MEMORANDUM

Missouri Department of Transportation
Bridge Division
Central Office

TO: Jay Bestgen - de

FROM: Shyam Gupta, P.E.
State Bridge Engineer

DATE: February 1, 2007

SUBJECT: 2007 Awards For Excellence – Practical Design
Bridge Division Entry
Job No. J3P0501, Br. No. A7382
Route 61(NBL), Pike/Ralls County

We are pleased to submit this entry for the 2007 Awards for Excellence competition. The purpose of this project was to replace the detiorating bridge over Spencer Creek (G0923). The original proposed bridge design involved constructing a five span prestressed concrete bulb-tee girder bridge to match the type and length of the existing southbound structure. Each time a bridge is laid out, both steel and concrete girders are considered. In general, prestressed concrete girders tend to be the most cost effective type.

One problem with the proposed bridge design at this location was that the depth of the prestressed concrete bulb-tee girders reduced the vertical clearance under the bridge to a point that a deed requirement with a local farmer was violated. To address this issue, three options were considered. The first option was to excavate under the bridge to provide the needed vertical clearance. This was not feasible because of a large culvert the farmer had that needed to remain in place. The second option was to change the girder type to steel plate girders, allowing the profile grade to stay the same. The third option was to raise the profile grade. It should be noted that the heights of prestressed concrete girders are not as easy to vary as steel plate girders due to the difference in fabrication methods.

Of these three options, raising the profile grade and keeping the prestressed concrete bulb-tee girders was the lowest cost option even after taking into account the increased roadway costs due to the longer tie-in's to the existing roadway. The total cost of the project was now higher than the STIP budget. A fourth option was needed.

Applying Practical Design principles, an innovative solution was found. Recognizing that prestressed concrete girder fabricators are limited by the different standard forms they have on hand, we looked at fabricators in neighboring states to see if they had some different shapes that might solve our problem. We found that Nebraska used a different set of shapes developed by the University of Nebraska. Working with the professor that developed these new shapes, we were able to select a girder type that seemed perfect for this application. This new shape eliminated the need to raise the profile grade while still costing less than steel plate girders. We were also able to eliminate a girder line, further reducing the cost and saving construction time.

Another Practical Design idea implemented on this bridge was that two of the intermediate bents were changed from drilled shafts to encased pile caps to save money and time. The combined net savings for these changes was about $400,000 or 18%.

If you have any questions regarding this submittal, please contact Dennis Heckman at (573) 526-3672.

dwh
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2007 APPLICATION FORM

(required for each entry)

Job No. J3P0501 **Route** 61 **County** Pike/Ralls

STIP Description (Scoping or Construction, state which STIP) 05-09 ☐ 06-10 ☐ 07-11 ☒

Grading, paving and replacement bridge over Spencer Creek 0.1 mile north of Pike County. Projects involves bridge G0923R.

Project Manager (could have both)

MoDOT Chad Daniel (BR), Richard Domzalski (D3) **Consultant** N/A

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

Aaron Kemna	David Hagemeyer	Bryan Hartnagel
Gabriel Schubert	Mike Van De Riet	Kimberly Trainor

Project Contacts (will have both for consultant entry)

District Dennis Heckman (BR), Richard Domzalski **Consultant** $

STIP budget $ 1,959,000 or **Award cost** $

Value Engineering study during design? yes ☐ no ☒ (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) This entry is the "poster" image for MoDOT's Practical Design philosophy for several reasons. It involved the innovative use of a new type of girder which was found by looking "outside the box." The solution met the purpose and need of the job while also lowering the cost and allowing for quicker construction time (fewer girders). By changing two of the bents from drilled shafts to encased pile caps, more time and money were saved. The cost estimate for the original proposal was $2,276,385 ($496,385 roadway + $1,780,000 bridge) while the cost estimate for the final design was $1,872,835 ($436,835 roadway + $1,436,000) for a net savings of about $400,000. This project is in the February 2007 letting.

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

Note:

For General Notes, Estimated Quantities, Estimated Quantities for Slab on Concrete I-Girder, Pile Data, Hydrologic Data, Rock Socket Data and Location Sketch, see Sheet No. 2.

Roadway fill shall be completed to the final roadway section and up to the elevation of the bottom of the concrete beam within the limits of the structure and for not less than 25 feet in back of the fill face of the end bents before any piles are driven for any bents falling within the embankment section.

