2009 APPLICATION FORM

(required for each entry)

Complete this section for (check one): ☐**Small Project** ■**Large Project**

☐**Post-Design Solution** ☐**Off System Project**

Job No. J4I 1507 **Route** I-29/35 **County / LPA** Jackson - Clay

Description (attach separate sheet if necessary) See Attached Sheet

Complete this section for: **Process Improvement**

Process or Product Inverted-T Bent Cap and Link Slab

Description (attach separate sheet if necessary) See Attached Sheet

Project Leader Bryan Wilkerson - PCC

Key Team Members (include key personnel irrespective of employer-nine individuals maximum)

Patrick Cassity - PCC	Thad Kosmicki - PCC	Tom Skinner - MoDOT
Shaoyun Sun - PCC	Eddie He - PCC	Mark Hartegan - PCC
Pamela Yuen - PCC	Luis Ramos - PCC	Kevin Irving - FHWA

Project Budget:

Initial Cost / Estimate $ 3.62 million **Final Cost / Award** $ 3.47 million

What would make this entry stand out from the rest of the entries when considering MoDOT's practical design philosophy? (In layman's terms - 200 words or fewer-attach separate sheet if necessary)

The I-29/35 bridge over Front Street is an outstanding illustration of how two innovative and economical structural systems can be applied to improve durability and functionality while at the same time reducing long-term maintenance costs. The first structural system, employing an inverted-T bent cap, eliminates the negative aspects of other traditional approaches while maintaining the reduced structural depth for vertical clearance. The inverted-T bent cap is a valuable alternative for locations where raising the geometric vertical profile is prohibited or costly. The second structural system is the implementation of a link slab. A link slab maintains the simple span performance of a bridge while accommodating deformations and loads typically accounted for by an expansion joint. The link slab eliminates joint leakage which causes damage to bridge elements with the infiltration of water and deicing chemicals through a typical expansion joint. The concept of link slab is not limited to new bridge decks, but could also be implemented in the replacement of deteriorated joints of existing bridge decks. The adoption of both an inverted-T and a link slab for other structures is, without question, a beneficial practical design application for the State of Missouri.

ALL ENTRIES MUST BE RECEIVED NO LATER THAN CLOSE OF BUSINESS ON DECEMBER 1, 2008

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

ALL ENTRIES MUST BE RECEIVED NO LATER THAN CLOSE OF BUSINESS ON DECEMBER 1, 2008

November 30, 2008

Mr. Joe Jones, P.E.
Engineering Policy Administrator
105 West Capital
Jefferson City, Missouri 65102

RE: Practical Design – 2009 Awards for Excellence
I-29/I-35 over Front Street

Description
Located in Kansas City, the $245 million kcICON design-build project involves the reconstruction of approximately 4 miles of Interstate I-29/I-35 and five interchanges. Included in the scope of work is the new cable stay Christopher S. Bond Bridge over the Missouri River. One of the new interchanges constructed is a single point interchange for I-29/I-35 over Front Street which includes a three-span prestressed girder bridge. The contract for the kcICON design-build project was awarded to Paseo Corridor Constructors (PCC) in November 2007 and design services performed by Parsons for the bridge, I-29/I-35 over Front Street. Parsons completed the bridge design in October 2008 and construction is scheduled to start in the summer of 2009. Two innovative practical design approaches were employed in the design of the three-span bridge that introduced immediate costs savings and reduced future maintenance expenses: an inverted-T bent cap and a link slab for a joint-free bridge deck.

Product
Inverted-T Bent Cap:
Early in the proposal stage, PCC and Parsons were aware of the need to limit the structural depth of the proposed bridge over the single point interchange at Front Street. Prestressed girders were selected for the superstructure as the obvious economical solution for the three-span bridge. Initially, a structural system consisting of integral bent caps at both intermediate bents was considered for the support of the prestressed girders to reduce the structural depth. For this initial concept, the three-span bridge would be simple-span for dead loads made continuous at the intermediate bents for live loads. The continuity of the bridge serves two key purposes: eliminating joints to reduce maintenance and improve ride quality, and increasing the beam's mid-span load capacities. However, one of the less understood and often overlooked issues in design of simple-span prestressed girders made continuous for live loads is the effect of secondary moments on the performance of the structure. Converting a simply supported girder, (without end constraints that is free to rotate at the end) to a continuous girder results in the introduction of restraints in the structural system. The result is restraint-induced moments and shears due to creep and shrinkage, thermal effects and loading. These positive secondary moments have resulted in tensile stresses and cracking at the soffit of the girders at the intermediate bents in similar designs used in other states. Parsons determined, if an intermediate integral bent cap was employed, it would be necessary to post-tension the longitudinal girders to prevent cracking the girder section adjacent to the bent cap. Post-tensioning the girders is an expensive approach with negative schedule impacts.

As an alternative, Parsons advocated using an inverted-T bent cap which has been implemented by other state DOTs. This structural system eliminated the negative economical, schedule and design aspects of the integral bent cap while maintaining the reduced structural depth for vertical clearance over Front Street. The prestressed girders were designed simple-span for dead loads and live loads. The ends of the girders supported by the inverted-T bent cap are allowed to rotate with elastomeric expansion bearings. Thus, the prestressed girders function as designed for the design service life of the bridge. In summary, the inverted-T bent cap is a valuable alternative for the State of Missouri where vertical clearance is critical and where economics demand the use of prestressed girders.

