Tennessee DOT’s Fast Fix 8 Project in Downtown Nashville

Wayne Seger, P.E., TDOT Director of Structures
Lia Obaid, P.E., TDOT Asst. Director Construction
Ted Kniazewycz, P.E. PM - Gresham, Smith & Partners
Project Overview

- Project Introduction
- Procurement
- Design Elements
- Looking Ahead
Project Overview
I-40 Bridges Before Rehabilitation

Charlotte Avenue (65% Bad Deck)  
Jo Johnston Avenue (56% Bad Deck)
Previous ABC in Tennessee

Rural Smith County, TN  2009
Superstructure Replacement
Prestressed Box Beams &
Full Depth Deck Panels

I-24 in Nashville, TN  2012
Deck Replacement
Full Depth Deck Panels
Weekend Closures
Previous ABC in Tennessee

Nashville, TN  2013
Superstructure Replacement
Steel Beams &
Cast-In-Place Deck
Weekend Closure

Sumner County, TN  2015
Superstructure Replacement
Two Options - Contractor Choice
Downtown Traffic  +130,000 ADT
Why consider ABC on Fast Fix 8 Project

• High Traffic Demands
  • Major Interstate Routes (I-40 E/W & I-65 N/S)
  • Urban Collector Routes

• Industry and Hospital Access
  • Main access to downtown & mid-town
  • CBD / Universities / Medical Campuses

• Limited Construction Window
  • Weekend only lane closures
  • Numerous weekend activities to coordinate / avoid

• General Site Location suited ABC
  • Frontage roads limited access
  • Limited space for laydown yards at bridge sites
Definition of CM/GC

“A project delivery system that entails a commitment by the construction manager to deliver the project within a guaranteed maximum price (GMP), in most cases. The construction manager acts as consultant to the owner in the development and design phases and as the equivalent of a general contractor during the construction phase.” (Leahy et al. Transportation Research Circular E-C137, TRB, 2009).
What is CM/GC?

- Construction Manager/General Contractor (CM/GC) is a project delivery method.
- It is the middle ground between DB and DBB.
- With this project delivery method, the owner usually selects a construction management firm early in the design process (a best-value basis).
- The CM provides input regarding scheduling, pricing, phasing and other input that helps the owner design a more constructible project.
- At approximately 90 percent design completion, the owner and the CM agree on a "guaranteed maximum price" for the construction of the project. If the negotiations are successful, the construction manager becomes the general contractor. If they are not able to negotiate an acceptable price, the owner has the option of completing the design and letting a traditional bid-build contract for construction.
Legislative Action

- Changes to Tennessee Code Annotated § 54-1-501 through § 54-1-508- Construction Manager/General Contractor allows the Department authority to use CM/GC.

- This is a PILOT PROGRAM consisting of three projects with a total aggregate of $200 million in construction costs.

- The first CM/GC project shall not exceed seventy million dollars ($70,000,000) in construction costs, and not one CM/GC project shall exceed one hundred million dollars ($100,000,000) in construction costs. The department shall not initiate any other project using the CM/GC method until after a contract for construction of the first CM/GC project has been awarded.

- The program SUNSETS after five years and is effective July 1, 2014 to July 1, 2019.
Rule Promulgation

Key TDOT Positions

• Oversight Committee
• Alternative Contracting Manager/ PM
• Selection Committee
• Technical Project Committee
CM/GC Project Candidate

- Opportunity to explore innovation or technology
- Opportunities for value engineering
- Third party concerns must be settled early in process

Selected Project

Fast Fix 8
Accelerated Bridge Construction Project
Davidson County, Nashville
Fast Fix 8 Project Objectives

- Rehabilitate with Accelerated Construction Methods with Weekend Closures Only
- All lanes must be operational during work week (Monday thru Friday)
- Value lane closures (Working road and multiple bridges together)
- Reduce the number of weekend closures
- Close I-40 for safety and efficiency
Why CMGC with ABC on Fast Fix 8 Project

• TDOT determined ABC would be used in order to minimize construction impacts to the traveling public.
• CM/GC delivery process was used in order to maximize design and construction efficiency.
• Existing condition of the structures necessitated the need for accelerated project delivery.
• CM/GC with ABC is a great approach because it provided the flexibility to better manage risk, dealing with uncertainty, and allowed contractor input very early on in the planning and design.
Why CMGC with ABC on Fast Fix 8 Project

