

# Practical Design



## 2007 Awards for Excellence



ACEC  
Missouri

AMERICAN COUNCIL OF ENGINEERING  
COMPANIES of Missouri

2007 APPLICATION FORM

(required for each entry)

Job No. J150823 Route N County DeKalb
STIP Description (Scoping or Construction, state which STIP) 05-09 [ ] 06-10 [X] 07-11 [ ]

Replace Bridge over Maple Grove Creek, 0.4 miles north of Stewartsville and 1 3/4" asphalt between Bridge and Route 36.

Project Manager (could have both) MoDOT Adam Watson Consultant N/A

Active core team members as approved by the MoDOT PM (may include consultants)

Mike Mooney (Designer) Erik Mawinga (RE) James Harcourt (Envir)
Jim Muehlbach (TPD) Dean Franke (Br) Tim Redmond (CO)
John Hackworth (RE) Dave Mofuen (Br.) Rick Kingery (Utilities)
Troy Slagle (Ops. Engo) Larry Ohinger (RIW)

Project Contacts (will have both for consultant entry)
District Tom SKINNER Consultant \$
STIP budget \$ 796,000 Const. + 2% or Award cost \$ 276,000 Construction
\$ 88,000 RIW \$ 13,000 RIW

Value Engineering study during design? yes [ ] no [X] (if yes) Project Stage

VE Contact person

Construction-stage VE (VECP)? yes [ ] no [ ] (if yes) Explain

Total VECP savings \$ VECP Contact Person

Why is this entry the "poster" image for MoDOT's practical design philosophy?

(In layman's terms - 100 words or fewer - attach additional sheet if necessary) The purpose and need of the project was clearly addressed without scope creep. The final engineering solution focused on not only construction savings but also RIW savings, which is many times overlooked. A high maintenance 3 span bridge was eliminated from the MoDOT system and replaced with a low maintenance box. Driver expectations were improved and the guardrail hazard was eliminated. The project was under budget at a time of escalating costs.

Send entries to: MoDOT Design Division, ATTN: Jay Bestgen
1320 Creek Trail Dr.
Jefferson City, Missouri 65109

All entries must be received no later than close of business on February 1, 2007



# MEMORANDUM

## Missouri Department of Transportation Project Development District 1

**TO:** Jay Bestgen-de

**CC:** Don Wichern-11d  
Tony McGaughy-11d

**FROM:** Tom Skinner *TAS*  
District Design Engineer

**DATE:** January 23, 2007

**SUBJECT:** 2007 Awards for Practical Design Excellence  
DeKalb County, Route N  
Replace Bridge X-473 over Maple Grove Creek

**Scope Comparison** The traditional scope of work for a small bridge replacement of this type would be to replace the existing bridge with a new three span bridge, having a deck width of 32 feet (two 12' lanes with two 4' shoulders). For hydraulic requirements, the existing profile grade would have to be raised a minimum of six feet, which translates into the reconstruction of approximately 800 feet of approach roadway at each end of the bridge. Approach slabs, bridge approach pavement and concrete paving would be included in the project, as well as the appropriate guardrail at all four corners of the bridge. In addition, acquisition of additional right of way from the adjacent property owners would be required. Generally, a small bridge replacement project of this type would cost over \$1,200,000.

**Purpose and Need** The scope of work was to replace a deteriorated three span bridge over Maple Grove Creek and resurface approximately 2,000 feet of extremely poor condition roadway between the bridge and Route 36.

**Engineered Practical Design Solution** The practical solution was to replace the existing bridge with a triple, 14 X14, reinforced concrete box culvert (RCB). What made the decision difficult was that a three span bridge structure was estimated to cost \$335,000, which is \$68,000 less than a large triple cell RCB (\$403,000). In order for the concrete box to compete with the bridge option, there had to be some significant savings in the roadway and right of way costs to offset the additional construction cost of the box culvert. By using the box culvert, the following roadway and right of way savings were realized:

1. The profile grade raise was reduced from six feet (for the bridge option) to only 1.5 feet for the concrete box option. This reduced the limits of the roadway work on the north end of the project by 600 feet, which reduced the paving requirements and the associated fill material from 32,000 C.Y. to approximately 20,000 C.Y.
2. The roadway typical section was reduced from 32 feet to 26 feet (two 11' lanes and two 2' gravel shoulders), which more appropriately match the existing roadbed.
3. By shortening the project, one property owner was deleted from the acquisition process and the property acquisition was significantly reduced from the remaining four property owners. The estimated \$88,000 cost to acquire the necessary right of way was reduced to less than \$13,000 (a savings of more than \$75,000).

