Downtown Nashville Full Depth Deck Panels for Accelerated Construction

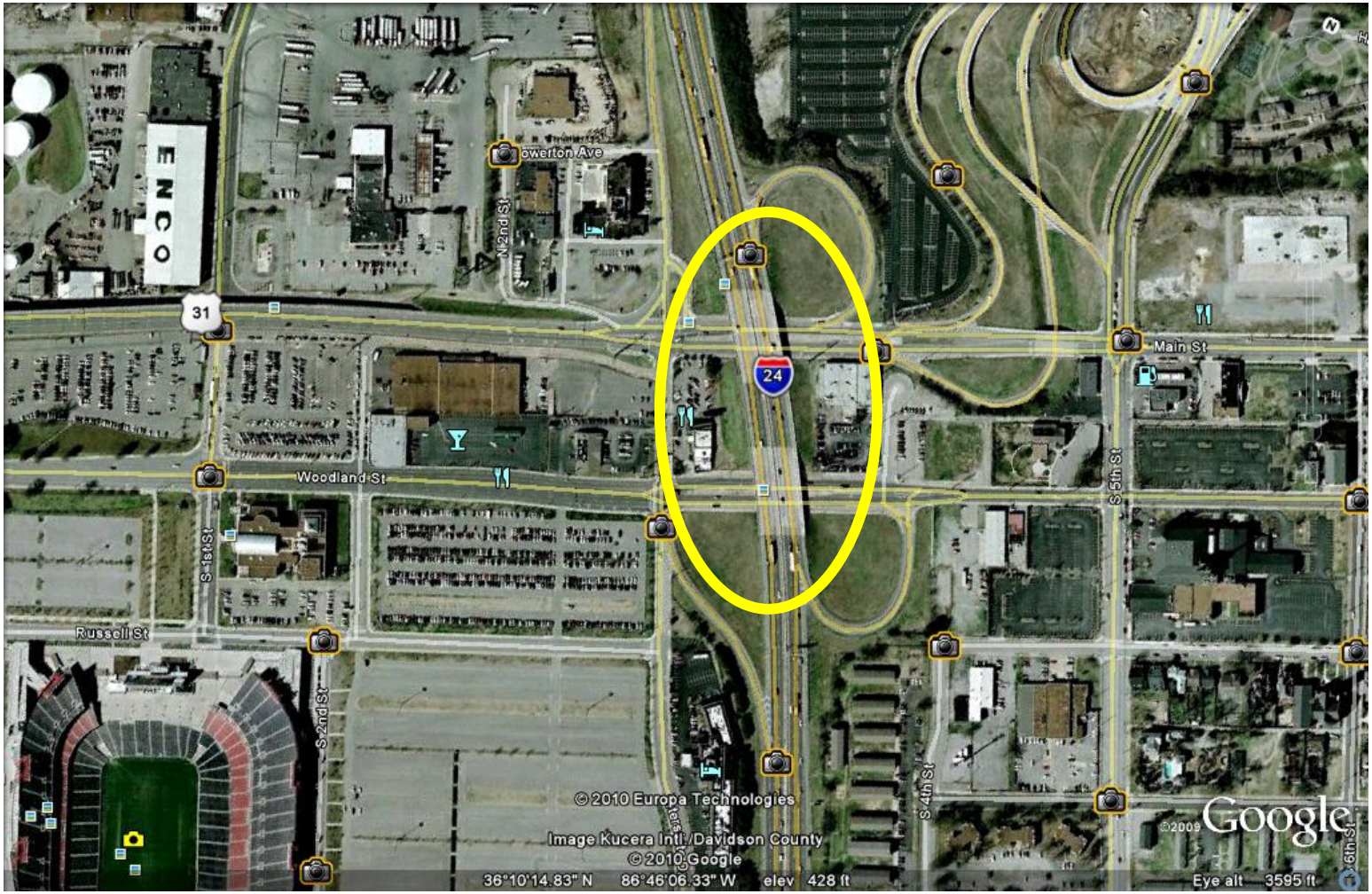
Presented by:

