+20

423+77.84
84.84'

END ASPHALT CURB
424+11.00

425+26.66
75.16'

BEGIN PROPOSED BRIDGE STA 424+20.00

425+49.43
125.04'

EXIST R/W

TRACT 1

425+27.20
125.15'

REQD R/W

M.P. 17.842

424+14.23
173.43'

425+49.43
166.87'

CLARKS HILL LAKE

OPEN WATER *1

MAINLINE SUPER ELEVATION TABLE				
NO.	STATION	LEFT	RIGHT	TYPE
SE-1	416+99.76	-0.0200	-0.0200	NC
SE-2	417+50.82	-0.0200	0.0000	FLAT
SE-3	418+01.88	-0.0200	0.0200	RC
SE-4	418+95.05	-0.0565	0.0565	BFS
SE-5	424+95.93	-0.0565	0.0565	EFS
SE-6	425+89.10	-0.0200	0.0200	RC

AM BUFFER ZONE
MENT FOR CONSTR OF BMP'S

ERTY AND EXISTING R/W LINE
IRED R/W LINE
TRUCTION LIMITS
MENT FOR CONSTR
AINTENANCE OF SLOPES

BEGIN LIMIT OF ACCESS.....BLA
END LIMIT OF ACCESS.....ELA
LIMIT OF ACCESS
REQUIRED R/W AND LIMIT OF ACCESS

SCALE IN FEET
0 50 100 200

DATE	REVISIONS	DATE	REVISIONS

DRAWING No. 13-01

GEORGIA
DEPARTMENT OF TRANSPORTATION
CONSTRUCTION PLAN

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.	BR000-0001-00(370)		

2

U. S. GOVERNMENT
CLARKS HILL LAKE

2

U. S. GOVERNMENT
CLARKS HILL LAKE

EXISTING 1566'x27.1'
REINF. CONC. BRIDGE

EXIST R/W

EXIST R/W

BEGIN EXISTING BRIDGE
STA. 424+84
M.P. 17.842

END EXISTING BRIDGE
STA. 440+50
M.P.O. 148

SEE SHEET 13-01

MATCH LINE STATION 426+00

430+00

GA.
S. CAR.

435+00

440+00

SEE SHEET 13-03

MATCH LINE STATION 441+00

REMOVE EXISTING BRIDGE

PC 439+82.20

N 18° 30' 33.3" E
U.S. ROUTE 378/STATE ROUTE 43 | CONST C/L | U.S. ROUTE 378

N. 1402613.2674
E. 588073.9904

N. 1403751.1943
E. 588454.9394

EXIST R/W

EXIST R/W

SAVANNAH RIVER

SE-7

END PROPOSED BRIDGE
STA. 441+00.00
M.P.O. 148

SE-8

1

U. S. GOVERNMENT
CLARKS HILL LAKE

1

U. S. GOVERNMENT
CLARKS HILL LAKE

PROPOSED 1680'x44'
REINF. CONC. BRIDGE

STATE LINE

LINCOLN COUNTY

McCORMICK COUNTY

MAINLINE SUPER ELEVATION TABLE				
NO.	STATION	LEFT	RIGHT	TYPE
SE-7	439+37.11	-0.0200	0.0200	RC
SE-8	440+30.29	-0.0565	0.0565	BFS

AM BUFFER ZONE

MENT FOR CONSTR OF BMP'S

ERTY AND EXISTING R/W LINE

IRED R/W LINE

TRUCTION LIMITS

MENT FOR CONSTR

BEGIN LIMIT OF ACCESS.....BLA
END LIMIT OF ACCESS.....ELA
LIMIT OF ACCESS
REQUIRED R/W AND LIMIT OF ACCESS

SCALE IN FEET

DATE	REVISIONS	DATE	REVISIONS

DRAWING No. 13-02

GEORGIA
DEPARTMENT OF TRANSPORTATION
CONSTRUCTION PLAN

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA.	BR000-0001-00(370)		

MAINLINE SUPER ELEVATION TABLE				
NO.	STATION	LEFT	RIGHT	TYPE
SE-9	442+72.81	-0.0565	0.0565	EFS
SE-10	443+65.98	-0.0200	0.0200	RC
SE-11	444+17.04	-0.0200	0.0000	FLAT
SE-12	444+68.11	-0.0200	-0.0200	NC

