2016 Tulane Engineering Form

I-49 North, Segment K
(I-220 to Martin Luther King Drive)
Interchange Project

Durk Krone, P.E., TRC Engineers Inc., Baton Rouge, La
I-49 North Segment K Project

I-220 at Russell Road

Ramp EN

Ramp WN

Ramp SE

I-49 over MLK Drive

PHASE 2

PHASE 1
AGENDA

• PROJECT OVERVIEW
• BRIDGE DESIGN
• ARCHITECTURAL ENHANCEMENTS
• SPECIAL PROVISIONS
• COST ESTIMATE AND FINAL BIDS
• CONSTRUCTION
SITE LOCATION

ARKANSAS

185 MILES TO DALLAS, TX
I-49 NORTH CORRIDOR

SEGMENTS A – J
ALL UNDER CONSTRUCTION OR COMPLETED

SEGMENT K
PROJECT TEAM

PRIME CONSULTANT - BRIDGE DESIGN:
- COORDINATION WITH DOTD AND TEAM MEMBERS
- DEVELOPMENT OF DESIGN CRITERIA & QC/QA PLAN
- 5 DESIGN TEAMS
- DESIGN OF ALL STEEL BOX GIRDER BRIDGES
- DESIGN OF RAMP EN (SEGMENTAL) BRIDGE

PRIME CONSULTANT - ROADWAY DESIGN:
- DESIGN OF RAMPS SE, WN (SEGMENTAL)
- PEER REVIEW OF TRC’S BRIDGE DESIGN.

• INTERCHANGE BRIDGE AESTHETICS
• VISUAL QUALITY MANUAL
• DESIGN OF I-220 BRIDGE WIDENING
# PROJECT TIME LINE

## TIMELINE OF EVENTS

<table>
<thead>
<tr>
<th>DATE</th>
<th>EVENT</th>
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<tbody>
<tr>
<td>JUN 6, 2006</td>
<td>NTP FOR PRELIMINARY BRIDGE DESIGN</td>
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<tr>
<td>MAY 25, 2007</td>
<td>PROJECT PLACED ON-HOLD</td>
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<tr>
<td>JUL 7, 2011</td>
<td>DOTD, ASBI, TRC – DISCUSS POTENTIAL IMPLEMENTATION OF SEGMENTAL ALTERNATIVE</td>
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<td>JAN 5, 2012</td>
<td>DOTD/TRC STEPS TO MOVE INTO FINAL PLANS THAT INCLUDE IMPLEMENTATION OF SEGMENTAL BRIDGE DESIGN</td>
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<td>JAN 2, 2013</td>
<td>ADVANCED NTP ISSUED</td>
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<td>DEC 6, 2013</td>
<td>PHASE I PS&amp;E SUBMITTAL</td>
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<td>FEB 5, 2014</td>
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<td>FEB 14, 2014</td>
<td>PHASE II PS&amp;E SUBMITTAL</td>
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<td>PHASE II LETTING</td>
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CONSTRUCTION PHASES

PHASE I

• INTERCHANGE ROADWAYS
• I-49 BRIDGE OVER MLK DR. (4-SPAN PPC GIRDER)

PHASE II

• RAMP EN, SE & WN BRIDGES
• I-220 AT RUSSELL RD BRIDGE WIDENING
RAMP BRIDGES

• Ramp EN:
  • Length = 3,070’
  • Width = Varies 42.5’ to 64’
  • Curvature = 3,500’ Rad.
  • Max. Ht. = 80’ (3\textsuperscript{rd} Level)

• Ramp SE:
  • Length = 3,300’
  • Width = 35.5’
  • Curvature = 840’ Radius
  • Max. Ht. = 105’ (4\textsuperscript{th} Level)

• Ramp WN:
  • Length = 700’
  • Width = 31.5’
  • Curvature = 550’ Radius
  • Max. Ht. = 60’
BRIDGE DESIGN

