MEMORANDUM

Missouri Department of Transportation
Bridge
Central Office

TO: Jay Bestgen -de

FROM: Dennis Heckman DHH
State Bridge Engineer

DATE: December 14, 2007

SUBJECT: 2008 Awards For Excellence-Practical Design
Bridge Division/HDR Engineering Inc. Entry, Best Conceptual Project
Job No. J2P0793, Br. No. G00694
Route 240 over Missouri River at Glasgow, Howard/Saline County

We are pleased to submit this entry for the 2008 Awards for Excellence competition. The purpose of this project is to replace the superstructure of the Missouri River Bridge at Glasgow.

This project has evolved from a rehabilitation of the bridge to a superstructure replacement under the following scenario. In 2004 a rehabilitation project for this bridge was established. Initially, it was thought rehabilitating some of the superstructure and sand blasting and painting the structure would help this bridge last another 20 years. As we do on all Missouri River Bridge Rehabilitation projects, we arranged for a snooper crew in-depth inspection to provide a description of work that needed to be completed for this rehabilitation project. The more information we received the more the Bridge Division realized that more work was going to be needed than expected. Even if this project were performed it would not be long before more structural repair would be needed because of the advanced structural deterioration that had developed through the 83-year life of the structure. To get a more complete understanding of the state of the structure, MoDOT hired HDR Engineering Inc. to inspect the bridge, provide structural repair recommendations and provide costs for the two alternatives of rehabilitation and total replacement.

HDR's inspection showed the following. Since the structure was constructed of open built up members held together with lacing bars, batten plates and rivets, the structure is prone to coating failure and pack rust formation. Angles holding the bottom chords together are deteriorating and severe pack rust is beginning to compromise vertical and diagonal connections to the bottom chord. A number of floorbeams in the main span show corrosion significant enough to perforate the web and a number of stringer connection angles have cracked. Bottom lateral bracing members have been severely compromised by corrosion and section loss. Gusset plates connecting the bottom and top chords of one truss are suffering severe corrosion and section loss that could develop into an unsafe situation if not addressed soon. Because of the large cost of a rehabilitation project and the fact that more structural repair would be required within 5 to 10 years due to the nature of the pack rust in the members, both MoDOT and HDR thought a new alternative should be investigated. This alternative would be to replace the existing superstructure and use the existing substructure as much as possible.

The alternatives analysis team assigned to study this project included MoDOT and consultant staff from HDR Engineering. HDR performed alternative life cycle cost analysis with extensive consultation and collaboration with MoDOT Bridge staff. Weekly, and oftentimes daily, conference calls were held to discuss the results of design, rating and cost calculations to arrive at the best value alternative.

The alternatives studied included a major rehabilitation project, replacement of the bridge on a new alignment, and replacement of the superstructure while reusing the existing substructure to the extent possible. The results of this cost comparison are shown below:

Summary Of Alternatives For The Bridge Over The Missouri River At Glasgow				
Description Of Alternative	**Life Cycle Constr. Cost**	**Service Life**	**Constr. Cost / Year**	**Initial Project Constr. Cost**
A - Rehabilitation, Overlay & Repaint	$21.0 M	50	$420,000	$11.5 M
B - Replacement On Offset Alignment	$29.3 M	100	$293,000	$21.6 M
C - New Super, Reuse River Piers	$21.2 M	75	$283,000	$15.0 M
D - New Super, Reuse River Piers Reuse Approach Substructure	$20.1 M	75	$268,000	$13.9 M

All Costs Are In 2008 Dollars.

As a result of this analysis, the MoDOT / HDR team recommended that Alternative D be pursued into final design. The estimated cost for construction of this project is $2.4 million more than the major rehabilitation project but results in a lower life cycle cost to the State. Rehabilitating the existing trusses would only be a temporary solution, requiring continual monitoring and heavy maintenance to preserve the integrity of the new paint system and truss members. The estimated maintenance costs and the relatively high initial construction estimate resulted in a higher life cycle cost with a shorter anticipated service life when compared to Alternative D.

The MoDOT / HDR team worked together while refining the scope of the superstructure replacement project. Every detail was scrutinized and put to the Practical Design litmus test to make sure that the purpose and need for the project was being met as efficiently as possible. The MoDOT / HDR team is confident that we have achieved this goal. The following highlighted items demonstrate the extent to which the Practical Design Initiative was incorporated into the development of this project and are sure to result in significant savings and benefits to the State on this project:

1) Typical Section: The existing bridge only carries two 10'-0" lanes with the through trusses spaced at 23'-0" centers. The new typical section had to be sized to mesh with the existing substructure and be as light as possible to prevent overload of the existing substructure. A 26'-0" roadway with 11'-0" lanes and 2'-0" shoulders was selected for this project.