4. By using the box culvert, the core team was able to eliminate the need for guardrail. Because guardrail is considered a roadside hazard and a costly maintenance item, eliminating the guardrail was a significant benefit and also improved driver expectations of the roadway.
5. The length of the box culvert was shortened by using the required 4:1 side slopes to the clear zone, but beyond the clear zone the side slopes were increased to 2.5:1. This tight design approach reduced the length of the box by an estimated 24 feet. The more narrow typical section also reduced the foot print of the project and reduced the amount of right of way required.
6. Since the bridge option was eliminated, the concrete approach slabs and concrete approach pavement were eliminated from the project, which also eliminated the bridge joints and improved the smoothness of the roadway. In addition, a uniform roadway cross section was placed on the fill material.

**Cost Savings** It is important to note that bridge construction costs were escalating during this time period and the District still stayed under budget for this bridge project. Following is a summary of the project cost comparisons:

	<u>STIP</u>	<u>Actual Cost</u>
Bridge	\$388,000	\$328,000
Roadway/Misc.	\$408,000	\$448,000
Right of Way	<u>\$ 88,000</u>	<u>\$ 13,000</u>
<b>Total</b>	<b>\$884,000</b>	<b>\$789,000</b>

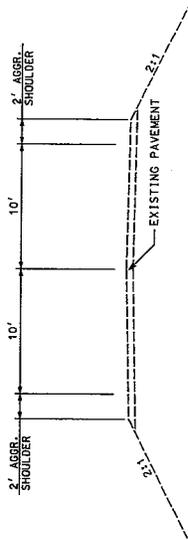
The net savings is \$95,000, which is a 10% savings.

**Additional Project Benefits** The RCB offers an economical long-term engineering solution that replaces a high maintenance, three span bridge on MoDOT 's system. The RCB also eliminates the guardrail hazard and provides an obstruction free roadway. The engineering solution addressed only the need of the project and the scope of work did not expand to incorporate the reverse curve at the north end of the bridge or the offset access with Route N at Route 36. Although these two issues were desirable to address, the core team focused only on the engineering solution that produced the greatest common good. At times, designers utilize the guidelines of practical design to only focus on the construction cost of a project and overlook the project savings that can also be realized through reduced right of way costs, which is the case for this project. In short, the trade off from the conventional three span bridge replacement, with a RCB, resulted in \$20,000 in construction savings and an additional \$75,000 in right of way savings, keeping the project on budget during a time of rapidly escalating construction costs.

This project embraced the principals of practical design using a diversified core team of roadway, bridge, traffic, construction, environmental and right of way staff as well as support from Central Office to realize the best value for every dollar spent. The RCB provides the best long-term solution by not only removing a bridge structure from the MoDOT system but also nearly eliminating future bridge maintenance costs for many years to come. In short, this project will continue to pay dividends and serve our customers for the next century.

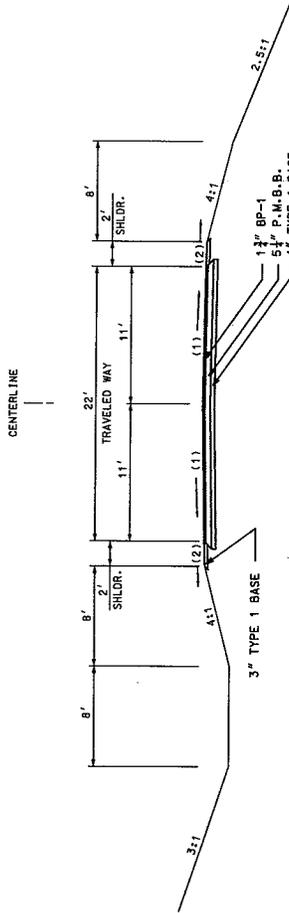
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ROUTE	STATE	DISTRICT	SHEET NO.
N	MD	1	2
JOB NO. J150823			
CONTRACT ID.			
PROJECT NO.			
COUNTY DEKALB			
DATE			



SECTION ON TANGENT  
EXISTING TYPICAL  
STA. 459+50 TO STA. 484+50.71

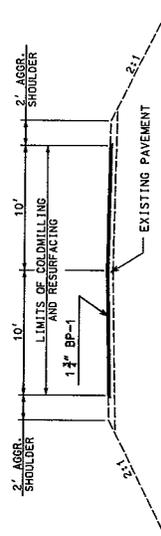
APPLICATION RATES	
TACK COAT	0.05 GAL./S.Y.
PRIME COAT	0.35 GAL./S.Y.