MISSOURI HIGHWAY AND TRANSPORTATION COMMISSION

(67'-69'-115'-69'-67') Prestressed Concrete NU 1100 Girder Spans

ROUTE	STATE	DISTRICT	SHEET NO.
61	MO	BR	

JOB NO. J3P0501

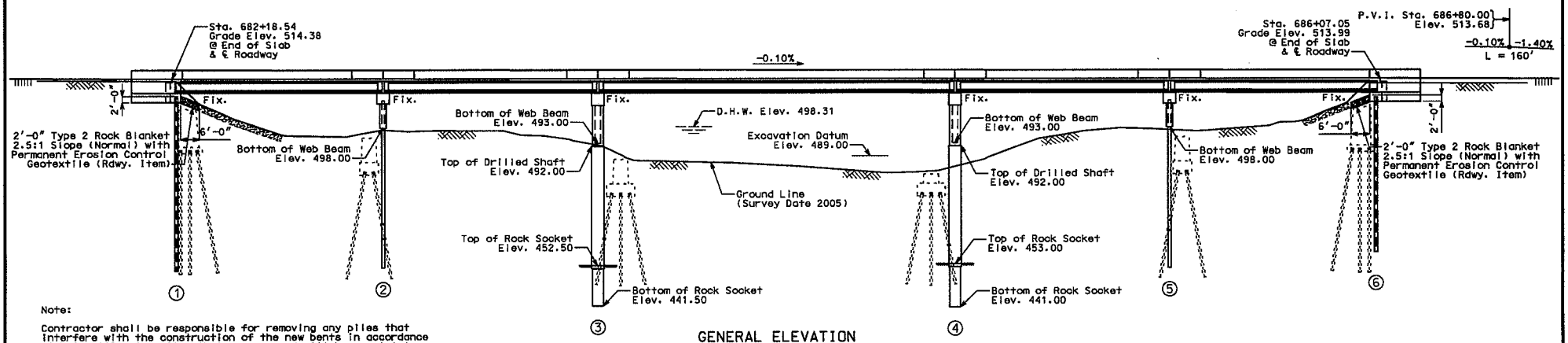
CONTRACT ID

PROJECT NO.

COUNTY RALLS

DATE

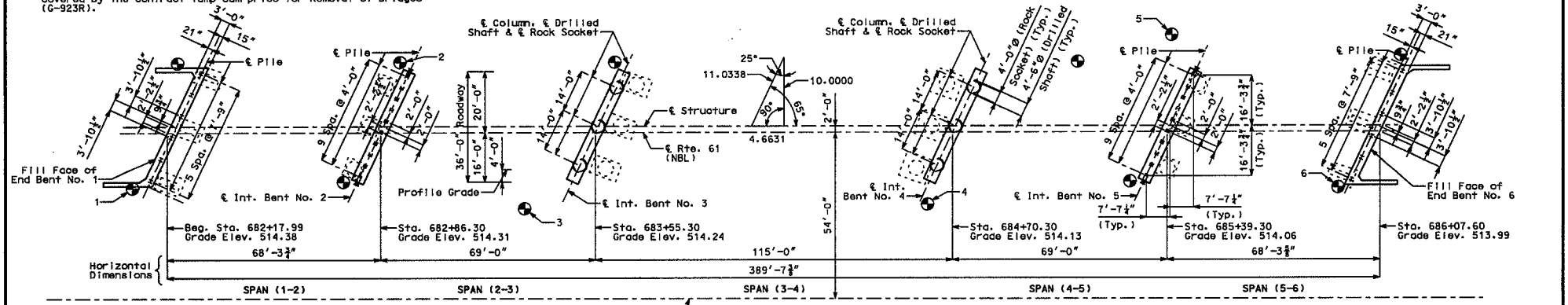
SEC/SUR 27 TWP 55N RGE 4W



GENERAL ELEVATION

Note:

Contractor shall be responsible for removing any piles that interfere with the construction of the new bents in accordance with Sec 216. Any piles that are removed will be completely covered by the contract lump sum price for Removal of Bridges (G-923R).



"⊕" Indicates location of borings.

℄ Median Rte. 61

PLAN

B.M. ELEV. 511.86 CHISELED "O" IN S.W. WING WALL OF BRIDGE G-0923. 33.6' LT. STA. 685+94.17

BRIDGE OVER SPENCER CREEK

STATE ROAD FROM RTE. 19 TO PIKE CO. LINE

AT PIKE CO. LINE

PROJECT NO. STA. 682+17.99

JOB NO. J3P0501 RTE. 61 (NBL)

Notice and Disclaimer Regarding Boring Log Data

The locations of all subsurface borings for this structure are shown on the bridge plan sheet for this structure. Boring data for the numbered locations is shown on Sheets No. 3 & 4. The boring data for all locations indicated, as well as any other boring logs or other factual records of subsurface data and investigations performed by the department for the design of the project, is available from the Project Contact upon written request as outlined in the Project Special Provisions. No greater significance or weight should be given to the boring data depicted on the plan sheets than is subsurface data available from the district or elsewhere.