2) Deck: A 7" deck was used to minimize dead load on the existing substructure and minimize construction cost while satisfying the loading requirements

3) Profile: The new profile was set to match existing grade at existing abutments to limit the length of the project and overall project costs

4) Reuse Substructure: The existing substructure was modified to support a new plate girder superstructure, simplifying permitting, minimizing risk exposure for construction in the river, reducing closure duration and construction cost

5) Three Girders:	The narrow typical section allows the use of a three-girder cross-section instead of four; minimizing construction cost and reduces closure duration
6) Road Closure:	The ability to shorten the anticipated project duration to approximately 1 year made a road closure viable with allowance for alternative transportation (possible ferry service or buses), thereby reducing overall construction cost, simplifying permitting, and reducing right of way needs
7) Rapid Design:	Replacing only the superstructure on existing alignment simplifies and minimizes environmental and Coast Guard permitting efforts, public involvement work, right of way negotiations, and ultimately results in a quicker and more efficient design phase
8) Rapid Construction:	Eliminating the substructure work in the river results in a shorter construction schedule thereby making the road closure alternative viable and reducing overall project costs
9) Best Value:	The partial replacement alternative is only marginally more expensive to construct than the major rehabilitation alternative while resulting in a more dependable, least maintenance crossing with the lowest life cycle cost

The MoDOT / HDR study team is confident that the concept selected for the Route 240 Bridge over the Missouri River at Glasgow is the most practical solution possible. We believe that it will best serve the citizens of the State at the least overall cost and for the longest amount of time. This conceptual study, recommended alternative, and the teamwork demonstrated between MoDOT and HDR staff is indeed deserving of recognition in the Practical Design 2008 Awards Of Excellence competition!!!

If you have any questions regarding this submittal, please contact Kurt Gribble at (573) 526-0248.

Kg
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attachment

MoDOT PROJECTS
2008 APPLICATION FORM
(required for each entry)

Job No. J2P0793 **Route** 240 **County** Saline/Howard

STIP Description (Scoping or Construction, state which STIP) Project Scoping including an alternatives analysis utilizing detailed inspection information, load rating calculations and life cycle cost analyses. Alternatives considered in the alternatives analysis were rehabilitation, replacement on offset alignment or partial replacement on alignment for the Route 240 bridge over the Missouri River at Glasgow, Missouri.

Is the submittal for the entire project or just a portion of the project? Please explain: The submittal is for the conceptual study/project scoping phase for the bridge over the Missouri River.

Project Manager (could have both) **MoDOT** Kurt Gribble (Bridge) **Consultant** Kerry Moore (HDR Engineering)

Key core team members as approved by the MoDOT PM (may include consultants) (limit of 9)

Kent Nelson (Bridge)	Cory Imhoff (HDR Engineering)	David Barrett (HDR Engineering)
Paul Kelly (Bridge)	Brian Zeiger (HDR Engineering)	
Jay Bestgen (Design)	Scott Fletcher (HDR Engineering)	

Project Contacts: **District** Kurt Gribble (Bridge) **Consultant** Kerry Moore (HDR Engineering)

Project Budget:

Conceptual budget $13.9 Million **Initial STIP Budget** $ _____

Final STIP budget $ _____ **Award amount** $ _____

Other : _____

Value Engineering study during design? yes ☐ no ☒ (if yes) **Project Stage** _____

Total VE savings implemented $ _____ **VE Contact Person** _____

Construction-stage VE (VECP)? yes ☐ no ☐ (if yes) **Explain** _____

Total VECP savings $ _____ **VECP Contact Person** _____

What would make this entry stand out from the rest of the entries when considering MoDOT's practical design philosophy? (In layman's terms - 100 words or fewer) The MoDOT/HDR Study Team recognized the service life remaining in the existing substructure and came up with a best value alternative. The substructure was in good condition and the superstructure was in bad condition. The recommendation was to replace the deteriorating superstructure and reuse the existing substructure. This approach best addresses the needs of the project at the best overall value to the citizens of the State, increases safety, and decreases maintenance costs and resource demands.