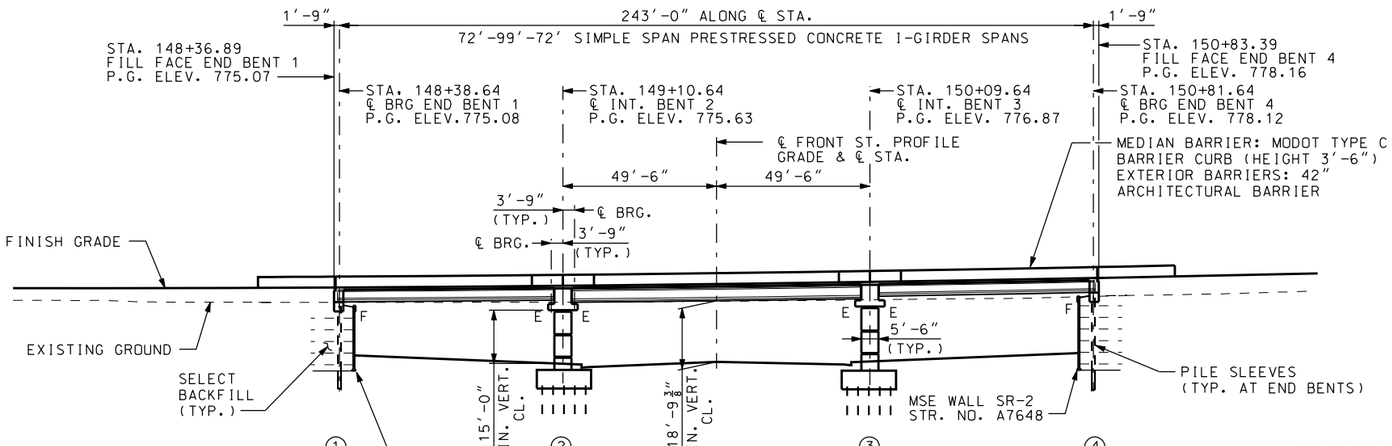
Link Slab for a Joint-Free Bridge Deck:

The standard approach is to provide a mechanical or controlled expansion joint in the bridge deck slab when using simply supported prestressed girders. An expansion joint allows the vertical and horizontal deck slab deformations to occur due to girder deflections, concrete creep and shrinkage, and temperature variations. Although a joint is a functional element of a bridge, it is common knowledge that joints in a deck slab are expensive to install and maintain. Furthermore, the functionality of the joint deteriorates over time as a result of debris accumulating in joint. This deterioration leads to the damage of other bridge elements with the infiltration of water and deicing chemicals through the joint. The structural integrity of beam ends, girder bearings, and supporting substructure are negatively impacted. The end results of employing a joint is the undermining of the economical operation of a bridge through future maintenance costs and the considerable expenses of replacing damaged bridge elements.

Parsons and MoDOT's district staff explored several alternatives to eliminate the joints over the intermediate inverted-T straddle bents. Through our research, it was determined that the best solution for the section of the deck slab connecting the two adjacent simple-span girders would be a link slab. A link slab maintains the simple span performance of the bridge while accommodating deformations and loads typically accounted for by the expansion joint. A link slab essentially functions as a hinge because it is substantially less stiff when compared to the composite section of the prestressed girders. To achieve the reduced stiffness of the link slab, a bond breaker is used over a small percentage of the adjacent deck between the top of the girder and the bottom of the slab as well as over the stem of the inverted-T bent cap. The reinforcement in the link slab is designed to satisfy the predicted maximum end rotation of the prestressed girder and conventional deck slab loading. The link slab eliminates joint leakage associated with the low durability of a joint along with the future maintenance costs. With the link slabs at the intermediate inverted-T bents and with integral end bents, the bridge, I-29/I-35 over Front Street, is a joint-free bridge deck.

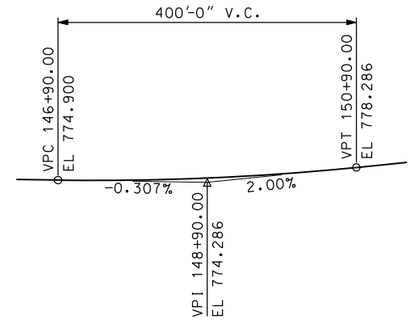
Although the link slab design was employed on this new bridge, the concept is not limited to new bridge decks, but could be implemented in the replacement of deteriorated joints of existing bridge decks. Standard plans and details could easily be developed and included MoDOT's policy guide for a link slab.