- With the innovative construction method and time constraints CM/GC was the best to be used in order to obtain final project acceptance no later than June 2016 (Actual Completion December 2015)
- Early contractor involvement
- Constant input on schedule and cost
- Opportunities to manage costs risks through CM/GC involvement
- Flexibility (Early Action Items)
- Design to contractors strengths
Fast Fix 8 Project Project Goals

- Minimize inconvenience to the traveling public and maximize safety of workers and the travelling public.
- Facilitate a collaborative partnership with all of the members of the project team and the stakeholders.
- Provide high quality design and construction.
- Shorten the delivery time at least two years.
Fast Fix 8 Project Project Goals

- Replace the existing poor bridge structures and improve traffic operations and safety within the project budget.
- Advance the knowledge, experience and cost efficiency of the TDOT construction program and the construction industry in Accelerated Bridge Construction and CM/GC project delivery.
- Provide a well-publicized, highly successful Accelerated Bridge Construction (ABC) project.
Pre-Construction Activities

• CM/GC utilizes a Project Team consisting of 3 components:
  • Owner (TDOT)
  • Designer - Gresham, Smith and Partners (GS&P) who is under contract with the Owner
  • Construction Manager / General Contractor (two-phase contract) Kiewit Infrastructure South Co. (KISC) who is under contract with the Owner
Pre-Construction Activities

• Construction Milestones
  • CM/GC Process Kick-Off 10-22-2014
  • ROM Pricing for All Options per Bridge Site Presented 11-7-2014
  • Preliminary Estimates 12/30/2014
  • GMP Estimate for all sites by 2/15/2015

• Construction Limitations
  • 13 Weekends (maximum) Available beginning 5/1/2015
  • Certain Weekends Not Allowed due to Major Community Events
  • 6/15/2016 Deadline for Substantial Completion
Pre-Construction Activities

• Primary Project Evaluation Factors
  • Budget
  • Schedule

• Project Limitations
  • Maintain Railroad Operations
  • Maintain Work-Week Traffic
  • Coordinate Local Access During Closures

• Project Types Considered
  • Structural Steel Superstructure Units
  • Full Depth Deck Panels
  • Lateral Bridge Slide
  • SPMT Bridge Move
  • Bridge Reconfiguration
Four pairs of bridges were included in the project
One weekend closure per bridge
Combinations of the various methods for best solution
Summary information on three bridge sites
Detailed discussion of Charlotte Avenue Bridge
Herman Street Highlights

- Superstructure Replaced with Structural Steel Superstructure Units
  - 16 Units set per weekend (more than any previous weekend project)
  - Units were longer, wider & heavier than previous projects
  - Link Slab used for Live Load Continuity

Tri-Star Detail added to bridge rails
Herman Street Highlights

Deck was sheared from the top and beams were removed from the ground.

Existing bearings were removed and new anchor bolts were placed prior to superstructure installation.
Herman Street Highlights

16 Deck units in place awaiting closure pours.

Bolsters were fabricated for each beam to allow for increasing the deck cross-slope.

Link slab with relief cut over bent. No cracking was noted after first week of in-service use.
Clinton / CSXT Highlights

- Six span bridge replaced with two single span structures
  - Retaining walls used to eliminate end spans and two interior spans
  - Pre-weekend work did not impact interstate traffic
  - Replacement structures used prestressed beams and full depth deck panels
Clinton / CSXT Highlights

Wall facing CSXT ROW were required to be cast-in-place concrete

Slab had to be cut and removed in pieces as no debris was allowed on CSXT ROW.

MSE Walls were used for all other wall segments.

Contractor was able to get fill placed to bottom of and between beams prior to weekend demolition with specialized equipment.
Clinton / CSXT Highlights

CSXT requirements for demolition and reconstruction along with 26 trains during the weekend added 8 hours to the project schedule.

Median and cantilever sections were cast-in-place after the weekend to allow for placement of barrier reinforcing and lighting conduit.

Work at these two bridge sites were independent operations with separate crews, equipment and work plans due to the constraints associated with maintaining railroad operations.
Jo Johnston Highlights

• Three span bridge replaced with single span structure
  • Retaining walls used to eliminate end spans
  • Pre-weekend work did not impact interstate traffic
  • Replacement structures used prestressed beams and full depth deck panels
Jo Johnston Highlights

- Bridge components included prestressed box beams, prestressed full depth deck panels and precast end walls.

Precast end walls were installed on the existing bents and the placement of the deck panels completed the superstructure.
Bridge approach slabs were also precast and supported by geosynthetic reinforced soil backfill.