U.S. 378
CONSTRUCTION CENTERLINE
KC9

Degree = 4°00'00.0" Delta = 13°32'52.9"
Radius = 1432.39 Length = 338.70
Tangent = 170.14 Length of Cord = 337.91
External = 10.07 S.E. Rate =7.120%
PC Sta = 439+82.20 DB = N 18°30'33.3" E
North 1403829.14 East 588481.03
PI Sta = 441+52.34
North 1403990.48 East 588535.05
PT Sta = 443+20.90 DA = N 4°57'40.4" E
North 1404159.99 East 588549.76
Speed Design = 55 MPH
Runoff Length = 182'

CLARKS HILL LAKE

2

CLARKS HILL LAKE

U.S. GOVERNMENT

445+00

450+00

PT 443+20.90

BEGIN ASPHALT CURB
441+26.50

TYPE 12 (SKT-350) GUARDRAIL ANCHORAGE
447+57.50

END ASPHALT CURB
447+46.50

END PROJECT
STA. 451+50
US 378
M.P. 0.347 SOUTH CAROLINA

EXIST R/W

EXIST EOP

EXIST C/L

CONST C/L

N 4°57'40.4" E

U.S. ROUTE 378

441+35.41
147.49'

441+38.98
147.32'

TEMP EASM'T FOR THE CONST OF BMP'S

443+00.00
126.91'

443+00.00
96.44'

OBLITERATE AND GRADE TO DRAIN

CURVE KC9

TOE OF SLOPE

BERM

TOE OF ROCK EMBANKMENT

TRACT 2

REOD R/W

441+24.59
18.02'

SE-9

SE-10

SE-11

SE-12

444+00
150.00'

BEGIN APPROACH SLAB STA. 441+00

END APPROACH SLAB STA. 441+30

BEGIN ASPHALT CURB
441+09.00

441+11.91
115'

PI 441+52.34

OPEN WATER #2

451+50
50.00'

451+50
100.00'

END ASPHALT CURB
451+02.50

448+11.75
50.00'

TYPE 1 (SKT-350) GUARDRAIL ANCHORAGE
451+07.00

1

U.S. GOVERNMENT

CLARKS HILL LAKE

SEE SHEET 13-02

MATCH LINE STATION 441+00

AM BUFFER ZONE

MENT FOR CONSTR OF BMP'S

ERTY AND EXISTING R/W LINE

IRED R/W LINE

TRUCTION LIMITS

MENT FOR CONSTR

AINTENANCE OF SLOPES

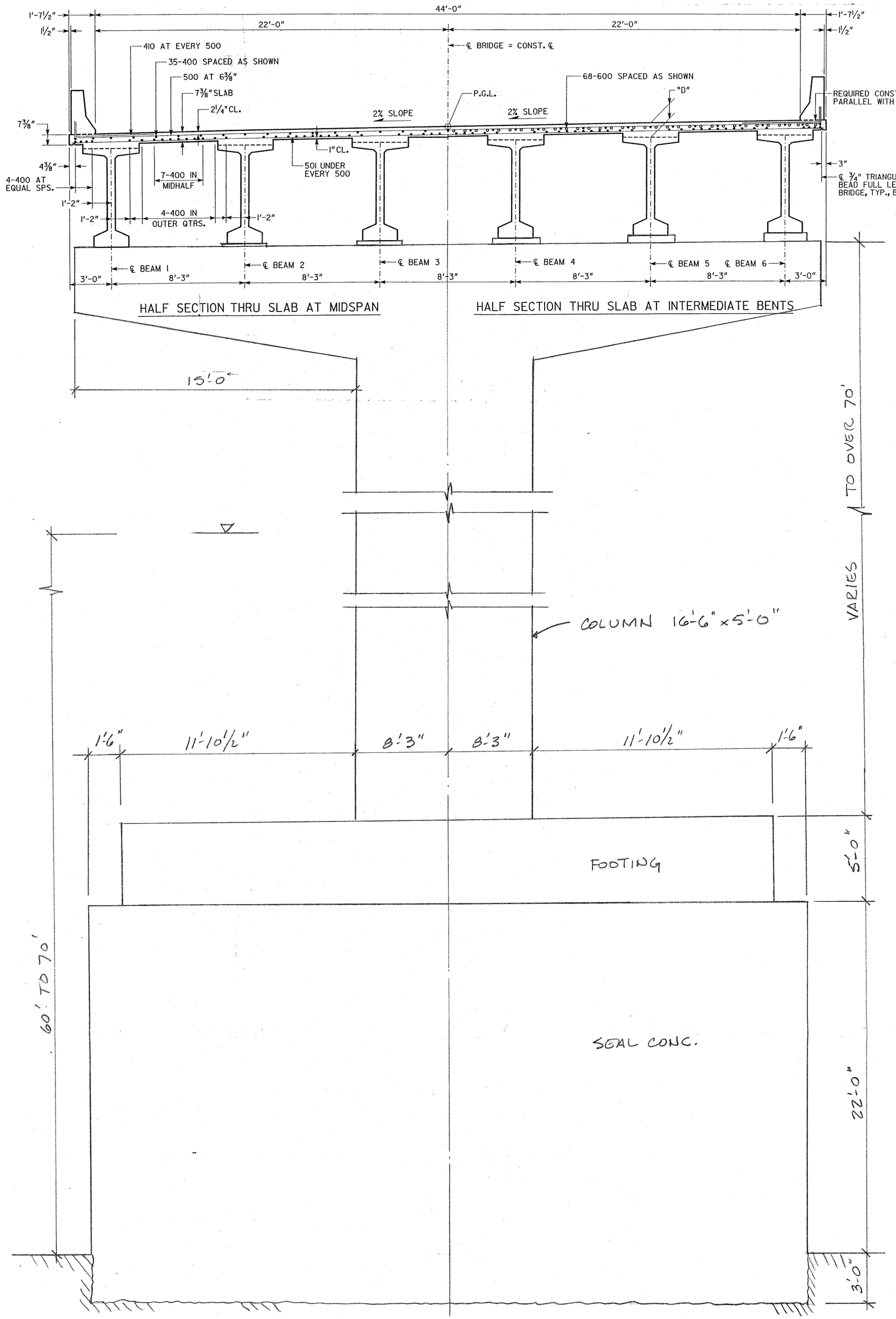
BEGIN LIMIT OF ACCESS.....BLA
END LIMIT OF ACCESS.....ELA
LIMIT OF ACCESS
REQUIRED R/W AND LIMIT OF ACCESS