ROUTE	STATE	DISTRICT
I-29	MO	4
JOB NO.	J411507	
COUNTY	JACKSON-CLAY	

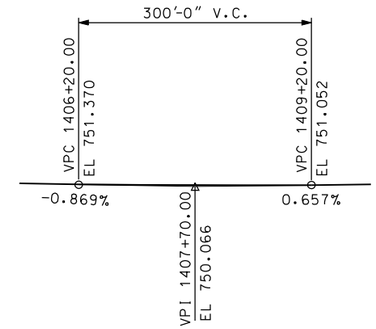


ELEVATION

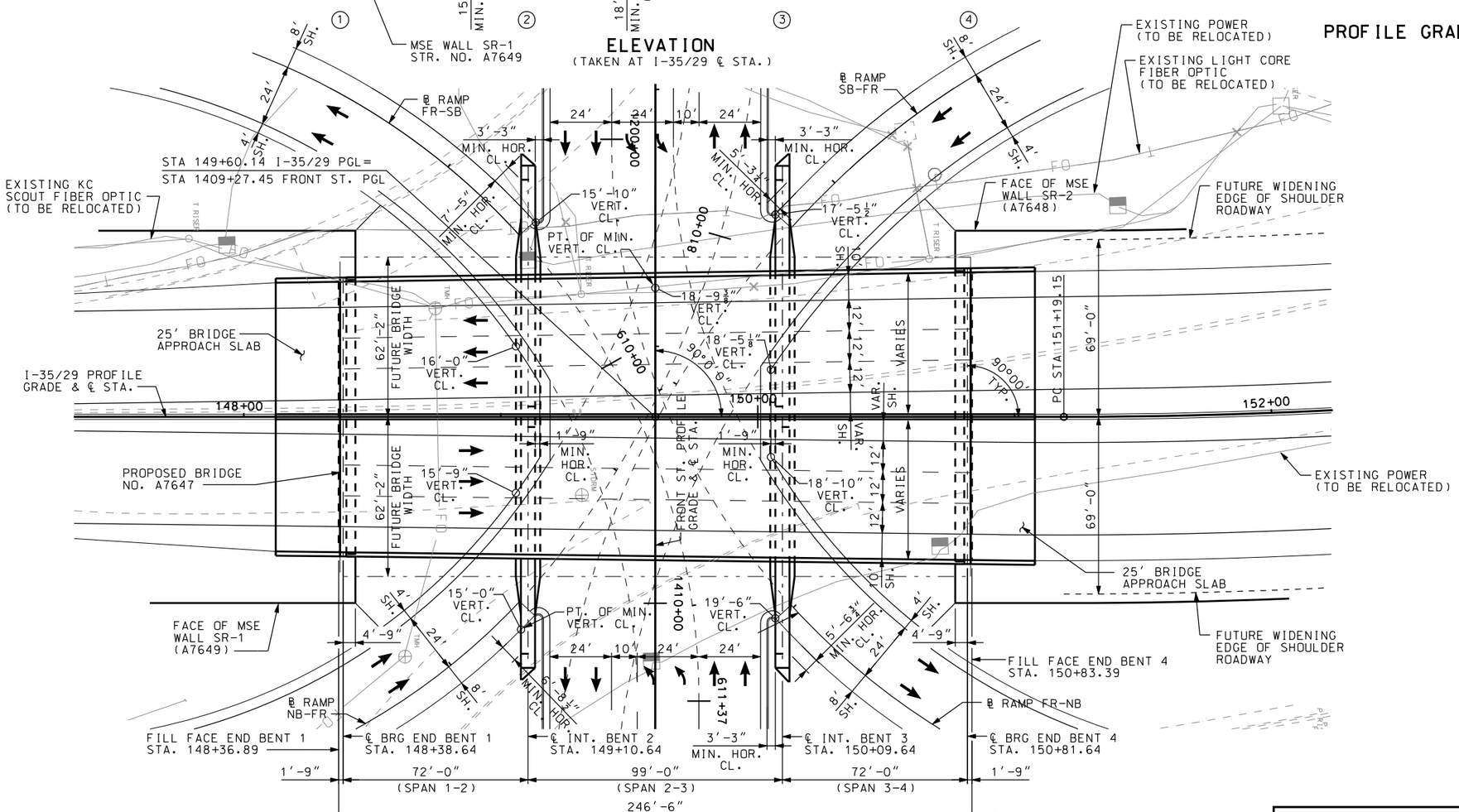
(TAKEN AT I-35/29 ℄ STA.)



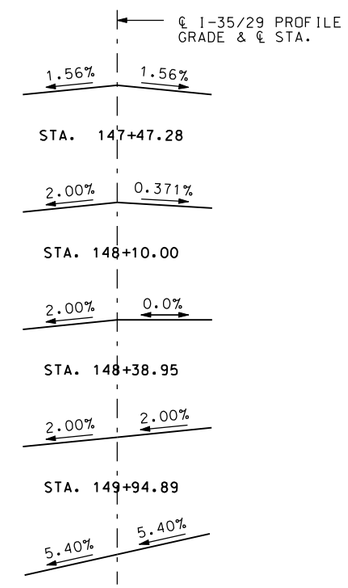
PROFILE GRADE I-35/29



PROFILE GRADE FRONT STREET



PLAN



S.E. TRANSITION DETAIL

A7647

STATE OF MISSOURI
LUIS PATRICK RAMOS
NUMBER PE-2008012198
PROFESSIONAL ENGINEER
THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.

