

I-355 Design-Build



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Introduction

◆ Purpose & Need

- Provide Regional Connection
- Reduce Travel Times
- Protect Local Endangered Species



Introduction (cont'd)

◆ History

- 1989 – Study of Southern Extension
- 1995 – Discovery of Hine's Emerald Dragonfly – Project Delayed
- 2002 – FHWA issued Record of Decision
- 2004 – Land Acquisition & Utility Relocation
- 2006 – Construction of Bridge

Introduction (cont'd)

◆ Location / Owner

- Bolingbrook, Illinois
- Illinois State Toll Highway Authority



Introduction (cont'd)

- ◆ Centerpiece of New 14 mile I-355 Extension
 - 1.3 Miles Long
 - 125 feet Wide
 - Six Travel Lanes
 - \$125 Million of \$730 Million Extension Cost
 - Largest of 18 Contracts Let for Corridor

Project Scope

- ◆ Construction of 6600 ft long bridge
 - Per Plan Steel Structure
 - Per Plan Concrete Segmental Box
 - Design-Build Alternate
 - ◆ Given Design Constraints

Project Scope (cont'd)

◆ Wetland / Environmental Constraints

- Restoration of Wetlands
- Limited Area of Disruption to Wetlands
- Provide Access for Crossing of Wildlife



Project Scope (cont'd)

◆ Geometrics

- 3 – 12' Lanes Each Direction (NB & SB)
 - ◆ 12' Median and Outside Shoulders (NB & SB)



Project Scope (cont'd)

- ◆ Design Constraints
 - Number and location of Piers
 - No alteration of Profile Grade
 - Maximum Structure Depth



Bid Alternatives

- ◆ As-Designed Steel
 - 80" Deep Plate Girder
 - 12 Delta Frame Piers
- ◆ As-Designed Concrete Segmental Box
 - 11' Deep Post-Tensioned Box
- ◆ Design-Build
 - Complete Design & Construction of Alternate Structure

Design-Build Alternates

◆ Prestressed & Post-Tensioned Concrete Bulb-Tees

- 8 Units – 35 Spans
- 102" Deep Post-Tensioned Bulb Tees
- PT Beams Haunched to 120" on Main Spans
- 90" Prestressed Beams
- Post-Tensioned Spans Ranged 216' to 271'
- Prestressed Spans Ranged 114' to 170'

Design-Build Alternates (cont'd)

◆ Steel Plate Girders / Prestressed Beams

- 8 Units – 35 Spans
- 96" Deep Plate Girder (17 Spans – 6 Lines)
- 90" Prestressed Beams (18 Spans – 7 Lines)
- Utilized HPS Grade 70W and Grade 50W
- Steel Spans Ranged 215' to 268'
- Prestressed Spans Ranged 140' to 170'

Design-Build Alternates (cont'd)

- ◆ Low Bid Award Based on Concrete Alternate
 - \$8 Million Savings from As-Designed Plans
 - Bid Price also Included Design Fees
 - Contract Days not Extended for Design Lead Time

Concrete Bulb-Tee Alternate



- ◆ Total Bridge Length = 6,593 ft
 - Divided into 8 Units (4 Prestressed Beams, 4 Post-Tensioned Beams)
 - Piers – Drilled Shafts / Columns Supporting Post-Tensioned Cap

Substructure

◆ Piers

- 6'-6" Diameter Caisson
- 6'-0" Diameter Column
- Maximum Height = 70'-0"
- 4000 psi Concrete



Substructure

◆ Pier Caps

- 6'-6" Wide
- 7'-0" Max. Depth
- 125'-0" Long
- Post-Tensioned (Multi-Staged)
- 3 or 4 Tendons (19-0.6" Strands)
- 5000 psi Concrete



Superstructure

◆ Units 1-3 & 8

- 90" Prestressed Beams
- 0.6" Prestressing Strand
- Varied in Length from 114' to 170'
- 7000 psi Concrete
- No Concrete Diaphragms



Superstructure

◆ Units 4-7

- 102" Prestressed Beams
- 120" Haunched Beams
- 4 Tendons (15 - 0.6" Strand)
- Pieces Varied in Length from 113' to 150'
- 7500 psi & 8000 psi Concrete
- Falsework Required

Superstructure



Segmental Construction

Superstructure



Post-Tensioned Splice

Superstructure

◆ Deck

- High Performance Concrete
- 4000 psi
- SIP Metal Deck Forms
- FWS = 31 psf



Site Challenges

- ◆ Environmental
- ◆ Other

Environmental Challenges

- ◆ Construction Wetland Disturbance
- ◆ Permanent Wetland Disturbance
- ◆ Endangered Species



Other Challenges

- ◆ Railroads
- ◆ River
- ◆ Canals
- ◆ County Roads



Final Plan Development

- ◆ Design Quality Management Plan
- ◆ Staged Submittals
- ◆ Schedule
- ◆ Constructability Review
- ◆ Shop Drawing Review & Approval

Design Quality Management Plan

- ◆ Submitted and Approved Prior to Authority Reviewing any Design Submittals
- ◆ Independent Check Required
- ◆ Marked up QC plans submitted with Each Design Submittal
- ◆ Frequently Audited

Staged Submittals

- ◆ Design / Plans Submitted in 6 Elements
 - Prestressed Beams
 - Piers 1 – 14
 - Post-Tensioned Beams
 - Piers 15 – 34 & Abutments
 - Deck
 - Site Plan & Erection Scheme