The Commission does not represent or warrant that any such boring data accurately depicts the conditions to be encountered in constructing this project. A contractor assumes all risks it may encounter in basing its bid prices, time or schedule of performance on the boring data depicted here or those available from the district, or on any other documentation not expressly warranted, which the contractor may obtain from the Commission.

STD. 609.00	
STD. 617.10	
STD. 706.35	
A7382	REV.

Designed Nov. 2006
Detailed Dec. 2006
Checked Dec. 2006

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 40

Date: / /

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Concrete for prestressed girders shall be Class A-1 with f'c = 8000 psi and f'ci = 6500 psi. See Special Provisions for additional requirements for High Strength Concrete.

(+) indicates prestressing strand.

Use 20 strands with an initial prestress force of 879 kips.

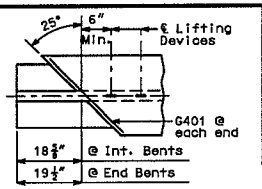
Prestressing strand shall be uncoated, seven-wire, low-relaxation strands, 0.6" diameter in accordance with AASHTO M 203, Grade 270. Pretensioned members shall be in accordance with Sec 1029.

PRESTRESSED GIRDER NOTES:

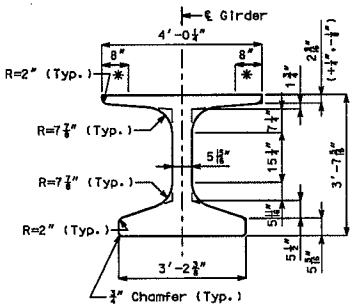
Girders shall be lifted by devices designed by the fabricator.

* Girder top flange shall be steel troweled to a smooth finish for 8" at the edges, as shown. Bond breaker shall be applied to this region only. The center portion shall be rough finished by scarifying the surface transversely with a wire brush, and no laitance shall remain on the surface.

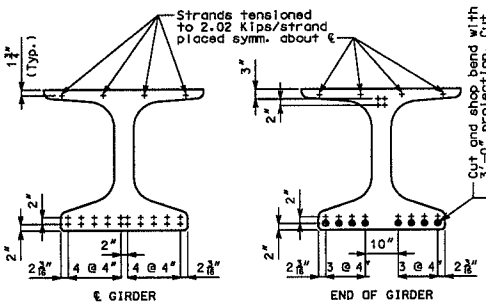
Reinforcing steel shall conform to the requirements of AASHTO M 31, Grade 60. Welded Wire Reinforcement (WWR) shall conform to the requirements of AASHTO M 221.



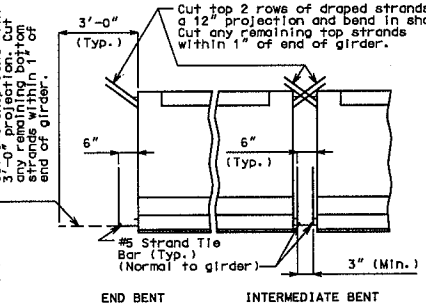
ROUTE	STATE	DISTRICT	SHEET NO.
61	MO	BR	
JOB NO. J3P0501			
CONTRACT ID			
PROJECT NO.			
COUNTY RALLS			DATE



DIMENSIONS



STRAND ARRANGEMENTS



STRAND DETAILS AT GIRDER ENDS

TOP FLANGE BLOCK OUT DETAIL

All reinforcing dimensions are out to out.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

Minimum clearance to reinforcing shall be 1" unless otherwise shown.

All reinforcement shall be Grade 60.

Actual lengths are measured along centerline of bar to the nearest inch.