SCALE IN FEET
0 50 100 200

DATE	REVISIONS	DATE	REVISIONS

GEORGIA
DEPARTMENT OF TRANSPORTATION
CONSTRUCTION PLAN

DRAWING No. 13-03


44'-0"
1'-7½"
1½"
22'-0"
22'-0"
℄ BRIDGE = CONST. ℄
410 AT EVERY 500
35-400 SPACED AS SHOWN
500 AT 6⅜"
7⅜" SLAB
2¼" CL.
2% SLOPE
2% SLOPE
P.G.L.
68-600 SPACED AS SHOWN
"D"
REQUIRED CONST
PARALLEL WITH
7⅜"
4⅜"
4-400 AT
EQUAL SPS.
1'-2"
1'-2"
7-400 IN
MIDHALF
4-400 IN
OUTER QTRS.
1'-2"
1" CL.
501 UNDER
EVERY 500
3"
℄ ¾" TRIANGU
BEAD FULL LE
BRIDGE, TYP., E
℄ BEAM 1
℄ BEAM 2
℄ BEAM 3
℄ BEAM 4
℄ BEAM 5
℄ BEAM 6
3'-0"
8'-3"
8'-3"
8'-3"
8'-3"
8'-3"
3'-0"
HALF SECTION THRU SLAB AT MIDSPAN
HALF SECTION THRU SLAB AT INTERMEDIATE BENTS
15'-0"
TO OVER 70'
VARIES
COLUMN 16'-6" × 5'-0"
1'-6"
11'-10½"
8'-3"
8'-3"
11'-10½"
1'-6"
FOOTING
5'-0"
60' TO 70'
SEAL CONC.
22'-0"
3'-0"

VALUE ANALYSIS AND CONCLUSIONS

INTRODUCTION

This section describes the procedures used during the VE study. It is followed by separate narratives and conclusions including:

- Value Engineering Study Agenda
- Value Engineering Workshop Participants
- Economic Data
- Cost Estimate Summary and Cost Model
- Function Analysis
- Creative Idea Listing and Evaluation of Ideas

A systematic approach was used in the VE study and the key procedures involved were organized into three distinct parts: 1) preparation; 2) VE workshop; and 3) post-study. A Task Flow Diagram that outlines each of the procedures included in the VE study is attached for reference.

PREPARATION EFFORT

Pre-study preparation for the VE effort consisted of scheduling study participants and tasks, gathering necessary background information on the facility, and compiling project data into a cost model and graphic cost histogram. Information relating to the design, construction, and operation of the facility is important as it forms the basis of comparison for the study effort. Information relating to funding, project planning operating needs, systems evaluations, basis of cost, soil conditions, and construction of the facility was also a part of the analysis.