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

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

(119')(114'-114'-106')(249'-316')(316'-344'-224')(95'-103')(119') CONTINUOUS COMPOSITE PLATE GIRDER SPANS

ROUTE	STATE	DISTRICT	SHEET NO.
240	MO	BR	1

JOB NO. J2P0793

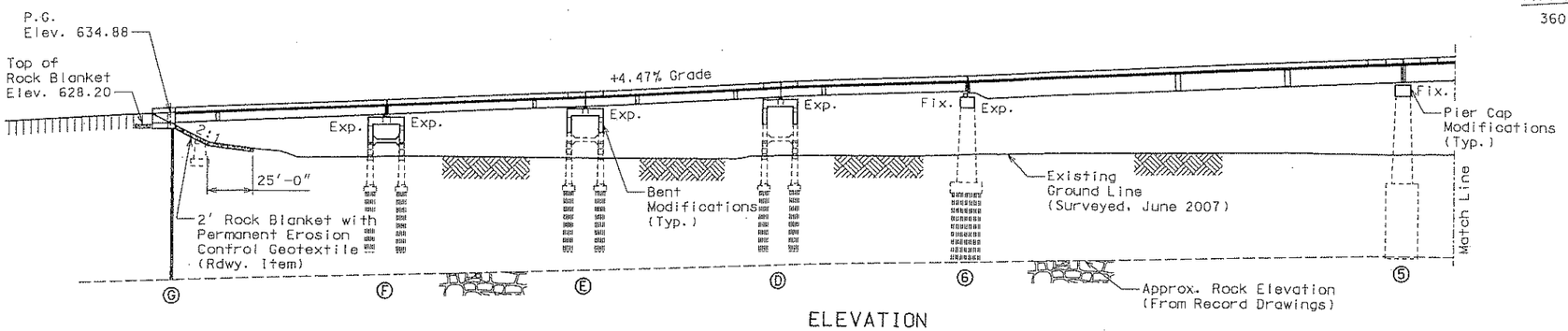
CONTRACT ID

PROJECT NO.

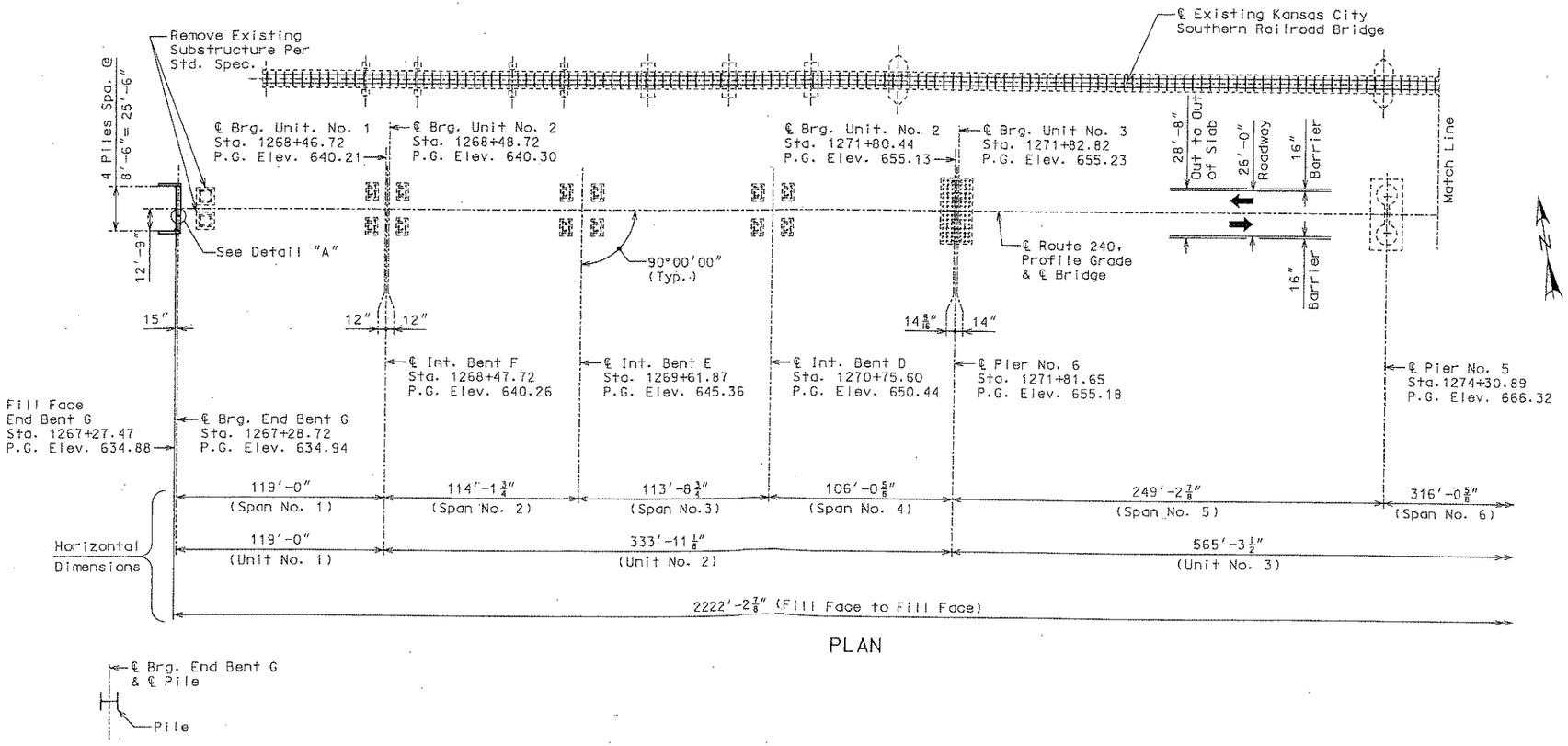
COUNTY HOWARD/SALINE DATE 8-28-07

SEC/SUR 3 TWP 51N RGE 18W

SEC/SUR 17 TWP 51N RGE 17W



ELEVATION



PLAN

DETAIL "A"