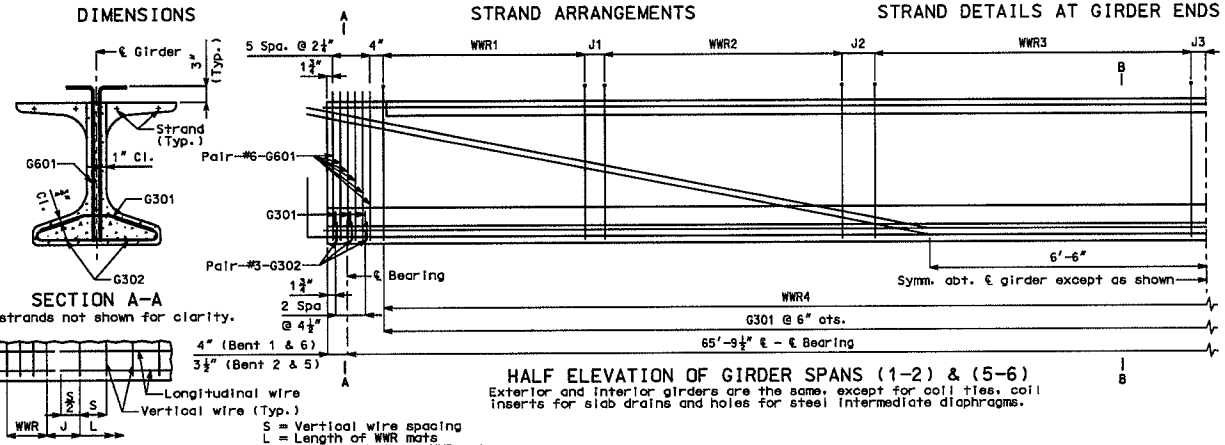
The two G302 bars may be furnished as one bar at the fabricator's option.

BILL OF REINFORCING STEEL - EACH GIRDER

NO.	SIZE & MARK	ACTUAL LENGTH
135	3 G301	2'-11⅞"
12	3 G302	3'-3⅞"
2	4 G401	4'-3"
24	6 G601	4'-2½"

WELDED WIRE REINFORCEMENT
(WWR4 & WWR5 as shown in Bending Diagrams)

SPAN NO.	WWR1				WWR2				WWR3			
	BAR SIZE	S1	L1	J1	BAR SIZE	S2	L2	J2	BAR SIZE	S3	L3	J3
1	D18	4"	11'-8"	6"	D18	8"	5'-4"	10"	D18	12"	13'-0"	5½"
5	D18	4"	11'-8"	6"	D18	8"	5'-4"	10"	D18	12"	13'-0"	5½"

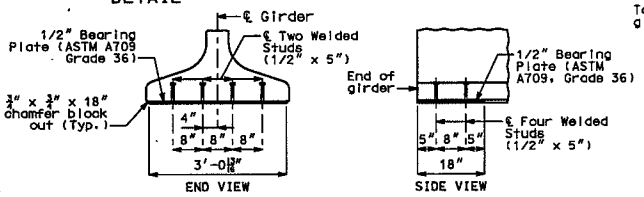


SECTION A-A
Some strands not shown for clarity.

HALF ELEVATION OF GIRDER SPANS (1-2) & (5-6)
Exterior and interior girders are the same, except for coil ties, coil inserts for slab drains and holes for steel intermediate diaphragms.

REINFORCEMENT PLACEMENT DETAIL

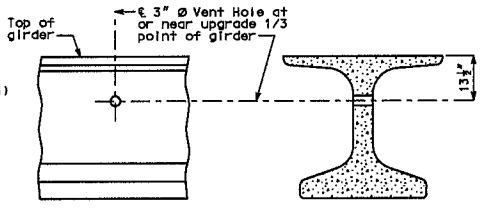
S = Vertical wire spacing
L = Length of WWR mats
J = Distance between WWR mats



BEARING PLATE DETAILS

Galvanize the 1/2" bearing plate (ASTM A709 Grade 36) in accordance with ASTM A123.

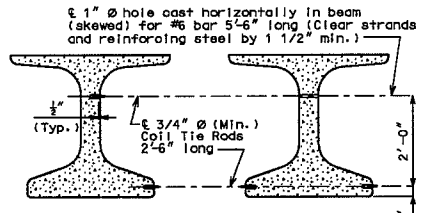
Cost of furnishing, galvanizing, and installing the 1/2" bearing plate (ASTM A709 Grade 36) and welded studs in the prestressed girder will be considered completely covered by the contract unit price for Prestressed Concrete NU-girder per each.