Schedule

- ◆ Preliminary Schedule Submitted with Design-Build Bid Proposal
- ◆ Coordinated Design Elements with Contractor's Schedule
- ◆ Accelerated Design Schedule due to Nature of Design-Build Process

Constructability Review

- ◆ Preliminary drawings were reviewed by Walsh field personnel and modified to our strengths.
- ◆ Preliminary beam drawings were reviewed by precast supplier to their strengths

Shop Drawing Review & Approval

- ◆ Contractor's Engineer Responsible for Review and Approval of all Shop Drawings
- ◆ Shop Drawings Prepared for
 - Precast Beams
 - Bearings
 - Modular Joints
 - Falsework

Construction

- ◆ Video
- ◆ Staging
- ◆ Caissons
- ◆ Pier Columns & Caps
- ◆ Prestressed Beams
- ◆ Post-Tensioned Beams
- ◆ Deck Pour

Video



Staging

◆ Wetland Mitigation

- Excavation
- Temporary Rock Fill

◆ Beam Erection Dictated Access Roads

◆ Beam Fabrication

◆ Abutment Fill

Wetland Mitigation



Caissons

- ◆ Additional Geotechnical Investigation
- ◆ Establishment of competent rock
- ◆ Dewatering / Tremie of shafts

Caissons



Pier Columns & Caps

- ◆ Uniform Column Construction
- ◆ Post-Tensioned Pier Caps
- ◆ Substructure Reinforcement – 2.8 million pounds
- ◆ 325,000 lbs Post-Tensioning

Pier Columns & Caps



Prestressed Beams

- ◆ Ranged in length from 105 lf to 170 lf
- ◆ Weighed 125,000 lbs to 225,000 lbs
- ◆ Shipped by truck

Prestressed Beams



Post-Tensioned Beams

- ◆ Ranged in length from 90 lf to 135 lf
- ◆ Weighed 175,000 lbs to 250,000 lbs
- ◆ Shipped by truck
- ◆ Haunched Girders
- ◆ Two Phased Post-Tensioning
- ◆ 2.4 million lbs Post-Tensioning

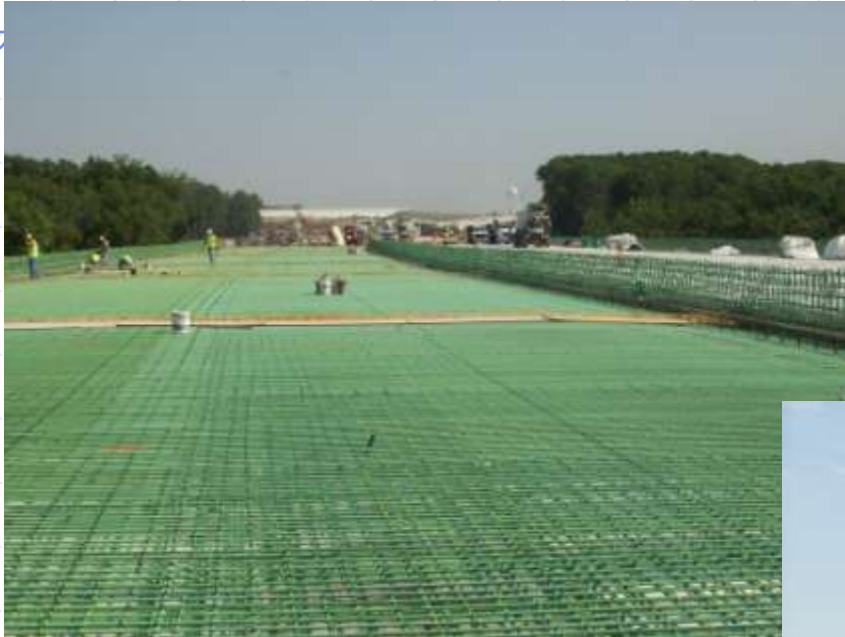
Post Tensioned Beams



Deck Pour

- ◆ Staged Pour Sequence
- ◆ Typical Pour - 600 cubic yards per day
- ◆ Stay-In-Place Forms (412,000 sq. ft.)
- ◆ 27,448 cubic yards of deck concrete
- ◆ Superstructure Reinforcement – 6.4 million pounds

Deck Pours



Design-Build Benefits

- ◆ Cost Savings
- ◆ Ability to change design during construction
- ◆ Means & Methods Savings
- ◆ Value Engineering

Cost Savings

- ◆ \$8 million savings over Owner's Design
 - Engineering Fees included
- ◆ Pier Caps
- ◆ Strand changed from 0.5" to 0.6" dia.
In Prestressed Beams
- ◆ Replacement of Spread Footings with
Drilled Shafts

Ability to change design during construction

- ◆ Location of Construction Joints
- ◆ Changed Pier Cap Width for Uniformity
- ◆ Steel Mesh Alternate for Precast Beams
- ◆ Steel Diaphragm Configuration

Means & Methods Savings

- ◆ Modification of beams to facilitate erection & transportation
- ◆ Shoring towers
- ◆ Change of Stressing Sequence
- ◆ Engineering analysis of equipment placement

Value Engineering

◆ Slip Form of Parapets

Lessons Learned

◆ Caissons

- Pre-Bid Additional Geotechnical Information
- Individual Design

◆ Pier Caps

- Eliminate Staged Post-Tensioning

◆ Communication

◆ Formalize Submittal / RFI Process in Design-Build Team



Questions?