DUAL DESIGN ALTERNATES

• POST-TENSIONED SEGMENTAL CONCRETE
• STEEL TRAPEZOIDAL BOX GIRDERS
BRIDGE DESIGN

PROJECT SPECIFIC QC/QA PLAN

• DEFINE ROLES AND RESPONSIBILITIES
• REQUIRED PROCEDURES FOR THE QC AND QA PROCESS
• ADHERANCE TO CAD STANDARDS
• INDEPENDENT PEER REVIEW

STANDARDIZE DESIGN METHODOLOGY

• COMPREHENSIVE DESIGN CRITERIA
• DESIGN DIRECTIVES – SOFTWARE & DESIGN APPROACH
BRIDGE DESIGN

SUBSTRUCTURE

• SIMILAR FOR EACH ALTERNATE
• MULTI-DRILLED SHAFT (66”Φ) FOOTINGS
• HAMMERHEAD BENTS
• STRADDLE BENTS
• CANTILEVER BENT

STRADDLE BENT

HAMMERHEAD BENT

CANTILEVER BENT
DESIGN METHODOLOGY & CONSTRUCTIBILITY:

- PRECAST SEGMENTAL
- BALANCED CANTILEVER ERECTION
- TEMPORARY SHORING
- ERECTION BY CRANES
- OFFSITE CASTING YARD
- ONE SET OF CASTING MACHINES FOR ALL SEGMENTS
DESIGN METHODOLOGY & CONSTRUCTIBILITY

- 732 SEGMENTS
- TYPICAL SEGMENT LENGTH +/-10’
  - SPLIT PIER SEGMENTS
- LINEAR HAUNCH AT PIERS
- TYPICAL SPAN LENGTHS:
  - +/-250’ INTERIOR SPANS
  - +/-160’ END SPANS
SEGMENT BOX DESIGN

- SAME CORE DIMENSION
- VARYING WING DIMENSION TO ACCOMMODATE DIFFERENT BRIDGE WIDTH

RAMP EN  50’-11” TO 42’-6”
RAMP SE  35’-6”
RAMP WN  31’-6”
BOX 20’-2”

TYPICAL SECTION
BRIDGE DESIGN - SEGMENTAL ALTERNATE

POST-TENSIONING SYSTEM

- TEMPORARY & PERMANENT PT BARS
- CANTILEVER TENDONS
- CONTINUITY TENDONS
- TRANSVERSE TENDONS

CONTINUITY TENDONS

CANTILEVER TENDONS

BALANCED CANTILEVER ERECTION
SUPERSTRUCTURE

- PRECAST SEG. CONTINUOUS UNITS ARRANGEMENT

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<td>803</td>
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<tr>
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<td>SE</td>
<td>8</td>
<td>1900</td>
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</tr>
<tr>
<td>SE</td>
<td>6</td>
<td>1400</td>
<td></td>
</tr>
<tr>
<td>WN</td>
<td>4</td>
<td>700</td>
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GENERAL ELEVATION VIEW OF RAMP EN BRIDGE
DESIGN METHODOLOGY

• BRIDGE GEOMETRY SIMILAR TO THE SEGMENTAL ALTERNATE
• TRAPEZOIDAL BOX GIRDERS WITH STANDARDIZED WEB SLOPE
• CONSTANT WEB HEIGHT PER BRIDGE
• SHOP PIECES LIMITED TO 130’ & 170 KIPS
• CROSS FRAMES DESIGNED AS PRIMARY MEMBERS
• AASHTO M270 Gr. 50 STEEL
• PERMANENT EXTERNAL CROSS FRAMES
BRIDGE DESIGN - STEEL ALTERNATE

SECTION A-A

EXTERNAL BRACING

INTERNAL BRACING

CL GIRDER 1

CL GIRDER 2

EXTERNAL BRACING

BRG BENT 1

BRG BENT 2

INTERNAL “K” BRACING (TYP)

TOP FLANGE LATERAL BRACING (TYP)

EXTERNAL BRACING (TYP)