BEARING PILE DATA

BENT		G	A
Pile Type and Size		HP14x89	HP14x89
Number		4	4
Approximate Length	ft.	88	67
Design Bearing (Strength)	tons	143.5	143.5
Hammer Energy Required (**)	ft.-lbs.	25,500	25,500

Minimum energy requirement of hammer is based on plan length and design bearing value of piles.
All piles shall be driven to practical refusal.
Manufactured pile points shall be used on all piles in this structure.
No Boring information was obtained by the Commission for this work. Rock elevation is approximate according to record drawings of existing bridge.

(**) According to FHWA Gates Formula and practical refusal at 54 Blows per Inch. See Sheet No. 78 for calculating Design Bearing at the Strength Limit State in accordance with the FHWA Gates Formula.

B.M. - CHISELED "□" ON SW CORNER OF EXISTING BRIDGE APPROACH 11.85' RT., STA. 1267+06.29, ELEV. 633.86

B.M. - "+" ON ROCK SUPPORT OFF NE CORNER OF RAILROAD BRIDGE 82.42' LT., STA. 2+70.26, ELEV. 665.13

REPAIRS TO BRIDGE OVER THE MISSOURI RIVER

STATE ROAD FROM RTE. 41 TO RTE. 87

ABOUT 20.5 MILES NORTHEAST OF RTE. 41

STA. 1267+27.47 RTE. 240

DESIGNED AUG 2007
DETAILED AUG 2007
CHECKED AUG 2007
HDR

NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS

GENERAL ELEVATION AND PLAN

Date: / /

STD. 706.35

G00694

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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