PCC Released for Construction 2008.10.29 16:51:10 -05'00'

DESIGNED BY: LPR
DRAFTED BY: WES
CHECKED BY: MAH

PASEO CORRIDOR CONSTRUCTORS
PARSONS

ISSUE RECORD

NO.	DESCRIPTION	DATE
A	30% SUBMITTAL	03/11/08
B	100% SUBMITTAL	09/08/08
1	RELEASED FOR CONSTRUCTION	10/28/08

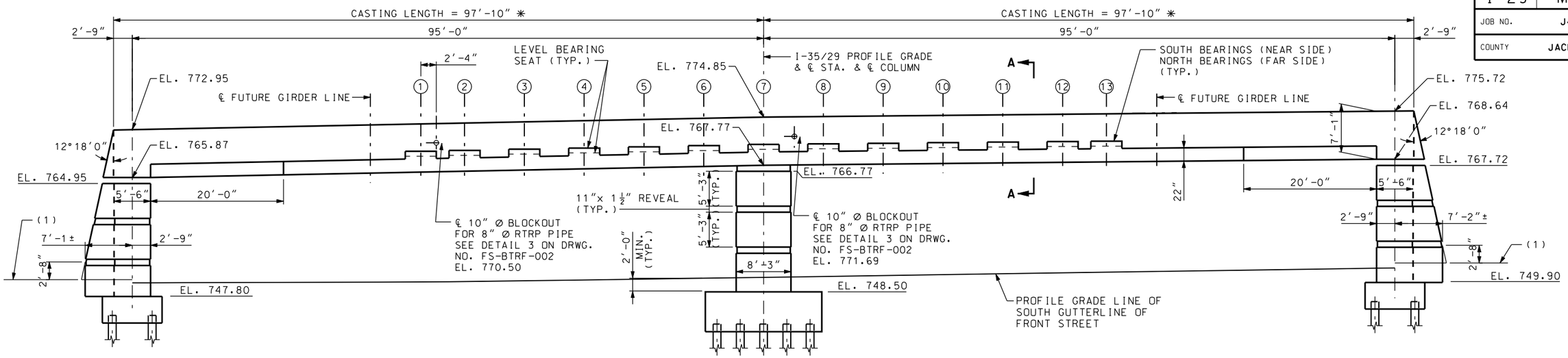
kcICON
MoDOT

THE kcICON PROJECT
I-35/29 OVER FRONT STREET
GENERAL PLAN & ELEVATION

DRAWING NUMBER
FS-GNPE-001

File Name: C:\PW_WORKING_XM\PTG\C0042307\DMS10842\FS-GNPE-001.DGN
User: C0042307
Time Plotted: 11:50:14 AM
Date Plotted: 10/28/2008
Pen Table: KCICON.TBL

ROUTE	STATE	DISTRICT
I-29	MO	4
JOB NO.	J411507	
COUNTY	JACKSON-CLAY	



ELEVATION OF INTERMEDIATE BENT 2
(LOOKING UPSTATION)

NOTES:

(1) DENOTES FINISH GRADE TO BE FIELD DETERMINED.

THE BENT CAP MAY BE CAST IN TWO POURS WITH A CONSTRUCTION JOINT AT THE TOP OF THE WIDENED BEAM SEAT.

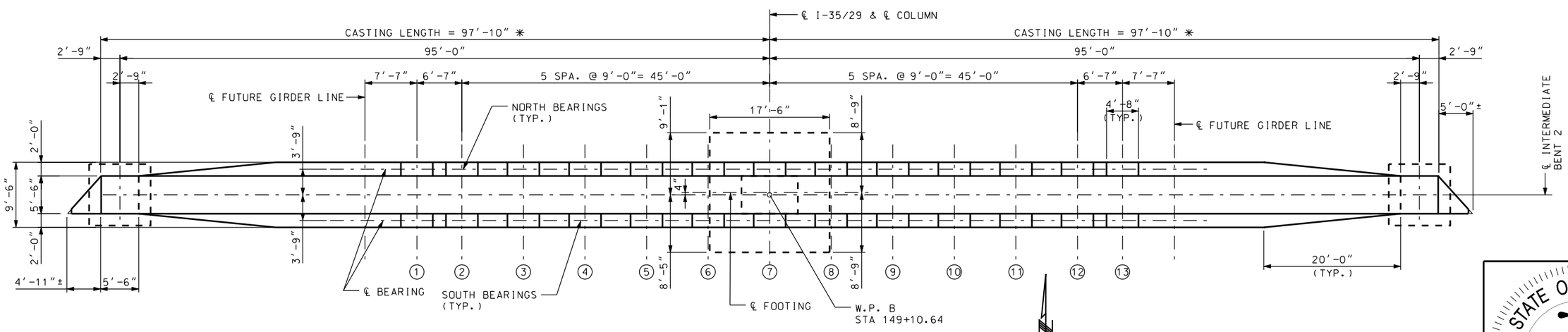
A CONSTRUCTION JOINT MAY BE USED AT THE BASE OF EACH BEARING PEDESTAL.

SEE SHEET FS-BTDT-005 FOR SECTION A-A.