Fine grading was completed on the GRS backfill and then the precast approach slabs were installed.
Charlotte Avenue Highlights

- Structure Replacement with Single Span Steel Structure
  - Construct New Abutments Between “K-Frame” and Existing Abutment
  - Eliminate End Spans 1 & 3
  - Use Steel Superstructure Units to Replace Existing Bridge
  - Use MSE walls to Contain New Roadway Fill
  - Spray Membrane Deck Seal & Asphalt Overlay
Charlotte Avenue Highlights

Temporary Soil Nail Wall

Excavation Adjacent to Thrust Blocks to Solid Bedrock.
Charlotte Avenue Highlights

Leveling Concrete

Isolated Footings
Charlotte Avenue Highlights

Wall Constructed Between old and new supports

Strip Footing for MSE Block Wall
Charlotte Avenue Highlights

Cap Easily Constructed from Wall Fill Elevation.

Gap Between Existing Beams and New Bent Cap as Small as 1”
Charlotte Avenue Highlights
All cross-frames were installed and block-outs were formed for the closure pours. The deck was cast full width with a screed.

The “Bridge Farm” was a Two Acre Laydown Yard Located in the Median of I-40 within the Weekend Closure Limits of the Project.
Charlotte Avenue Highlights

Supplemental reinforcing was used around the pick device block-outs. The contractor used heavy WT sections bolted to the top flanges for the lifting devices.

Plywood block-outs were used to create a void for the closure pours between the units.

Metal deck panels were used between all bays of the bridge. Styrofoam was used to fill the flutes of the forms to lessen the weight of the units.
Since metal decking was also used in the bays between units, the contractor cut the panels from the bottom after the deck was cast to allow the units to be separated. The panels will act as the form for the closure pour.

Simple window screen was placed over the saw cut gap in the closure pour strips which prevents the cement paste from leaking through the gap.
Charlotte Avenue Highlights

Deck was demolished with impact hammers from the top of the bridge.

Beams were cut into manageable sized pieces and processed from the ground.
Charlotte Avenue Highlights

- Metal decking in-place for closure pour form
- Diaphragms attached to bridge to speed up installation.
- Bearings vulcanized to steel plate sized for needed cross slope adjustment.
Charlotte Avenue Highlights

For the first phase of construction, the superstructure units needed to cross onto the remaining portion of the existing bridge. Special spreader beams were required on the SPMT’s to distribute the unit weight such that the existing bridge would not be overloaded.
Since the units were match-cast, the rebar and cross-frames join together without conflict allowing for quick placement of the five units.
Charlotte Avenue Highlights

Closure pour reinforcing includes overlapping bars and longitudinal lacing bars to provide a robust mechanical joint. The edges of the unit slabs were chemically roughened to aid in the bond strength.

The screen placed over the cut line in the forms was easily placed from the top of the deck.
Charlotte Avenue Highlights

The original design had the end walls cast into the superstructure units. These were redesigned to separate Precast pieces to lessen the lift and transport weights of the units – saving some 45,000 pounds.
Charlotte Avenue Highlights

The end wall blocks are pinned to the abutment cap and the approach slabs will be pinned to the end walls. A closure pour ties the superstructure unit to the end wall units.
Charlotte Avenue Highlights

Two feet of reinforced backfill was placed under the approach slab zone in lieu of using a concrete sleeper slab. Once the fill was in-place and compacted, the precast slab sections were installed and joined together using the same detail used between the superstructure units.
Charlotte Avenue Highlights

Closure pour connecting the end blocks with the deck units and precast approach slabs.
Charlotte Avenue Highlights

One of the outcomes of the project was a new concrete mix (TDOT Class X) that meets the required project performance requirements with the bonus of being batched from a plant, delivered by truck and reaching 4000 psi in 4 hours with exceptional shrinkage and bond strength characteristics.
Charlotte Avenue Highlights

First use of spray applied membrane by TDOT.
Lessons Learned

• Early Coordination and Community Outreach
• Communication between owner, designer, and contractor is imperative all of the way through the project.
• Set the maximum allowable construction and traffic lane closure times at the beginning of the project planning and stick to it.
• Work operations were improved from weekend to weekend by observations and time studies.
• Keep the door of innovation open during the planning and design phases.
Looking Forward

• Next CM/GC Opportunity with ABC
• TDOT’s ABC Philosophy
• Future Projects Urban & Rural
Questions