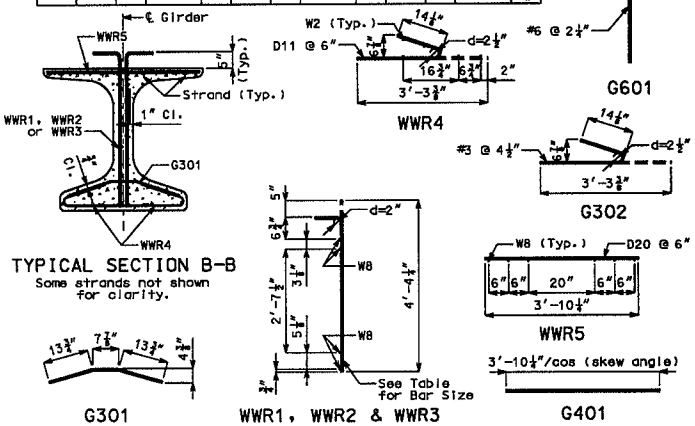
PART ELEVATION OF GIRDER

PART SECTION NEAR VENT HOLE

Place vent holes at or near upgrade 1/3 point of girders and clear reinforcing steel or strands by 1 1/2" minimum and steel intermediate diaphragm bolt connections by 6" minimum.



DETAILS OF COIL TIES



BENDING DIAGRAMS

Cost of 3/4" Ø coil tie rods placed in diaphragms will be considered completely covered by the contract unit price for Prestressed Concrete NU-Girder.

Coil ties shall be held in place in the forms by slotted wire-setting-studs projecting through forms. Studs are to be left in place or replaced with temporary plugs until girders are erected, then replaced by coil tie rods.

For location of coil inserts at slab drains, see Sheet No. 28.

For location of coil ties, see Sheets No. 5, 19 & 26.

The 1 1/2" Ø holes shall be cast in the web for steel intermediate diaphragms. Drilling is not allowed.

For details of diaphragms, see Sheet No. 25.

For Girder Camber Diagram, see Sheet No. 29.

Detailed Aug. 2006
Checked Dec. 2006

Note: This drawing is not to scale. Follow dimensions.

A7382 REV.

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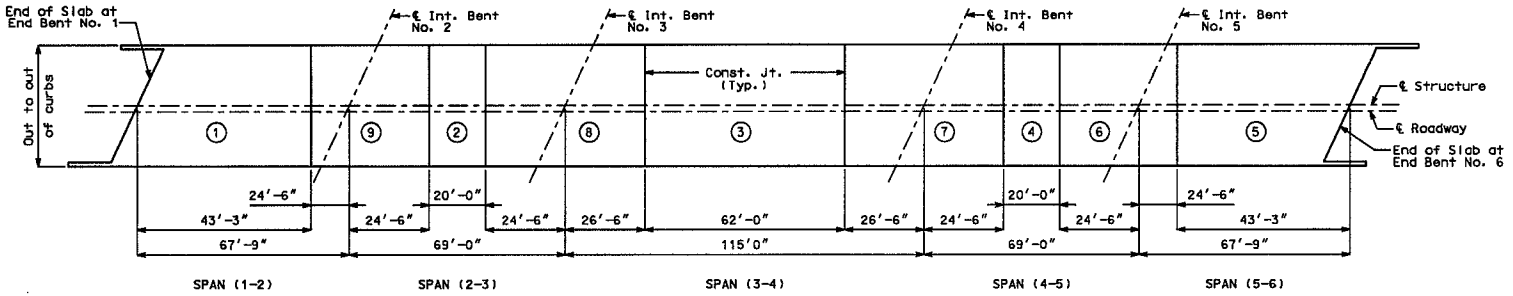
ROUTE	STATE	DISTRICT	SHEET NO.
61	MO	BR	
JOB NO. J3P0501			
CONTRACT ID			
PROJECT NO.			
COUNTY RALLS			DATE