(119′)(114′-114′-106′)(249′-316′)(316′-344′-224′)(95′-103′)(119′) CONTINUOUS COMPOSITE PLATE GIRDER SPANS

ROUTE	STATE	DISTRICT	SHEET NO.
240	MO	BR	2

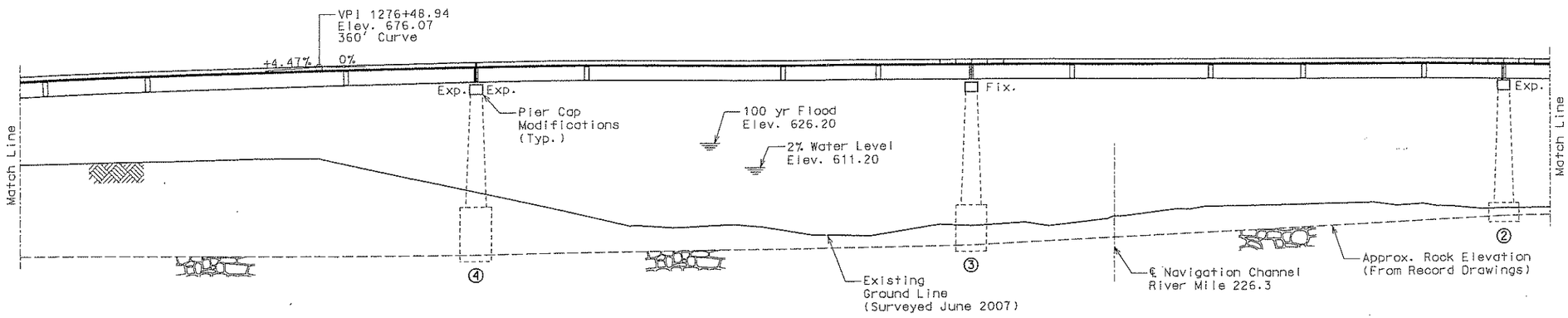
JOB NO. J2P0793

CONTRACT ID

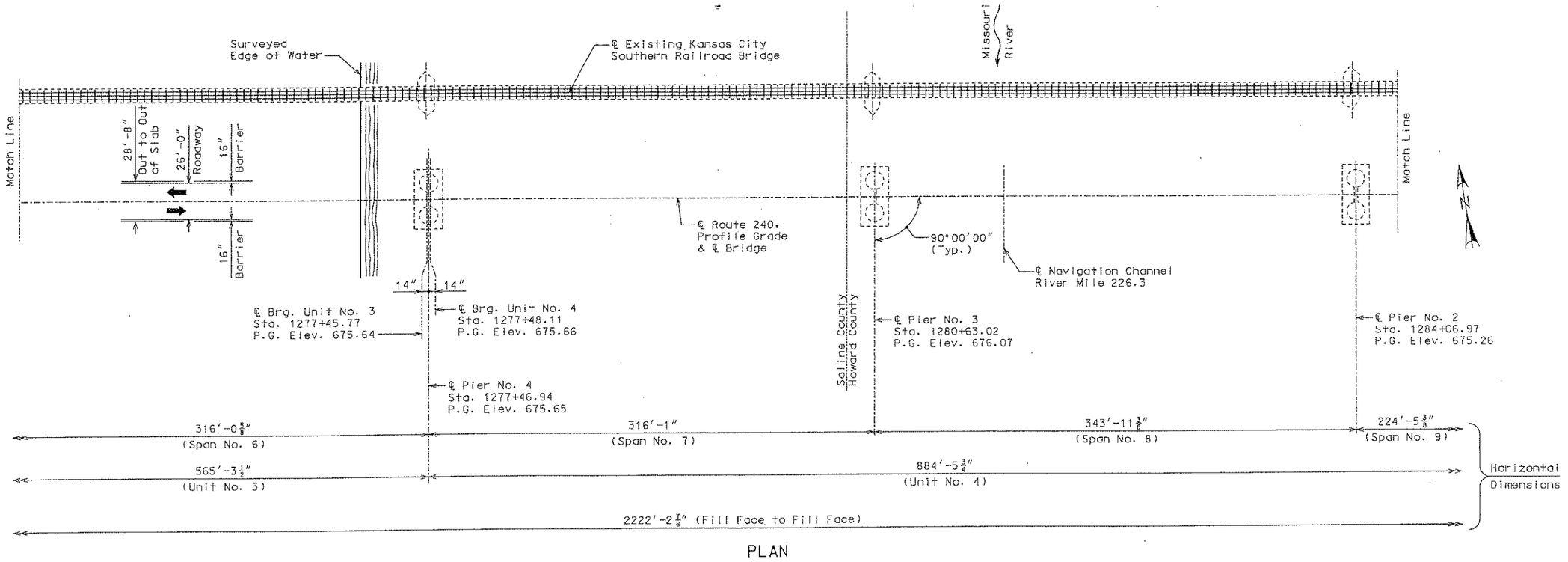
PROJECT NO.

COUNTY HOWARD/SALINE

DATE 8-28-07



ELEVATION



PLAN

GENERAL PLAN & ELEVATION

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DETAILED AUG 2007
CHECKED AUG 2007

HDR

NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS

G00694

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

(119')(114'-114'-106')(249'-316')(316'-344'-224')(95'-103')(119') CONTINUOUS COMPOSITE PLATE GIRDER SPANS

ROUTE	STATE	DISTRICT	SHEET NO.
240	MO	BR	3

JOB NO. J2P0793

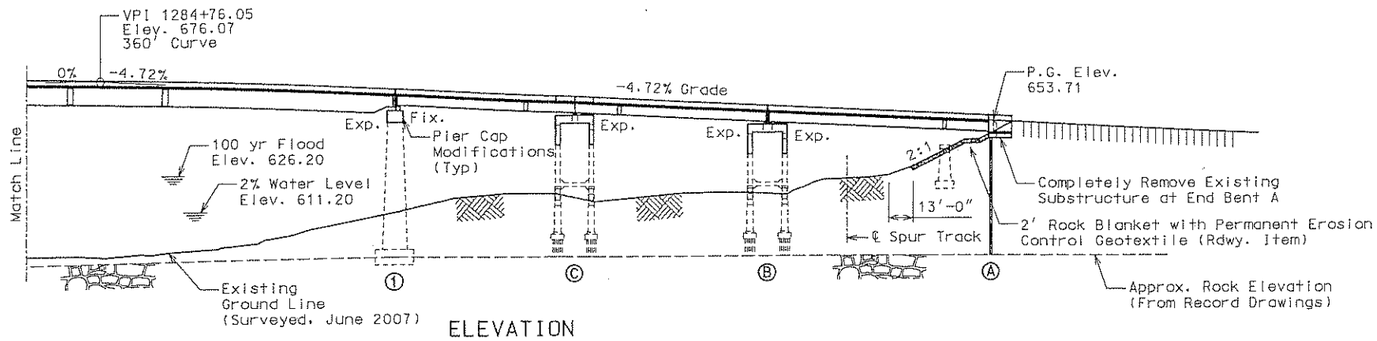
CONTRACT ID

PROJECT NO.