VALUE ENGINEERING WORKSHOP EFFORT

The VE workshop was a three and a half-day effort (see attached agenda). During the workshop, the VE job plan was followed. The job plan guides the search for high cost areas in the project and includes procedures for developing alternative solutions for consideration. It has six phases:

- Information Phase
- Function Identification and Analysis Phase
- Creative Phase
- Evaluation Phase
- Development Phase
- Presentation Phase

Value Engineering Study Task Flow Diagram

Preparation Effort

Coordination Project
- Verify Schedule
- Suggest Format for Designer Presentation
- Outline Project Responsibilities
- Outline Needed Background Data
- Define *Project Value Objectives*
- Identify Project Constraints

→

Prepare for Workshop
- Collect Project Data
- Distribute Data to Team Members
- Team Members Become Familiar with Project

→

Construct Cost Models
- Construct Cost Models
- Construct Graphic Function Analysis
- Outline High Cost Areas

→

LCC Model
- Roadway
- Bridges
- MOT
- Energy
- User Impact

Workshop Effort

Information Phase
- Introduction by VETL
- Project Description and Presentation by Designer
- Outline Owner Requirements
- Review Project Data
- Visit Project Site (Alt.)

→

Function Identification and Analysis Phase
- Analyze Project Costs and Energy Usage
- Perform Function Analysis and FAST Diagram
- Identify High Cost and Energy Areas
- Calculate Cost/Worth Ratios
- Identify Paradigms

List Ideas Generated During Function Analysis

→

Speculation Phase
- Introduction by VETL
- Creative Idea Listing:
  - Quantity of ideas
  - Association of Ideas
- Brainstorm
- Do Creative Thinking
  - Group Thinking
  - Individual Thinking
- Use Checklist for Ideas

→

Evaluation Phase
- Eliminate Impractical Ideas
- Rank Ideas with Advantages/ Disadvantages
- Evaluate Alternatives (Include Non-Economic considerations: Safety, Reliability, Environment, Aesthetics, O&M, etc.)
- Select Best Ideas for Implementation

→

Development Phase
- Develop Proposed Alternatives
- Prepare Alternative Design Sketches
- Estimate Costs
- Perform Life Cycle Comparison
  - Initial Cost
  - Redesign Cost
  - O&M Cost
  - LCC Cost

→

Presentation Phase
- Summarize Findings
- Present VE Ideas to Owner/ User/Designer
- Oral Presentation

Post-Workshop Effort

VE Study Report
- Develop Implementation VE Report
- Designer Prepares Responses to VE Report
- Owner Evaluates Recommendations

→

Implementation Phase
- Participate in Implementation Meeting with Owner/User/ Designer/ VE Team, as needed
- Prepare Final VE Report

→

Final Acceptance
- Redesign by Designer

Information Phase

At the beginning of the study, the conditions and decisions that have influenced the development of the project must be reviewed and understood. For this reason, the design team presented information about the project to the VE team on first day of the session. Following the presentation, the VE team discussed the project using the following documents:

- Department of Transportation State of Georgia Plan and Profile of Proposed Bridge Replacement S.R.43-U.S.278 At Savannah River, BR000-0001-00(370), Lincoln County, dated 2/11/2009, prepared by GDOT
- Bridge Plans date February 2009, prepared by GDOT
- Department of Transportation State of Georgia Interdepartmental Correspondence, Project No. BR)))-0001-00(370), Lincoln County, SR 43/US378 @ Savannah River, Revision to Programmed Costs, dated 12/4/2008
- Department of Transportation State of Georgia Interdepartmental Correspondence, Project No. BR-0001-00(370), Lincoln County, P.I. Number 0001370, SR 43/US378 @ Savannah River, Project Concept Report, dated January 16, 2002, prepared by GDOT
- Plan and Elevation Bridge Over Savannah River, Sta. 401+33 to Sta.416+37 Lincoln County, GA – McCormick Co., S.C., prepared by GDOT

Function Identification and Analysis Phase

Based on historical and background data, a cost model and graphic function analysis were developed for this project by major construction elements. They were used to distribute costs by project element, serve as a basis for alternative functional categorization, and assign worth to the categories, where worth is the least cost to provide the required function, as determined by the VE team. The VE team identified the functions of the various project elements and subsystems by using random function generation techniques resulting in the attached Random Function Analysis worksheet.

Creative Phase

This VE study phase involved the creation and listing of ideas. Creative idea worksheets were organized by project element. During this phase, the VE team developed as many ideas as possible to provide the necessary functions within the project at a lower cost to the owner, or to improve the quality of the project. Judgment of the ideas was restricted at this point. The VE team was looking for a large quantity of ideas and association of ideas.

The GDOT project team may wish to review the creative list since it may contain ideas that can be further evaluated for potential use in the design.