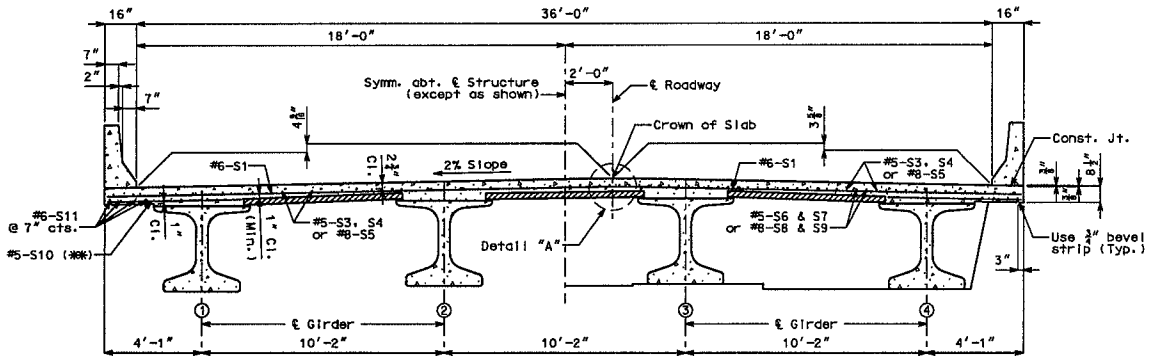


	Sequence of Pours									Min. rate of pour cu. yds./hr.
	Direction									With retarder
Basic sequence	1	2	3	4	5	6	7	8	9	25
	Either direction									
Alternate pours to the basic skip sequence are subject to the approval of the engineer in accordance with Sec 703.										
Alternate "A" pours	1	9 + 2		8 + 3		7 + 4		6 + 5		25
	End to 9	1 to 8		2 to 7		3 to 6		4 to end		
Alternate "B" pours	1 + 9 + 2			8 + 3			7 + 4 + 6 + 5			25
	End to 8			2 to 7			3 to end			
Alternate "C" pours	1 + 9 + 2 + 8 + 3					7 + 4 + 6 + 5				25
	End to 7					3 to end				
Alternate "D" pours	1 + 9 + 2 + 8 + 3 + 7 + 4 + 6 + 5									25
	End to end									

Note: The contractor shall furnish an approved retarder to retard the set of the concrete to 2.5 hours, and shall pour and satisfactorily finish the slab pours at the rate given.

The concrete diaphragm at the intermediate bents and integral end bents shall be poured a minimum of 30 minutes and a maximum of 2 hours before the slab is poured.

SLAB POURING SEQUENCE

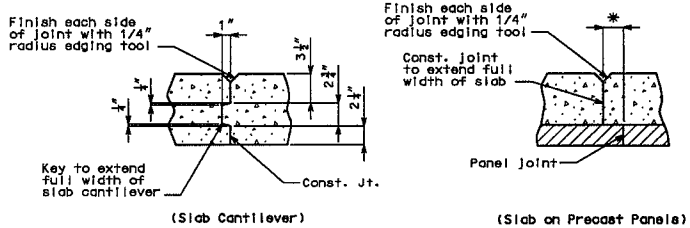


HALF SECTION NEAR ℄ SPAN HALF SECTION NEAR INTERMEDIATE BENT

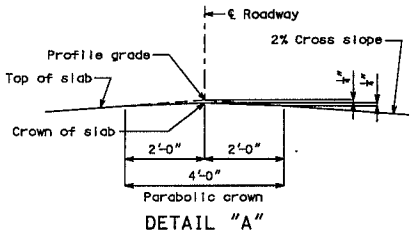
SECTION THRU SLAB

(**) Alternate bar shape available, see Safety Barrier Curb sheet.

* Adjust the construction joint to a clearance of 6 inches minimum from the panel joint.



SLAB CONSTRUCTION JOINT DETAILS



DETAIL "A"

Notes:

For plans of slab showing top & bottom reinforcement, see Sheets No. 30 & 31.

For Details of Precast Prestressed Panels, see Sheet No. 27.

For Details and Reinforcement of Safety Barrier Curb not shown, see Sheets No. 33, 34 & 35.

For Theoretical Bottom of Slab Elevations, see Sheet No. 29.

Detailed Oct. 2006
Checked Dec. 2006

Note: This drawing is not to scale. Follow dimensions.

A7382

REV.

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CostEst_New
Jan-03-06

Ralls County
Damian Geyer

Job No. J3P0501

Preliminary Cost Estimate for Bridge No. A7382
(66' -69' -115'-69'-66') Prestressed Bulb Tee Girder with Integral End Bents

Roadway Width (ft.) =	36.00	Slab Width (ft.) =	38.67
No. of Spans =	5	No. of End Bents =	2
No. of Girders per Span =	5	No. of Intermediate Bents =	4
Total Length of Slab (ft.) =	386.34	Skew (deg.) =	25.00