✱ BENT CAP IS CAST AN ADDITIONAL 1" IN LENGTH AT EACH END TO PROVIDE FOR CREEP AND SHRINKAGE.

GIRDER BEARING SEAT ELEVATIONS

LOCATION	GIRDER 1	GIRDER 2	GIRDER 3	GIRDER 4	GIRDER 5	GIRDER 6	GIRDER 7	GIRDER 8	GIRDER 9	GIRDER 10	GIRDER 11	GIRDER 12	GIRDER 13
NORTH BRG	768.73	768.86	769.04	769.22	769.38	769.56	769.74	769.82	769.91	770.00	770.08	770.17	770.21
SOUTH BRG	769.53	769.66	769.84	770.02	770.20	770.38	770.56	770.66	770.74	770.82	770.90	770.98	771.03



PLAN OF INTERMEDIATE BENT NO. 2

A7647

STATE OF MISSOURI
LUIS PATRICK RAMOS
NUMBER PE-2008012198
PROFESSIONAL ENGINEER
THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.

PCC Released for Construction 2008.10.29 16:51:20 -05'00'

DESIGNED BY: TK
DRAFTED BY: WES
CHECKED BY: MAH

PASEO CORRIDOR CONSTRUCTORS
PARSONS

ISSUE RECORD

NO.	DESCRIPTION	DATE
B	100% SUBMITTAL	09/08/08
1	RELEASED FOR CONSTRUCTION	10/28/08

kcICON
MoDOT

THE kcICON PROJECT
I-35/29 OVER FRONT STREET
INTERMEDIATE BENT 2

DRAWING NUMBER
FS-BTDT-001

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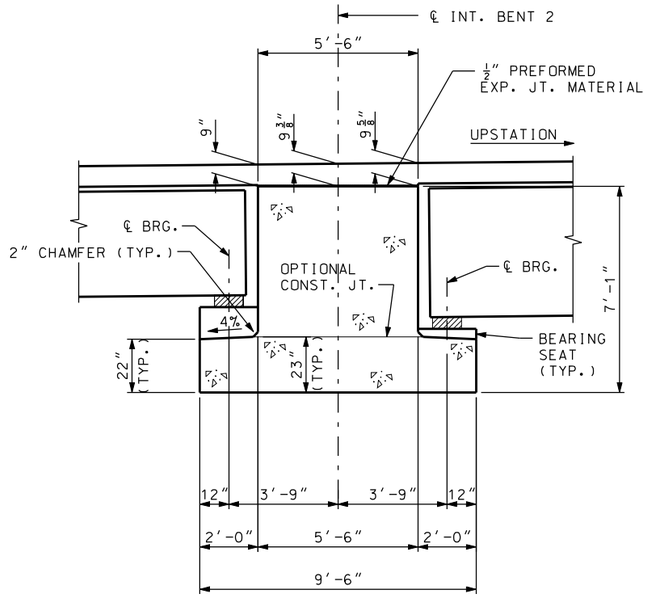
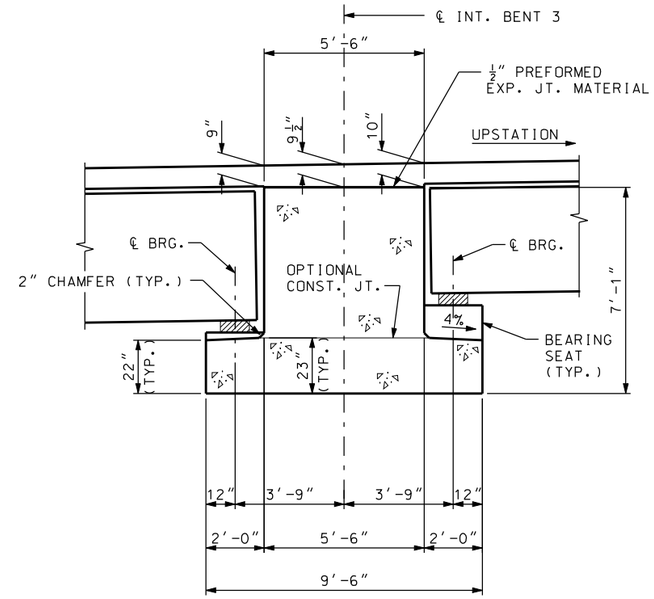
User: C0042307 Time Plotted: 11:57:11 AM Date Plotted: 10/28/2008

ROUTE	STATE	DISTRICT
I-29	MO	4
JOB NO.	J411507	
COUNTY	JACKSON-CLAY	



SECTION A-A
(INT. BENT 2)



SECTION B-B
(INT. BENT 3)

NOTES:

WORK THIS DRAWING WITH DRAWINGS FS-BTDT-001 AND FS-BTDT-002.

REFER TO DRAWINGS FS-BTDT-001 AND FS-BTDT-002 FOR COLUMN AND PILE CAP ELEVATION.

A7647

STATE OF MISSOURI
LUIS PATRICK RAMOS
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PROFESSIONAL ENGINEER
THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.