TYP. SE FRAMING PLAN

SPLICE
ARCHITECTURAL ENHANCEMENTS

PIER DESIGN

• SHAPE AND COLOR
• DECORATIVE PANELS AND RUSTICATION

SEGMENTAL ALTERNATIVE  STEEL
ARCHITECTURAL ENHANCEMENTS

STRADDLE BENT AND C-BENT

STRADDLE BENT

C-BENT
ARCHITECTURAL ENHANCEMENTS

DECORATIVE PANELS

• ARTWORK SHOWN FOR REFERENCE ONLY

• FINAL ARTWORK TO BE DETERMINED THROUGH CALL-TO-ARTISTS AND PROVIDED TO THE CONTRACTOR TO FABRICATE
ARCHITECTURAL ENHANCEMENTS

LIGHTING

- COMMUNITY INVOLVEMENT
- COLOR CHANGING OPTION
ARCHITECTURAL ENHANCEMENTS – FROM CONCEPT TO CONSTRUCTION DOCUMENTS

- Agreement between City and State for the Incorporation of Aesthetics into the Interchange Design
- No Cost / Low Cost Aesthetic Methodology
  - Shape
  - Color
  - Lighting
- Engineer Produced Bid/Contract Documents
DESIGN CHALLENGES

ARCHITECTURAL ENHANCEMENTS – FROM CONCEPT TO CONSTRUCTION DOCUMENTS

- PIER SHAPE
- INITIAL SELECTION OF THEME
- DETERMINATION OF DIMENSIONS

Option 1 - Fluted Columns

The fluted Pier column vertical orientation in the face of the pier to accentuate the directionality of the pier. The vertical flutes also create contrast between the vertical shapes of the pier and the long elegant span of the superstructure.

Option 2 - Vertical Panels

A vertical pattern is created through the use of precast panels applied to the face of the pier. This approach creates a sense of roughness and adds textural contrast to the different design.

Option 3 - Individual Medallions

In this option, the pier is accentuated through the use of an individual design on the medallion. This approach integrates the use of a more detailed and specific image.

Option 4 - Sculptural Piers

The support system utilizes a unique and complex form to create visual contrast. The form of the pier changes throughout its length, reflecting the changing forces being applied to the structure.
DESIGN CHALLENGES

ARCHITECTURAL ENHANCEMENTS – FROM CONCEPT TO CONSTRUCTION DOCUMENTS

• LIGHTING
• SELECTION OF LIGHTING SYSTEM & LOCATIONS
• PHOTOMETRIC & GLARE ANALYSIS
ARCHITECTURAL ENHANCEMENTS – FROM CONCEPT TO CONSTRUCTION DOCUMENTS

- DECORATIVE PANELS
- CALL TO ARTISTS FOR SELECTION OF DESIGN
- PLANS SHOW LOCATIONS & CONCEPTUAL DETAILS
- SPECIAL PROVISION INDICATES QUALIFICATIONS, TYPE, ETC...
- VECTOR FILE PROVIDED TO THE CONTRACTOR
SPECIAL PROVISIONS

• A SIGNIFICANT EFFORT FOR SEGMENTAL ALTERNATIVE

• REVIEWED OTHER STATE DOT’S SPECIFICATION AND BEST-PRACTICES

• CONSULTED WITH ASBI & PTI, INCORPORATED LATEST TECHNOLOGY, SPECIFICATION AND PUBLICATIONS

• USED NON-STANDARD PAY ITEMS:
  • PRECAST SEGMENTAL SUPERSTRUCTURE BY LN. FOOT
  • POST-TENSIONING STEEL BY LBS.
COST ESTIMATE AND FINAL BIDS

FINAL BID RESULTS-PHASE I
- LETTING DATE: 2/5/2014, WINNING BID: $33.2M

<table>
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<tr>
<th>RANK</th>
<th>BID ALTERNATIVE</th>
<th>BID</th>
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<tr>
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<td>3</td>
<td>STEEL</td>
<td>$154.2M</td>
<td>$129.4M</td>
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<td>SEGMENTAL</td>
<td>$159.1M</td>
<td>$135.9M</td>
<td>17.1%</td>
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FINAL BID RESULTS-PHASE II
- LETTING DATE: 4/30/2014
- FINAL BIDS