Estimated Quantities

Item	Unit	Total	Unit Price	Total	unit	unit price
Class 1 Excavation	Cu. Yd.	120	$40.00	$4,800		
Class 2 Excavation	Cu. Yd.	0	$50.00	$0		
Cofferdams-Bent	Sq. Ft.	0	$7.00	$0	0	7.00
Cofferdams-Bent	Sq. Ft.	0	$7.00	$0	0	7.00
Temporary Shoring	Lump Sum	0	$0.00	$0	0	7.00
Removal of Bridges	Lump Sum	1	$96,900.00	$96,900	12113	8.00
Bridge Approach Slab (Bridge)	Sq. Yd.	200	$210.00	$42,000		
Drilled Shafts (4' - 6")	Lin. Ft.	210	$450.00	$94,500		
Rock Sockets (4' - 0")	Lin. Ft.	60	$700.00	$42,000		
Suppl. Television Camera Inspection	Each	6	$800.00	$4,800		
Foundation inspection hole	Lin. Ft.	420	$130.00	$54,600		
Concrete Coring	Lin. Ft.	45	$80.00	$3,600		
Sonic logging Test	Each	6	$1,200.00	$7,200		
Piling	Lin. Ft.	1,768	$38.00	$67,184		
Prebore for Piling	Lin. Ft.	168	$48.00	$8,064		
Pile Point Reinforcement	Each	0	$100.00	$0		
Class B Concrete (Substr.)	Cu. Yd.	364	$450.00	$163,949		
Deadman Anchors	Each	0	$0.00	$0		
Seal Concrete	Cu. Yd.	0	$150.00	$0		
Slab on Concrete Bulb-Tee Girder	Sq. Yd.	1,660	$220.00	$365,164	(precast panel option)	
Safety Barrier Curb	Lin. Ft.	861	$60.00	$51,641		
Slab on Semi-Deep Abutment	Sq. Yd.	0	$265.00	$0		
Prestressed Concrete I-Girder (Type 3 = 3'-3")	Lin. Ft.	0	$105.00	$0		
Prestressed Concrete I-Girder	Lin. Ft.	0	$0.00	$0		
Prestressed Concrete bulb-Tee Gdr (Type 7 = 6'-1/2")	Lin. Ft.	3,340	$200.00	$668,000		
Steel Intermediate Diaphragms	Each	24	$550.00	$13,200		
Reinforcing Steel (Bridges)	lb.	63,431	$0.95	$60,260		
Conduit System on Structure	Lump Sum	0	$15,000.00	$0		
Protect.Coating-Concrete Bents & Piers (Epoxy)	Lump Sum	0	$800.00	$0	800	1.00
Fabricated Structural Steel	lb.	1,800	$5.00	$9,000		
Slab Drains	Each	64	$215.00	$13,760		
Vertical Drain at End Bents	Lin. Ft.	79	$35.00	$2,781	40	35.00
Plain Neoprene Bearing Pad	Each	0	$100.00	$0		
Laminated Neoprene Bearing Pad	Each	50	$130.00	$6,500		
Preformed Compression Seal Exp. Joint System	Lin. Ft.	0	$275.00	$0	0	
				$1,779,902		

		Base Estimate =	$1,779,902
Add	0%	for Misc. Pay Items =	$0
Add	0%	for Staging =	$0
Add	0%	for Tight Site =	$0
Add	0%	for Horiz. Curve =	$0
Add	0%	for Earthquake =	$0
Add	0%	for Early Completion =	$0
			$1,779,902

Preliminary Cost Estimate for Bridge No. A7382 **$1,780,000**

Square Feet of Slab = 14,939

Cost per Square Foot = $113
(w/o Br. Removal)

11/11/2006

Pre-practical Design Estimate

Date: 12/18/2006 **SUMMARY SHEET** Time: 2:42:12 PM

File Name: T:\br-proj\Final Estimates\Houshh\J3P0501.BDW

JOB: J3P0501 YEAR: MONTH: DAY: DIST.: 03
ROUTE: 61 NBL COUNTY: RALLS
LENGTH: 00.000 COUNTY:
BEGIN LOG MILES: END LOG MILE:
BEGIN STA: 1 END STA: 1
LONGITUDE: 91°45'00" LATITUDE: 39°45'00"
DESIGNED BY: IN HOUSE ESTIMATED BY: H- HOUSHMAND
WORK TYPE: 21, Bridge (new)

JOB DESCRIPTION: REPLACE BRIDGE

LOCATION DESCRIPTION: RTE. 61 NBL

COMMENTS:

COST SUMMARY

ROADWAY	0.00
LIGHTING	0.00
SIGNALS	0.00
SIGNING	0.00
SPECIAL	0.00
ALT PVMT A	0.00
ALT PVMT B	0.00
ALT PIPE A	0.00
ALT PIPE B	0.00
RESERVED	
	0.00
	0.00
	0.00
BRIDGES	1,435,572.80
	0.00
	0.00
	0.00
CONTRACT TOTAL	1,435,572.80
NON-CONTRACT	0.00
	0.00
	0.00
TOTAL ALL COST	**1,435,572.80**