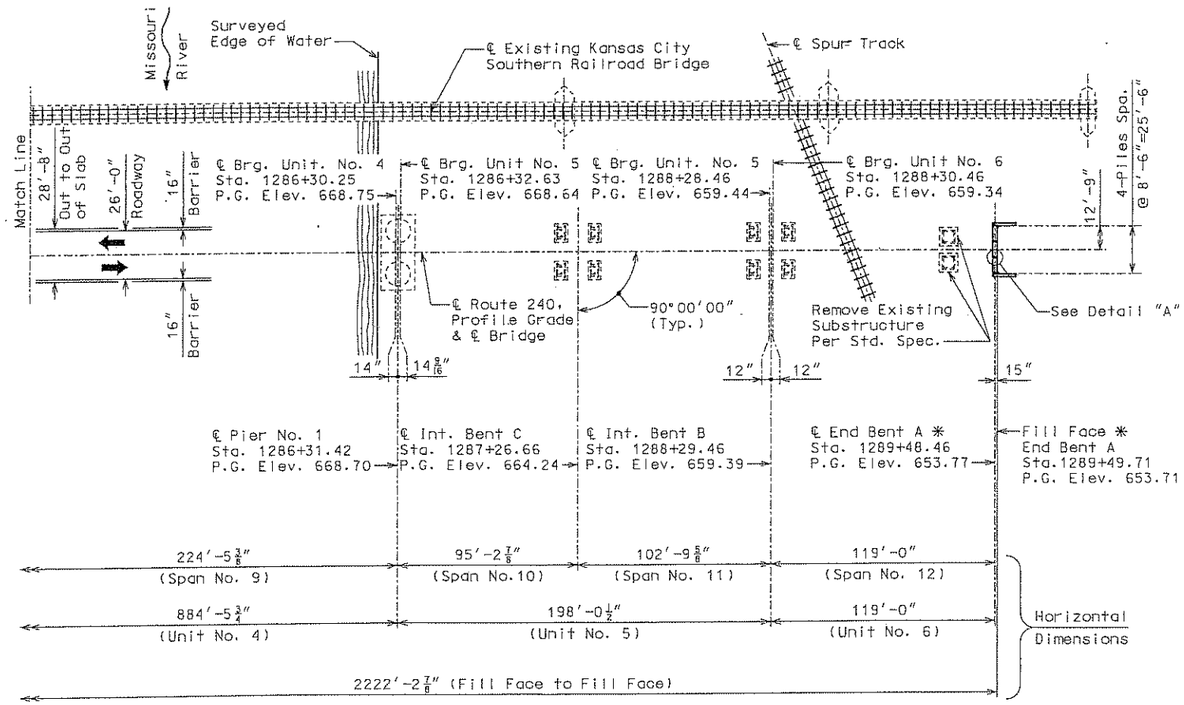
COUNTY HOWARD/SALINE

DATE 8-28-07

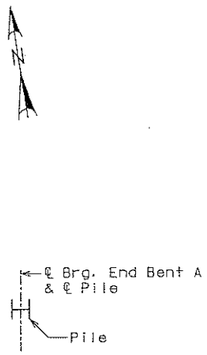
STATE OF MISSOURI CORY MICHAEL WINOFF NUMBER PE-2002016669 PROFESSIONAL ENGINEER



ELEVATION



PLAN



DETAIL "A"

✳ ℄ Route 87 Sta. 0+00 = ℄ Route 240 Sta. 1289+43.95
℄ End Bent A = ℄ Route 87 Sta. 0+4.51
Fill Face End Bent A = ℄ Route 87 Sta. 0+5.76
Continuation Of Route 240 Stationing Used Throughout
Plans For All Ties To End Bent A.

GENERAL ELEVATION AND PLAN

USER: dbernard DATE: 8/28/2007 PATH: C:*Working*DMA*dbernard\d0176478\G00694_GPE_03_.dgn

DETAILED AUG 2007
CHECKED AUG 2007
HDR

NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS

G00694

ROUTE	STATE	DISTRICT	SHEET NO.
240	MO	BR	4

JOB NO. J2P0793

CONTRACT ID

PROJECT NO.

COUNTY HOWARD/SALINE

DATE 8-28-07

STATE OF MISSOURI — CORY MICHAEL BARHOFF — NUMBER PE-2002019988 — PROFESSIONAL ENGINEER

ESTIMATED QUANTITIES

	Item	Unit	Substr.	Superstr.	Total
	Class 1 Excavation	Cu. Yd.	45		45
	Partial Removal of Bridges (G00693)	Lump Sum			1
	Partial Removal of Substructure Concrete	Lump Sum			1
	Water Transportation for Engineer	Lump Sum			1
	Foundation Inspection Holes	Lin. Ft.	172		172
	Structural Steel Piles (14 in.)	Lin. Ft.	620		620
	Pile Point Reinforcement	Each	8		8
	Class B Concrete (Substructure)	Cu. Yd.	652.1		652.1
	Slab on Steel	Sq. Yd.		7058	7058
*	Safety Barrier Curb	Lin. Ft.		4481	4481
	Substructure Repair (Unformed)	Sq. Ft.	85		85
	Reinforcing Steel (Bridges)	Lbs.	58520		58520
	Reinforcing Steel (Epoxy Coated)	Lbs.	46850		46850
	Protective Coating - Concrete Bents and Piers (Urethane)	Lump Sum			1
	Temp. Coating - Conc. Bents and Piers (Weathering Steel)	Lump Sum			1
	Expansion Device (Finger Plate)	Lin. Ft.		79	79
	Fab. Struc. Low Alloy Steel (Plate Girder) A709, Grade 50W	Lbs.	3389370		3389370
	Slab Drain	Each		270	270
	Vertical Drain at End Bents	Each			2
	Laminated Neoprene Bearing Pad (Tapered)	Each		6	6
	Laminated Neoprene Bearing Pad Assembly	Each		6	6
	Type N PTFE Bearing	Each		27	27
	Pot Bearing	Each		15	15
	Strip Seal Expansion Joint System	Lin. Ft.		57	57
	Navigation Lighting System	Lump Sum			1
	Clearance Gauge	Lump Sum			1

* Safety Barrier Curb shall be Cast-In-Place option or Slip-Form option.