Evaluation Phase

During this phase of the workshop, the VE team judged the ideas generated during the creative phase. Advantages and disadvantages of each idea were discussed to find the best ideas for development. Ideas found to be irrelevant or not worthy of additional study were discarded. Those that represented the greatest potential for cost savings or improvement to the project were then developed further.

Each idea was compared with the present schematic design concepts, in terms of how well it met the design intent. Advantages and disadvantages were discussed, and each team member rated the ideas on a scale of zero to five, with the best ideas rated 4 or 5. Only those ideas rated 4 or 5 were developed into alternatives. In cases where there was little cost impact but an improvement to the project was anticipated, the designation DS, for design suggestion, was used. The design team should review this listing for possible incorporation of ideas into the project.

The creative listing was re-evaluated frequently during the process of developing alternatives. As the relationship between creative ideas became more clearly defined, their importance and ratings may have changed, or they may have been combined into a single alternative. For these reasons, some of the originally high-rated items may not have been developed into alternatives.

Development Phase

During the development phase, each highly rated idea was expanded into a workable solution. The development consisted of a description of the alternative, life cycle cost comparisons, where applicable, and a descriptive evaluation of the advantages and disadvantages of the proposed alternatives. Each alternative was written with a brief narrative to compare the original design to the proposed change. Sketches and design calculations, where appropriate, were also prepared in this part of the study. The VE alternatives are included in the Study Results section.

Presentation Phase

The last phase of the VE study was the presentation of the findings. The VE alternatives were screened by the VE team before draft copies of the Summary of Potential Cost Savings worksheets were provided to GDOT representatives during an informal presentation on the last day of the workshop. The VE alternatives were arranged in the same order as the idea listing sheets to facilitate cross-referencing.

POST-WORKSHOP EFFORT

The post-study portion of the VE study includes the preparation of this report. It is recommended that personnel from GDOT analyze each alternative and prepare a short response, recommending either incorporating the alternative into the project, offering modifications before implementation, or presenting reasons for rejection.

VALUE ENGINEERING WORKSHOP PARTICIPANTS

The VE team was organized to provide specific expertise on the unique project elements involved. Team members consisted of a multidisciplinary group with professional highway and bridge design and construction experience and a working knowledge of VE procedures. The VE team included the following professionals:

Michael Moilanen, PE	Structural Engineer	ARCADIS US, Inc.
Dominic Saulino, PE	Highway Design Engineer	HNTB, Incorporated
Vinique Word	Construction Engineer	Delon Hampton & Associates
Howard Greenfield, PE, , CVS	VE Team Leader	Lewis & Zimmerman Associates

OWNER/DESIGNER PRESENTATION

Representatives from GDOT presented an overview of the project on Tuesday, March 3, 2009. The purpose of this meeting, in addition to being an integral part of the Information Gathering Phase of the VE study, was to bring the VE team "up-to-speed" regarding the overall project. Additionally, the meeting afforded the design team the opportunity to highlight in greater detail, those areas of the project requiring additional or special attention.

VALUE ENGINEERING TEAM PRESENTATION

The VE team conducted an informal presentation on Friday, March 6, 2009 to GDOT and District 7. Copies of the draft Summary of Value Engineering Alternatives worksheets were provided for interim use.

A copy of both meeting participants is attached for reference.

VE STUDY SIGN-IN SHEET

Project No.: BR000-0001-00(370) County: Lincoln PI No.: 0001370 Date: March 3-6, 2009