PROJECT INITIALIZATION TOTALS

GRADING AND DRAINAGE:	$0.00
BASE AND SURFACE:	$0.00
BRIDGE:	$1,435,572.80
MISCELLANEOUS:	$0.00

use #1,436,000

Date: 12/18/2006 **USER ITEM LIST** Time: 2:42:12 PM

District: 03 Job Number: J3P0501
Route: 61 NBL County: RALLS
File Name: T:\br-proj\Final Estimates\Houshh\J3P0501.BDW
English

ITEM NUM.	ITEM DESCRIPTION	UNITS	QUANTITY	PB	UNIT PRICE	ITEM COST
206-10.00 SEC[70] PI#[03]	CLASS 1 EXCAVATION	CUYD 0.5	120.0	AH	44.00	$5,280.00
216-05.00 SEC[70] PI#[03]	REMOVAL OF BRIDGES	LS 1.0	1	AH	85000.00	$85,000.00
216-20.00 SEC[70] PI#[03]	REMOVAL AND STORAGE OF EXISTING BRIDGE RAILS	LF 1.0	765.0	AH	12.00	$9,180.00
503-10.10 SEC[70] PI#[03]	BRIDGE APPROACH SLAB (BRIDGE)	SQYD 1.0	206.0	AH	245.00	$50,470.00
701-11.07 SEC[70] PI#[03]	DRILLED SHAFTS (4 FT. 6 IN. DIA.)	LF 0.1	235.5	AH	620.00	$146,010.00
701-12.06 SEC[70] PI#[03]	ROCK SOCKETS (4 FT 0 IN. DIA.)	LF 0.1	69.0	AH	805.00	$55,545.00
701-13.00 SEC[70] PI#[03]	SUPPLEMENTARY TELEVISION CAMERA INSPECTION	EA 1.0	6.0	AH	1500.00	$9,000.00
701-14.00 SEC[70] PI#[03]	FOUNDATION INSPECTION HOLES	LF 0.1	129.0	AH	120.00	$15,480.00
701-15.00 SEC[70] PI#[03]	CONCRETE CORING	LF 0.1	52.0	AH	120.00	$6,240.00
701-16.00 SEC[70] PI#[03]	SONIC LOGGING TESTING	EA 1.0	6.0	AH	1200.00	$7,200.00
702-10.12 SEC[70] PI#[03]	STRUCTURAL STEEL PILES (12 IN.)	LF 1.0	1696.0	AH	42.00	$71,232.00
702-70.00 SEC[70] PI#[03]	PILE POINT REINFORCEMENT	EA 1.0	32.0	AH	105.00	$3,360.00
703-20.03 SEC[70] PI#[03]	CLASS B CONCRETE (SUBSTRUCTURE)	CUYD 0.1	236.4	AH	510.00	$120,564.00
703-42.13 SEC[70] PI#[03]	SLAB ON CONCRETE I-GIRDER	SQYD 1.0	1670.0	AH	240.00	$400,800.00
703-42.15 SEC[70] PI#[03]	SAFETY BARRIER CURB	LF 1.0	831.0	AH	77.00	$63,987.00

ITEM NUM.	ITEM DESCRIPTION	UNITS	QUANTITY	PB	UNIT PRICE	ITEM COST
705-99.02 SEC[70] PI#[03]	PRESTR. CONC. NU-GDR, 67 FT SPAN	EA 1.0	8.0	AH	13210.00	$105,680.00
705-99.02 SEC[70] PI#[03]	PRESTR. CONC. NU-GDR, 69 FT SPAN	EA 1.0	8.0	AH	13520.00	$108,160.00
705-99.02 SEC[70] PI#[03]	PRESTR. CONC. NU-GDR, 115 FT SPAN	EA 1.0	4.0	AH	21350.00	$85,400.00
706-10.60 SEC[70] PI#[03]	REINFORCING STEEL (BRIDGES)	LB 10.0	52640.0	AH	.97	$51,060.80
712-33.01 SEC[70] PI#[03]	STEEL INTERMEDIATE DIAPHRAGM FOR P/S CONCRETE GIRDERS	EA 1.0	18.0	AH	550.00	$9,900.00
712-36.10 SEC[70] PI#[03]	SLAB DRAIN	EA 1.0	70.0	AH	256.00	$17,920.00
715-10.01 SEC[70] PI#[03]	VERTICAL DRAIN AT END BENTS	EA 1.0	2.0	AH	1200.00	$2,400.00
716-10.00 SEC[70] PI#[03]	PLAIN NEOPRENE BEARING PAD	EA 1.0	8.0	AH	133.00	$1,064.00
716-10.02 SEC[70] PI#[03]	LAMINATED NEOPRENE BEARING PAD	EA 1.0	32.0	AH	145.00	$4,640.00

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