PCC Released for Construction 2008.10.29 16:51:22 -05'00'

DESIGNED BY: SS/
DRAFTED BY: WES
CHECKED BY: LPR

PASEO CORRIDOR CONSTRUCTORS
PARSONS

ISSUE RECORD

NO.	DESCRIPTION	DATE
B	100% SUBMITTAL	10/01/08
1	RELEASED FOR CONSTRUCTION	10/28/08

kcICON
MoDOT

THE kcICON PROJECT
I-35/29 OVER FRONT STREET
INTERMEDIATE BENT DETAILS

DRAWING NUMBER
FS-BTDT-005

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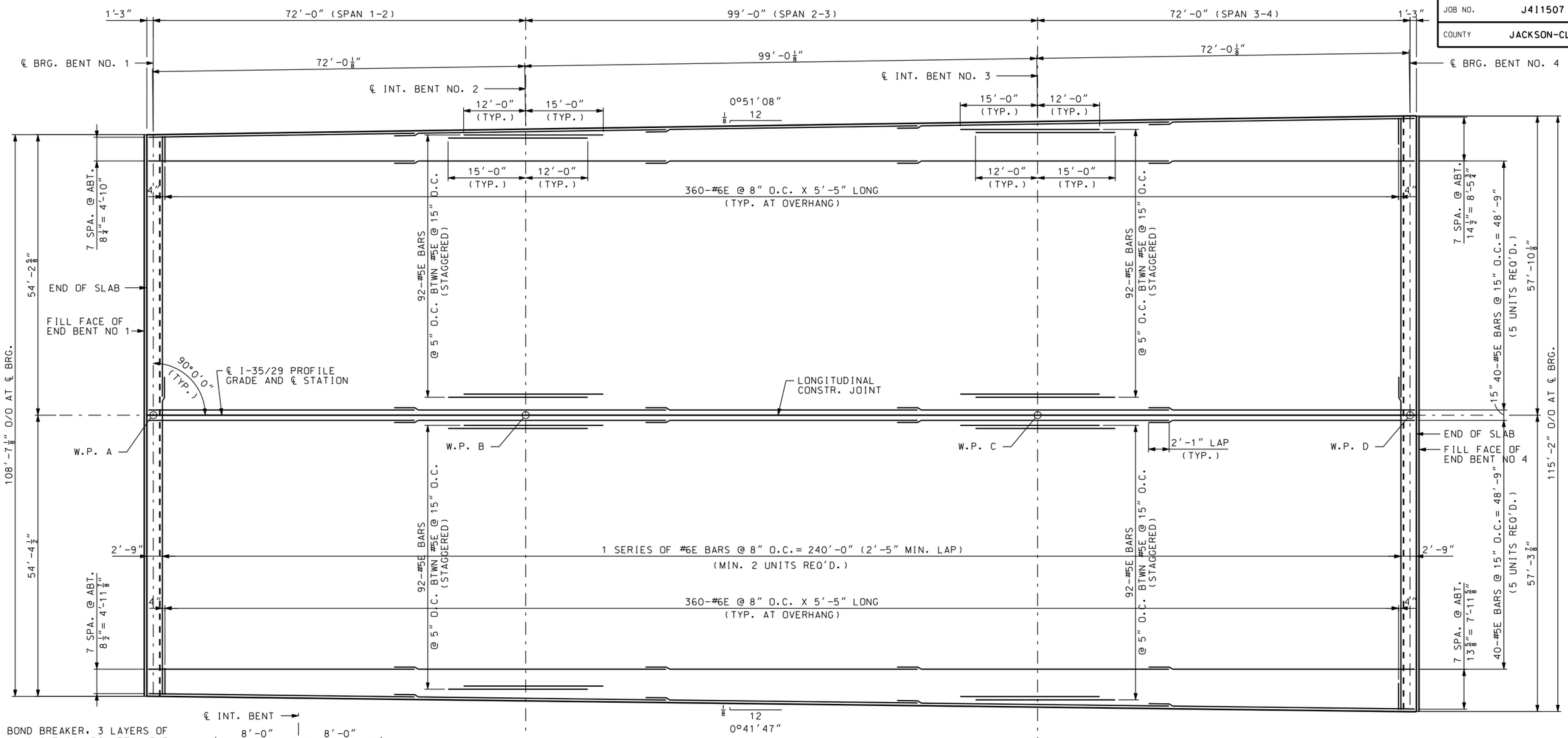
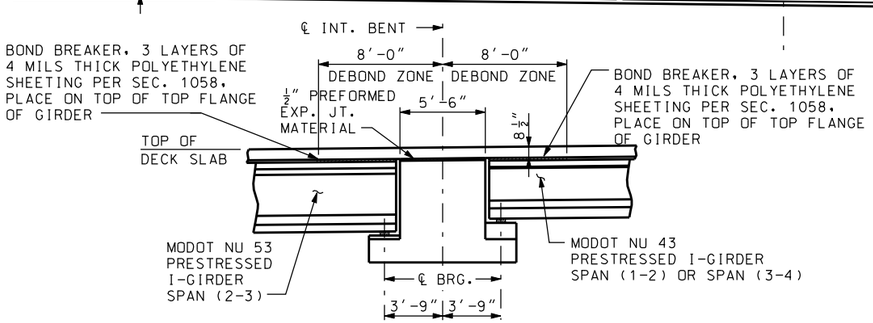
ROUTE	STATE	DISTRICT
I-29	MO	4