3-6-09

	NAME 3-3-09	EMPLOYEE ID NO.	DOT OFFICE OR COMPANY	PHONE NUMBER	EMAIL ADDRESS
Yes	~~Lisa L. Myers~~ Lisa L. Meyers	~~00244168~~	~~Engineering Services~~	~~404-631-1770~~	~~lmyers@dot.ga.gov~~
No	James K. Magnus	00208161	Construction	404-631-1971	jmagnus@dot.ga.gov
	~~Ken Werho~~	~~00258268~~	~~Traffic Operations~~	~~404-635-8144~~	~~kwerho@dot.ga.gov~~
	~~Jerry Milligan~~	~~00252745~~	~~Right of Way~~	~~404-347-0170~~	~~jmilligan@dot.ga.gov~~
Yes	Ron Wishon	00208180	Engineering Services	404-631-1753	rwishon@dot.ga.gov
Yes	Douglas Fadool	00928931	Engineering Services	404-631-1764	dfadool@dot.ga.gov
Yes	Howard Greenfield		Lewis & Zimmerman	301-984-9590	hgreenfield@lza.com
Yes	Mike Mclaren		ARCADIS	770-431-8666	Michael.Mclaren@ARCADIS-US.com
Yes	Vinique Word		Delon Hampton & Assoc.	404-419-8438	vword@delonhampton.com
Yes	Dan Saulino		HNTB	404-946-5745	dsaulino@hntb.com
Yes	Doug Franks	00809138	Bridge Design	404-631-1917	dfranks@dot.ga.gov
No	Nabil Raad	00729514	Traffic Op.	4-635-8126	hraad@dot.ga.gov.
	Via VIDEO DISTRICT 2				
Yes	Foster Grimes	00330697	District Design Squad Leader	478-552-4643	fgrimes@dot.ga.gov
Yes	Larry Morris	00812743	Design Engineer I	478-552-4640	lamorris@dot.ga.gov
Yes	Alan Smith	00234640	District Design Engineer	478-552-4642	asmith@dot.ga.gov
No	George Brewer	00279100	District Preconstruction Engineer	478-552-4629	gbrewer@dot.ga.gov
Yes	Rusty Merritt	00221784	District Construction Engineer	478-552-4603	rmerritt@dot.ga.gov
Yes	Lynn Bean	00294454	Asst. District Construction Engineer	478-553-2331	lbean@dot.ga.gov

ECONOMIC DATA

The VE team developed economic criteria used for evaluation with information gathered from the State of Georgia Department of Transportation, URS, Inc., and District 7 (D7). To express costs in a meaningful manner, the VE team alternatives are presented on the basis of discounted present worth. Criteria for planning project period interest rates are based on the following parameters:

Year of Analysis:	2009
Construction Start-Up:	Long Range
Construction Duration:	±36 Months (URS, Inc.)
Economic Planning Life:	30 years for Pavement
Economic Planning Life:	50 years for Bridges
Discount Rate/Interest:	0% (Per GDOT)
Inflation/Escalation Rate:	0.00% (Per GDOT)
Construction Mark-Up for Engineering & Const.	10.0%

COST ESTIMATE REVIEW

The value engineering team compared the cost estimate prepared by GDOT to the proposed construction documents. This review discovered that the $100.00 per square foot bridge cost with $375,000 for the cofferdams is not realistic for a 1,680-ft-long bridge being constructed over 60 plus feet of water. Thus the team re-estimated the cost of the bridge and the total project cost as shown on the following SR 43/US 378 Bridge Over the Savannah River Cost worksheet.

The with the bridge cost revised total cost of the project increases from $14.2 million to $24.2 million.

SR 43/US 378 Bridge Over the Savannah River Cost

Element	Units	Length	Width	Height	Number	Unit Cost	Units	Total Cost
Coffer Dam	EA	1	1	1	1	250,000	11	$ 2,750,000
Excavation	CY	44	19	22	1	40	11	299,721
Rock Excavation	CY	44	19	3	1	100	11	102,178
Seal Concrete	CY	44	19	25	1	300	11	2,554,444
Footings	CY	40.25	16.5	5	1	800	11	1,082,278
Column	CY	16.5	5	70	1	1100	11	2,588,056
Hammerhead Wings	CY	15	5	5.5	2	1100	11	369,722
Beams	LF	1680	1	1	6	200	1	2,016,000
Deck	CY	1680	47.25	0.925	1	600	1	1,631,700
Concrete Barrier	LF	1680	1	1	2	50	1	168,000
Abutment Piles	LF	990	1	1	1	86	1	85,140
Pile Tests	EA	2	1	1	1	5000	1	10,000
Abutment Concrete	CY	1	1	1	53	600	1	31,800
Subtotal								**$ 13,689,039**
General Conditions @ 10%								$ 1,368,904
Contractors OH & P @ 10%								$ 1,505,794
TOTAL								**$ 16,563,738**

$209/sf

Roadway	4,981,596
Erosion Control	222,629
Temporary Erosion Control	188,754
Traffic Signs	37,837
Subtotal	**$ 5,430,816**
Total	**$ 21,994,554**
Engineering & Inspection @ 5%	$ 1,099,728
Construction Contingenies	$ 879,782
Fuel Adjustment	$ 251,273
Grand Total	**$ 24,225,336**

COST ESTIMATE SUMMARY AND COST MODEL

The VE team prepared the attached cost model for the project prior to the workshop. The cost model is arranged in the Pareto Charting/Cost Histogram format to aid in identifying high cost areas. As can be expected, judgments at this stage of the study are based on experience and intuition rather than facts, which are not uncovered until well along in the analysis of function. As a result of these qualified hypotheses, there appears to be a potential for initial savings in the following areas:

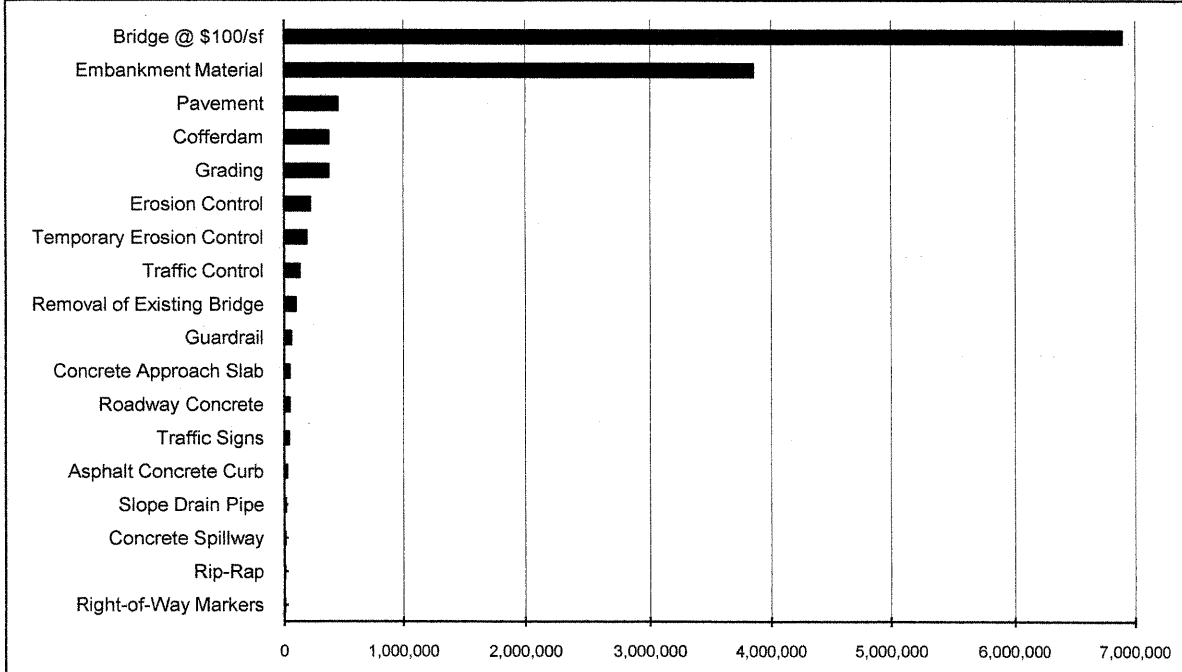
- Bridges
    - Foundation
    - Deck

- Embankment Material

COST HISTOGRAM

PROJECT: BRIDGE REPLACEMENT S.R. 43 - U.S. 378 AT SAVANNAH RIVER

PROJECT ELEMENT	COST	PERCENT	CUM. PERCENT
Bridge @ $100/sf	6,890,400	53.88%	53.88%
Embankment Material	3,849,436	30.10%	83.97%
Pavement	447,494	3.50%	87.47%
Cofferdam	372,512	2.91%	90.39%
Grading	372,000	2.91%	93.29%
Erosion Control	222,630	1.74%	95.04%
Temporary Erosion Control	188,754	1.48%	96.51%
Traffic Control	127,943	1.00%	97.51%
Removal of Existing Bridge	95,649	0.75%	98.26%
Guardrail	56,275	0.44%	98.70%
Concrete Approach Slab	42,483	0.33%	99.03%
Roadway Concrete	41,876	0.33%	99.36%
Traffic Signs	37,836	0.30%	99.66%
Asphalt Concrete Curb	20,924	0.16%	99.82%
Slope Drain Pipe	11,976	0.09%	99.91%
Concrete Spillway	8,470	0.07%	99.98%
Rip-Rap	2,424	0.02%	100.00%
Right-of-Way Markers	296	0.00%	100.00%
Subtotal	**$ 12,789,378**	**100.00%**	
Engineering & Inspection @ 5.00%	**$ 639,469**		
Construction Contingencies @ 4.00%	**$ 511,575**		
Fuel Adjustment @	**$ 251,273**		
TOTAL	**$ 14,191,695**	**Comp Mark-up:**	11%



Costs in graph are not marked-up.

FUNCTION ANALYSIS

A random function analysis was performed to (1) understand the project purpose and need, (2) define the requirements for each project element, (3) ensure a complete and thorough understanding by the VE team of the basic functions needed to attain the given project purpose and need, (4) identify other goals, and (5) identify secondary functions that should be addressed by the VE team. The Random Function Analysis worksheet completed by the team for the project in its entirety and the various elements follow.