GENERAL NOTES:

DESIGN SPECIFICATIONS:
2007 - AASHTO LRFD 4th Ed. (Super. & Sub.)
Load and Resistance Factor Design
Seismic Performance Category A.

DESIGN LOADING:
HL-93 (LRFD Superstructure & Substructure)
35#/Sq. Ft. Future Wearing Surface
Earth 120#/Cu. Ft., Equivalent Fluid Pressure 45#/Cu. Ft.
$\emptyset = 27°$

DESIGN UNIT STRESSES:

Class B Concrete (Substructure)	f'c = 3,000 psi.
Class B-1 Concrete (Safety Barrier Curb)	f'c = 4,000 psi.
Class B-2 Concrete (Superstructure, except Safety Barrier Curb)	f'c = 4,000 psi.
Reinforcing Steel (Grade 60)	fy = 60,000 psi.
Structural Steel (ASTM A709 Grade 50W)	fy = 50,000 psi.
Steel Pile (ASTM A709 Grade 36)	fy = 36,000 psi.

NEOPRENE PADS:
Bearings at End Bents A and G shall be 60 durometer neoprene pads.

FABRICATED STEEL CONNECTIONS:
Field connections shall be made with 7/8" diameter high strength bolts and 15/16" diameter holes, except as noted.

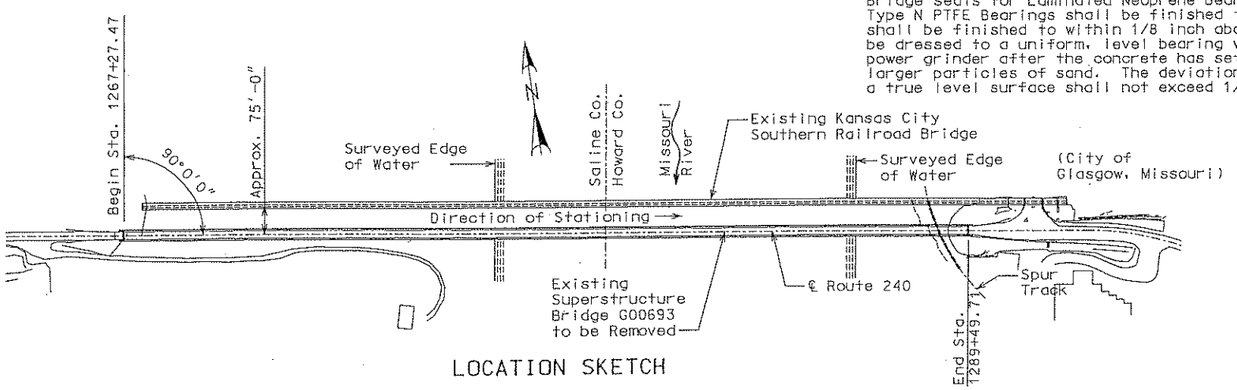
JOINT FILLER:
All joint filler shall be in accordance with Sec 1057 for preformed sponge rubber expansion and partition joint filler, except as noted.

REINFORCING STEEL:
Minimum clearance to reinforcing steel shall be 1-1/2", unless otherwise shown.

STRUCTURAL STEEL PROTECTIVE COATINGS:
Protective Coating: System H in accordance with Sec 1081.
Portions of the structural steel embedded in or in contact with concrete, including but not limited to the top flange of girders, shall be coated with not less than 2.0 mils of the prime coat for System H.
Prime Coat: The prime coat shall be applied in the fabrication shop. The cost of the prime coat will be considered completely covered by the contract unit price for the Fabricated Structural Steel.
The surfaces of all structural steel located under expansion joints shall be coated with complete System H within a distance of 1-1/2 times the girder depth, but not less than 10 feet, from the centerline of all deck joints. At the dapped ends of Units 3 & 4 Girders, the full height of the girder shall be considered when determining the 1-1/2 times the girder depth length. Within this limit, items to be coated shall include all surfaces of beam, girders, diaphragms,stiffeners, bearings and miscellaneous structural steel items. Field Coat: THe color of the finish field coat shall be Brown (Federal Standard #30045). The cost of the intermediate and finish field coats will be considered completely covered by the contract unit price for the Fabricated Structural Steel. At the option of the contractor, the intermediate and finish field coats may be applied in the shop. The contractor shall exercise extreme care during all phases of loading, hauling, handling, erection and pouring of the slab to minimize damage and shall be fully responsible for all repairs and cleaning of the coating systems as required by the engineer.