• TOTAL PROJECT BID COST: $ 171 M
CONSTRUCTION

SUBMITTALS

• TYPES
  • RFI's
  • SHOP DRAWINGS:
    • SEGMENT DRAWINGS FOR PRECAST SUPERSTRUCTURE (PIER, HAUNCHED, TYPICAL, EXPANSION & CLOSURE)
    • DISC BEARING ASSEMBLIES
    • EXPANSION JOINTS
    • DECK DRAINAGE
    • DECORATIVE PANELS
  • TEMPORARY WORKS:
    • LIFTING BEAMS,
    • STRONGBACKS/CLOSURE BEAMS,
    • STRESSING/ACCESS PLATFORMS,
    • SHORING TOWERS FOR BALANCE CANTILEVER SUPERSTRUCTURE/STRADDLE BENTS/RAMP EN SPAN 1 CIP SPAN,
    • FORMWORK FOR HAMMERHEAD, CANTILEVER AND STRADDLE BENTS, RAMP EN SPAN 1 CIP SPAN AND SEGMENTAL SUPERSTRUCTURE CLOSURE POURS
  • CONSTRUCTION ANALYSIS:
    • LONGITUDINAL CONSTRUCTION ANALYSIS – CONTRACTOR’S SCHEDULE, MEANS AND METHODS AND SEQUENCE WITH RESULTING COMPUTER MODELS TO DETERMINE CAMBER
    • TRANSVERSE CONSTRUCTION ANALYSIS – CALCULATIONS SUPPORTING CONTRACTOR’S MEANS AND METHODS FOR TEMPORARY WORKS, JACKING, TIE-DOWNS, ETC...
  • POST-TENSIONING:
    • POST-TENSIONING SYSTEM DRAWINGS
    • POST-TENSIONING LAYOUT DRAWINGS FOR SEGMENTAL SUPERSTRUCTURE, RAMP EN SPAN 1, STRADDLE BENTS
    • TENDON ELONGATIONS/STRESSING DATA (LONGITUDINAL AND TRANSVERSE)
    • POST-TENSIONING PLAN/MANUAL
    • FRICTION AND WOBBLE TEST DATA
  • CASTING YARD SUBMITTALS (PER SPECIAL PROVISIONS) – INCLUDES DETAILS OF SEGMENT CASTING FORMS AND CELLS
  • GEOMETRY CONTROL:
    • CASTING MANUAL (SEE ATTACHED EXCERPT FROM SPECIAL PROVISIONS)
    • UNCAMBERED & CAMBERED SEGMENT GEOMETRY
    • AS-CAST SEGMENT GEOMETRY AND CORRECTIONS
    • AS-ERECTED SEGMENT GEOMETRY AND CORRECTIONS
  • ERECTION MANUAL (SEE ATTACHED EXCERPT FROM SPECIAL PROVISIONS)
  • FULL SCALE GROUTING MOCK-UP PLAN
  • GROUTING OPERATIONS MANUAL/PLAN
  • JACKING PLAN FOR FUTURE BEARING REPLACEMENT
  • MATERIAL, VENDOR & PERSONNEL QUALIFICATIONS
  • ELECTRICAL/LIGHTING: SHOP DRAWINGS, EQUIPMENT SUBMITTALS AND O&M MANUALS
  • ETC...

• TRACKING & DOCUMENTATION
CONSTRUCTION

VALUE ENGINEERING PROPOSALS

• CONTRACTOR PROPOSAL FOR REPLACEMENT OF 60 KSI REINFORCEMENT WITH 75 KSI

• REPLACE RAMP WN BRIDGE WITH FILL

• RE-GRADING POND AND RAISE FOOTINGS AT EN & WN
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION

GROUTING MOCK-UP

• SPECIAL PROVISIONS REQUIRED THE GROUTING MOCK-UP OF AN ENTIRE CONTINUITY TENDON

• RAMP EN TENDON D1-1 (400’ LENGTH, 13’ HEIGHT)
CONSTRUCTION
CONSTRUCTION

RAMP SE – BENT 2
CONSTRUCTION

• RAMP SE – BENT 2
CONSTRUCTION
Construction

Decorative Panels
CONSTRUCTION

• RAMP SE
CONSTRUCTION
CONSTRUCTION
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