JOB NO. J411507

COUNTY JACKSON-CLAY



TOP OF SLAB REINFORCING PLAN



SECTION THRU INT. BENT
(AT GIRDER LINE, REINF. NOT SHOWN)

WORK POINT TABLE			
		COORDINATES	
W.P.	STATION	N	E
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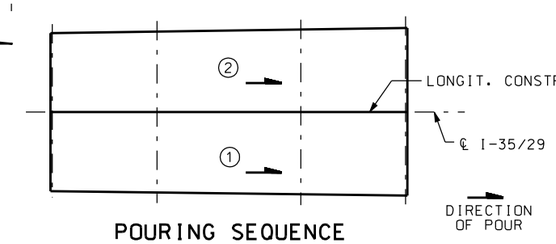
B	149+10.64	1,074,954.30	2,770,680.36
C	150+09.64	1,075,053.25	2,770,683.51
D	150+81.64	1,075,125.21	2,770,685.80

W.P.'S ARE THE INTERSECTIONS OF ℄ BEARING AT END BENT OR ℄ INTERMEDIATE BENT AND THE ℄ I-35/29.



POURING SEQUENCE

A7647

STATE OF MISSOURI
LUIS PATRICK RAMOS
NUMBER PE-2008012198
PROFESSIONAL ENGINEER

THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.

PCC Released for Construction 2008.10.29 16:51:29 -05'00'

DESIGNED BY: MAH
DRAFTED BY: WES
CHECKED BY: TK

PASEO CORRIDOR CONSTRUCTORS

PARSONS

ISSUE RECORD		
NO.	RELEASED FOR CONSTRUCTION DESCRIPTION	DATE
B	100% SUBMITTAL	09/08/08
1	RELEASED FOR CONSTRUCTION	10/28/08

kcICON MoDOT

THE kcICON PROJECT
I-35/29 OVER FRONT STREET
SLAB REINFORCING PLAN

DRAWING NUMBER
FS-DKPL-001

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Time Plotted: 12:00:02 PM
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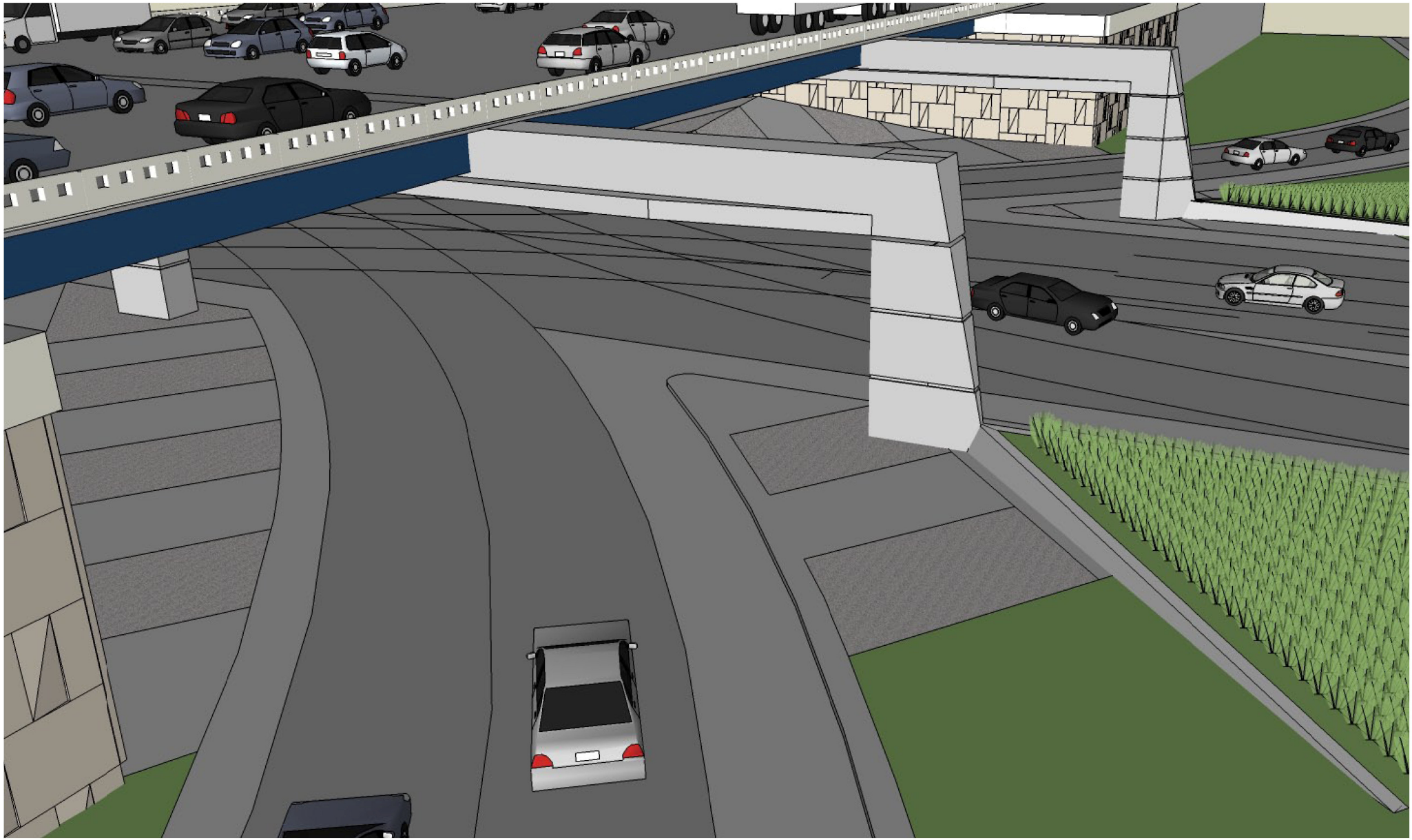
User: C0042307