SECTION ON TANGENT  
PROPOSED TYPICAL  
STA. 459+50 TO STA. 477+00

CROSS SLOPE  
(1) 2.0%  
(2) 4.0%

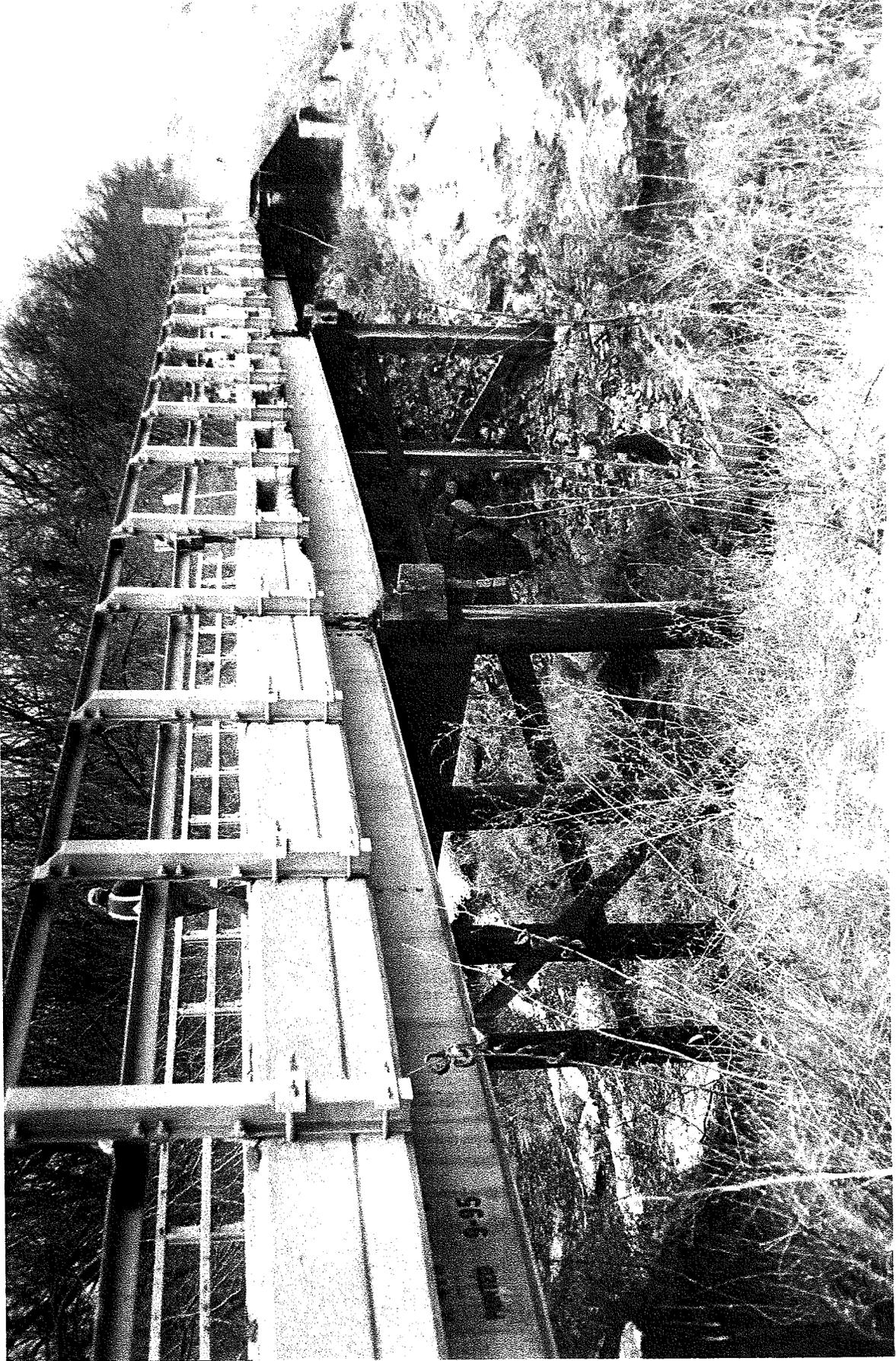
TYPE	CONVERSION FACTORS	
	MINERAL (TONS/YD <sup>3</sup> )	ASPHALT (TONS/YD <sup>3</sup> )
BP-1	1.966	0.110
P.M.B.B.	1.966	0.104
		% BINDER
		5.6
		5.3