The key opportunity areas for potential cost reduction and value improvement established during the function analysis session (including input from the design team during the design overview) includes the following:

- Foundations – Transfer Loads
- Deck – Provide Travel Way
- Cofferdam – Facilitate Construction
- Rock Embankment – Prevent Scour

RANDOM FUNCTION ANALYSIS

PROJECT: **SR 43/US 378 Bridge Replacement over the Savannah River**
Lincoln County, Georgia

SHEET NO.: **1 of 1**

DESCRIPTION	FUNCTION		
	VERB	NOUN	KIND
PROJECT	Improve	Travel Way	B
	Replace	Deficient Bridge	B
	Protect	Public	HO
	Move	Goods	HO
FOUNDATIONS	Transfer	Loads	B
BEAMS	Support	Load	B
DECK	Support	Vehicles	B
	Provide	Travel Way	B
BARRIER	Redirect	Vehicles	B
COFFERDAM	Facilitate	Construction	S
ROCK EMBANKMENT	Prevent	Scour	RS
PAVEMENT	Support	Vehicles	B
GRADING	Establish	Elevation	B
EROSION CONTROL	Prevent	Soil Movement	RS
TEMPORARY EROSION CONTROL	Prevent	Soil Movement	S

Function defined as: Action Verb
Measurable Noun

Kind: B = Basic
S = Secondary
RS = Required Secondary
HO = Higher Order
LO = Lower Order

CREATIVE IDEA LISTING AND EVALUATION OF IDEAS

During the Creativity Phase, numerous ideas were generated using conventional brainstorming techniques. These ideas were recorded and are shown with their corresponding ranking on the attached Creative Idea Listing Worksheets. For the convenience of tracking an idea through the VA process, the ideas were grouped according to the following categories and numbered in the order in which they were conceived. The following letter prefixes were used to identify the categories.

PROJECT ELEMENT	PREFIX
Bridge Deck	BD
Bridge Foundation	BF
Embankment	E
Contracting	C
Pavement	P

Creative Idea Evaluation

After discussing each idea, the team evaluated the ideas by consensus based on GDOT's value objectives for the project which are:

- Saves cost
- Maintenance schedule
- Enhances safety
- Improves constructability
- Improves functionality for recreational boaters

This effort produced 16 ideas rated 4 or 5 to research and develop into formal VE alternatives and 7 ideas to develop as design suggestions to be included in the Study Results section of the report. Ideas that were not developed further may have been combined with another related idea or discarded as a result of additional research indicating the concept as not being cost effective or technically feasible. The project team is encouraged to review the Creative Idea Listing and Evaluation worksheet since it may suggest additional ideas that can be applied to the design.

CREATIVE IDEA LISTING

PROJECT: **SR 43/US 378 Bridge Replacement over the Savannah River**
Lincoln County, Georgia

SHEET NO.: **1 of 1**

NO.	IDEA DESCRIPTION	RATING
	BRIDGE DECK (BD)	
BD-1	Use 11-ft-wide lanes on the bridge in lieu of 12-ft-wide lanes and reduce the width of the bridge	4
BD-2	Use 8-ft-wide shoulders in lieu of 10-ft-wide shoulders, narrow the bridge deck and eliminate one bridge girder	5
BD-3	Use a continuous deck and delete some expansion joints	DS
	BRIDGE FOUNDATIONS (BF)	
BF-1	Use drilled piers in lieu of spread footings on a concrete seal	4
BF-2	Eliminate one span of the bridge and use longer beams spaced 152 ft apart in lieu of 140 ft apart	4
BF-3	Reduce overall bridge length to match existing bridge	4
BF-4	Use pile foundations	2
BF-5	Use steel beams with piers at 210 ft apart and reduce the number of piers from 11 to 7	See BF-6
BF-6	Use steel beams with piers at 240 ft apart and reduce the number of piers from 11 to 6	5
BF-7	Use post-tensioned beams with piers at 250 ft apart and reduce the number of piers from 11 to 6	5
	EMBANKMENT (E)	
E-1	Use old bridge concrete for embankment or scour protection	3
E-2	Reduce the limits of rock embankment	4
	CONTRACTING (C)	
C-1	Procure the project using a design-build contract in lieu of a design-bid-build	5
	PAVEMENT (P)	
P-1	Reduce the length of approach slab from 30 ft to 20 ft	DS

Rating: 1→2 = Not to be developed 3→4 = Varying degrees of development potential 5 = Most likely to be developed
DS = Design suggestion ABD = Already being done