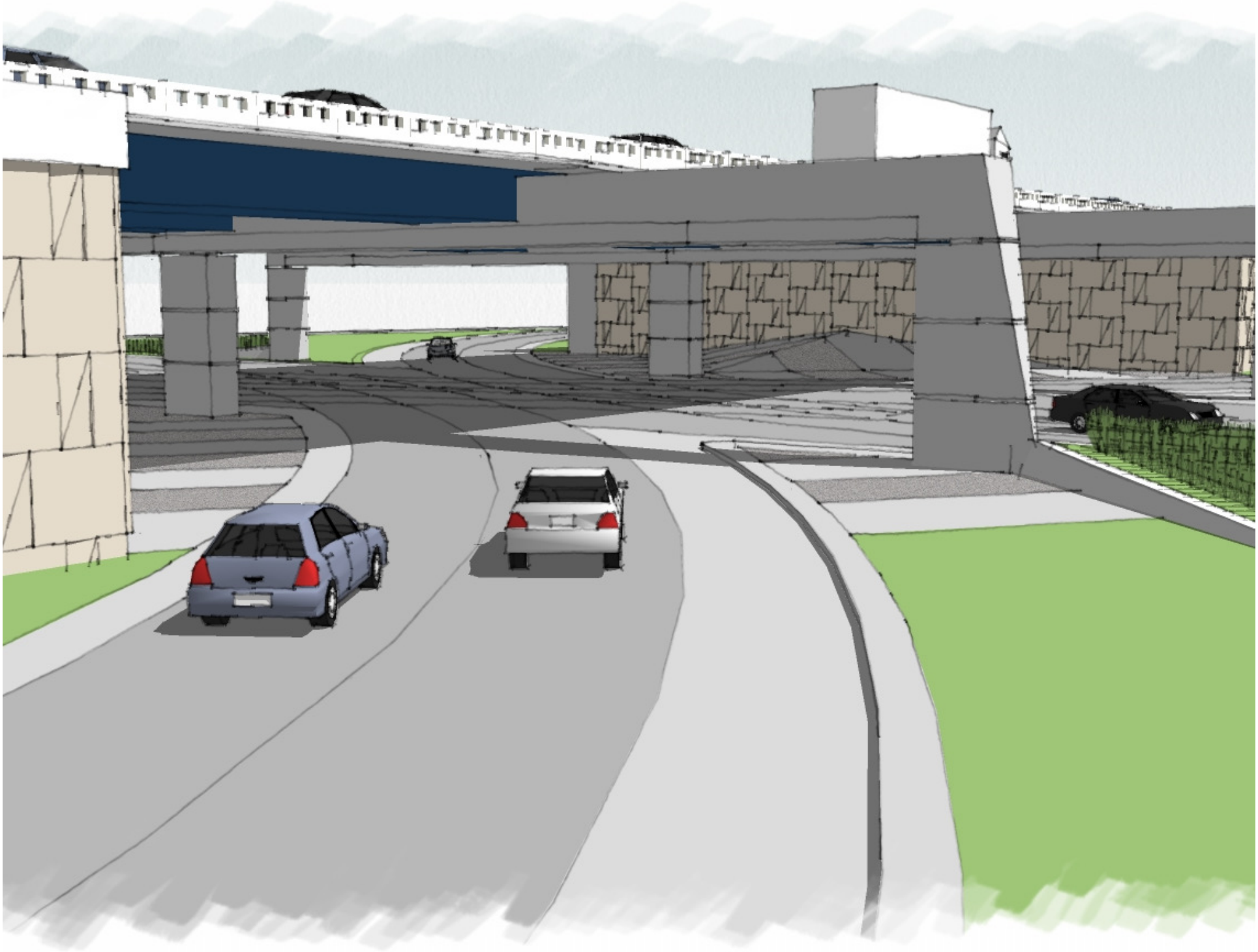
Front Street Enhancements

July 31, 2008

CONFLUENCE
410 DELAWARE • SUITE 400 • KANSAS CITY, MISSOURI 64106
TEL 816.631.7257 • FAX 816.631.7229 • THINKCONFLUENCE.COM



Front Street Enhancements

July 31, 2008

CONFLUENCE
410 DELAWARE • SUITE 400 • KANSAS CITY, MISSOURI 64106
TEL 816.531.7257 • FAX 816.531.7229 • THINKCONFLUENCE.COM