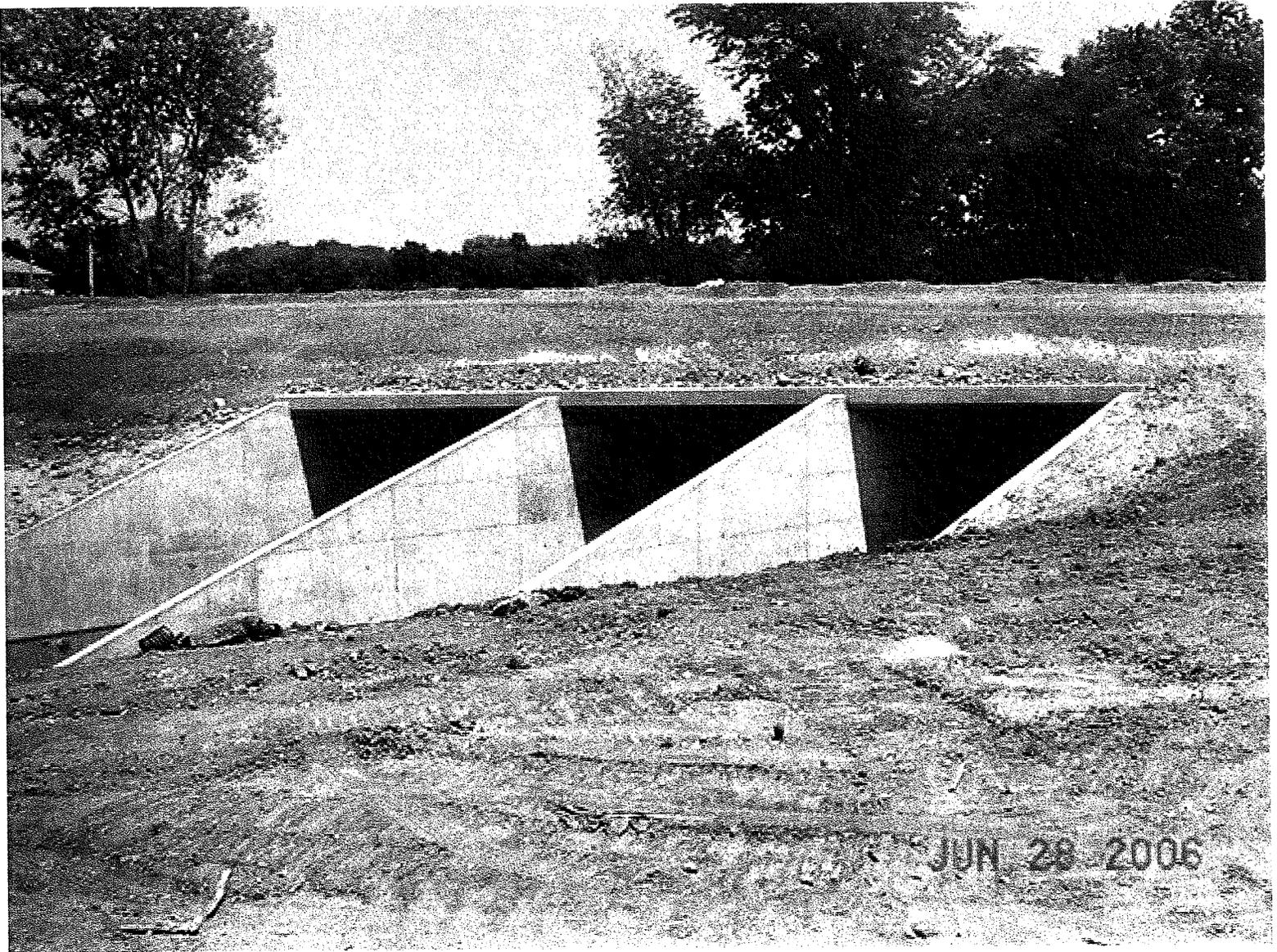
SECTION ON TANGENT  
1 1/2" GOLDMILLING AND RESURFACING  
STA. 477+00 TO STA. 484+50.71







Bridge X-473 over Maple Grove Creek (Before)



Triple cell 14'x14' Box Culvert (After)