CONCRETE PROTECTIVE COATINGS:
Temporary coating for concrete bents and piers (weathering steel) shall be applied on all concrete surfaces above the ground line or low water elevation on all abutments and intermediate bents in accordance with Sec 711.
Protective coating for concrete bents and piers (Urethane) shall be applied as shown on the bridge plans and in accordance with Sec 711. Additionally, the Contractor shall coat the top and sides of all existing crossbeams to be incorporated into the new structure.

MISCELLANEOUS:
High strength bolts, nuts and washers will be sampled for quality assurance as specified in Sec 106 and Field Section (FS-712) from Materials Manual.
"Sec" refers to the sections in the standard and supplemental specifications unless specified otherwise.
Bridge seats for Laminated Neoprene Bearing Pad Assemblies and Type N PTFE Bearings shall be finished to a smooth even surface and shall be finished to within 1/8 inch above plan elevation and shall be dressed to a uniform, level bearing with a Carborundum brick or power grinder after the concrete has set sufficiently to fix the larger particles of sand. The deviation of the bearing seat from a true level surface shall not exceed 1/16 inch.



LOCATION SKETCH

GENERAL NOTES (CONTINUED):

RESIN ANCHORS (PIER NO. 1, 2, 3, 4, 5 & 6):
The Contractor shall use one of the qualified resin anchor systems in accordance with Sec 1039.

Cost of furnishing and installing the resin anchor system complete-in-place will be considered completely covered by the contract unit price for Class B Concrete (Substructure).

The minimum embedment depth in concrete with f'c = 3,000 psi for the resin anchor system shall be that required to meet the minimum ultimate pullout strength in accordance with Sec 1039 but shall not be less than 12".

An epoxy coated #7 Grade 60 reinforcing bar 6'-0" long shall be substituted for the 7/8"Ø threaded rod.

ESTIMATED QUANTITIES:

CONCRETE:
All concrete between the upper and lower construction joints in the end bents is included in the Estimated Quantities for Slab on Steel. All reinforcement in the end bents is included in the Estimated Quantities for Slab on Steel..

NEOPRENE BEARING PADS:
Laminated Neoprene Bearing Pads (Tapered) shall be in accordance with Sec 716.

TRAFFIC CONTROL:
Road closed during construction.

ESTIMATED QUANTITIES FOR SLAB ON STEEL

Item		Total
Class B2 Concrete	Cu. Yds.	1520.8
Reinforcing Steel (Epoxy Coated)	Lbs.	554350
Reinforcing Steel (Bridges)	Lbs.	8150

The table of Estimated Quantities for Slab on Steel represents the quantities used by the State in preparing the cost estimate for concrete slabs. The volume of concrete was determined based on a constant slab thickness of 7 inches. The area of the concrete slab will be measured to the nearest square yard with the horizontal dimensions as shown on the plan of slab. Payment for stay-in-place forms, conventional forms, all concrete and coated and uncoated reinforcing steel will be considered completely covered by the contract unit price for the slab. Variations may be encountered in the estimated quantities but the variations cannot be used for an adjustment in the contract unit price.

Method of forming the slabs shall be as shown on the plans and in accordance with Sec. 703. All hardware for forming the slab to be left in place as a permanent part of the structure shall be coated in accordance with ASTM A123 or ASTM B633 with a thickness class SC 4 and a finish type I, II or III.

Slab shall be cast-in-place with conventional forming or stay-in-place corrugated metal forms. Precast prestressed panels will not be permitted.

Permanent steel bridge deck forms, supports closure elements and accessories shall be in accordance with ASTM A446, Grades A thru F, having a coating class of G165 in accordance with ASTM A525. Complete shop drawings of the permanent steel deck forms shall be required in accordance with Sec. 1080.

Corrugations of stay-in-place forms shall be filled with an expanded polystyrene material. The polystyrene material shall be placed in the forms with an adhesive in accordance with the manufacturer's recommendations.

Form sheets shall not rest directly on the top of girders, stringers or floorbeam flanges. Sheets shall be securely fastened to form supports with a minimum bearing length of one inch on each end. Form supports shall be placed in direct contact with the flange. Welding on or drilling holes in the flanges of the girders, stringers or floorbeams will not be permitted. All steel fabrication and construction shall be in accordance with Sec.'s 1080 and 712.

DETAILED AUG 2007
CHECKED AUG 2007
HDR

GENERAL NOTES AND SUMMARY OF ESTIMATED QUANTITIES

NOTE: THIS DRAWING IS NOT TO SCALE. FOLLOW DIMENSIONS

G00694