Terry Mackie of TDOT

February 28th, 2013

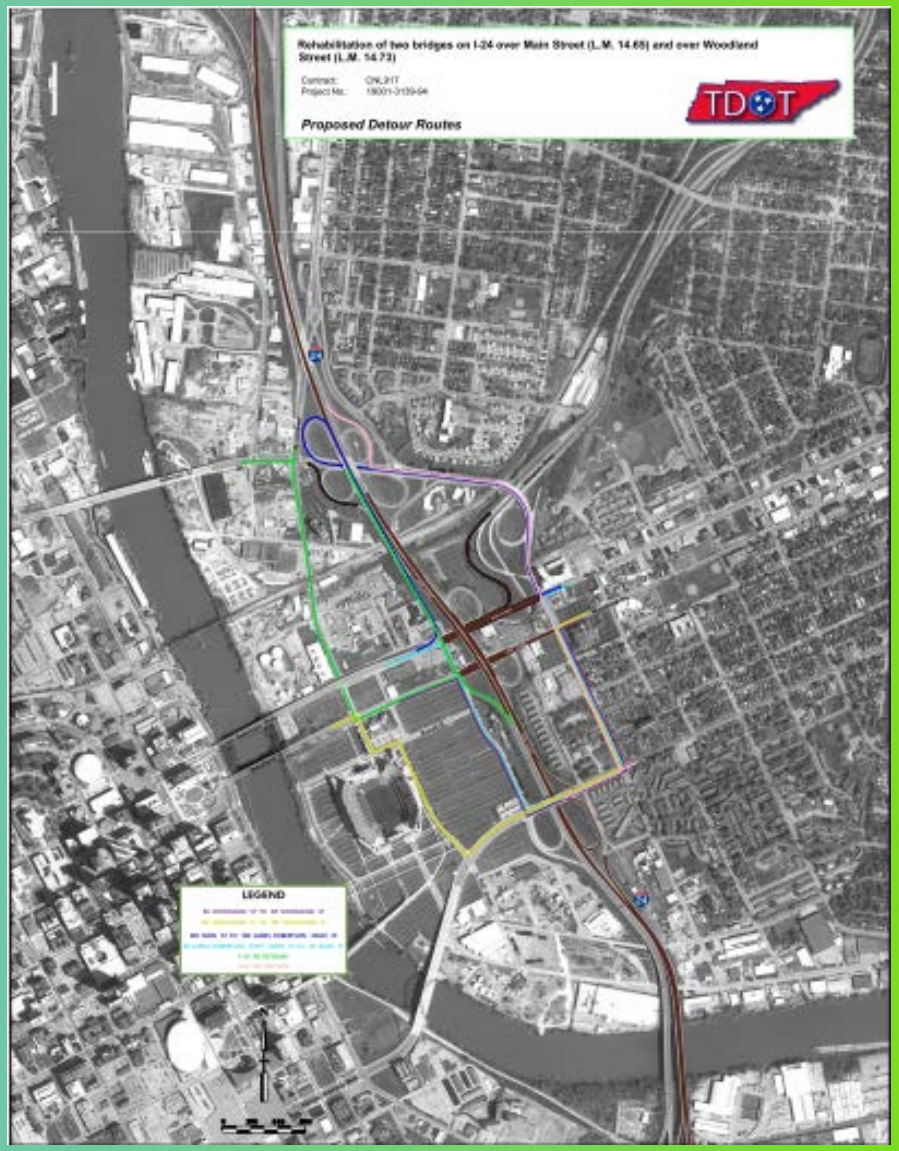
Project History

Downtown Bridge Location



Downtown Traffic -140,000 ADT

Weekend Closures/Detours



Patching By TDOT's Maintenance

Existing Bridge Deck Deterioration

Test Bridge Deck Replacement Objectives

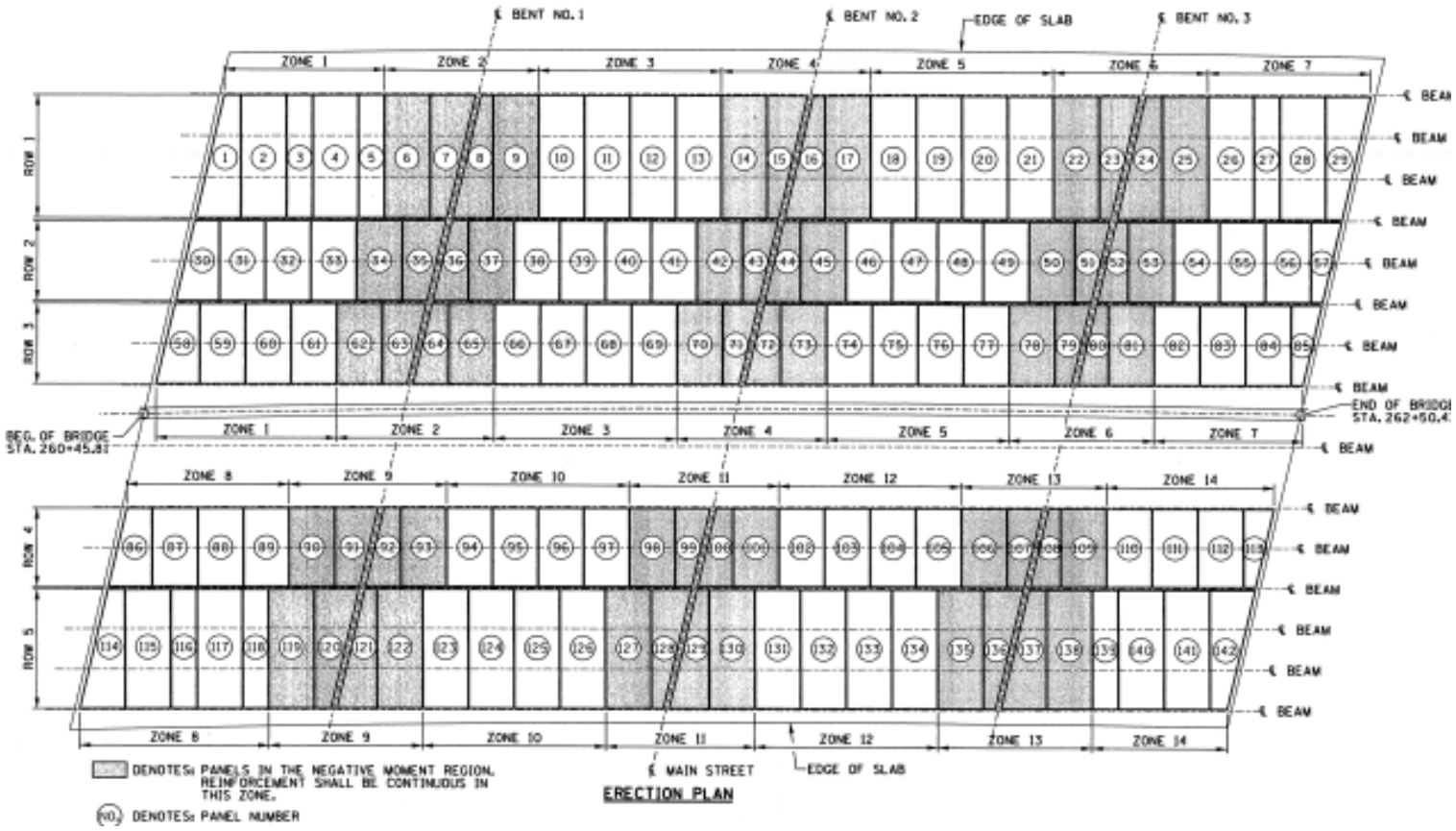
- Simulate the construction process that will be used for the downtown bridge deck replacement project
- Use closed full depth deck panels on one half of the bridge and open panels on the other half
- Use shims plates for adjusting panel elevations prior to grouting operation
- Gauge/Record how much time it takes for each task (contract time)
- Gain more experience with grouts used in closure pour areas
- Asphalt Overlay with waterproofing membrane

Design Objectives, Concepts and Details

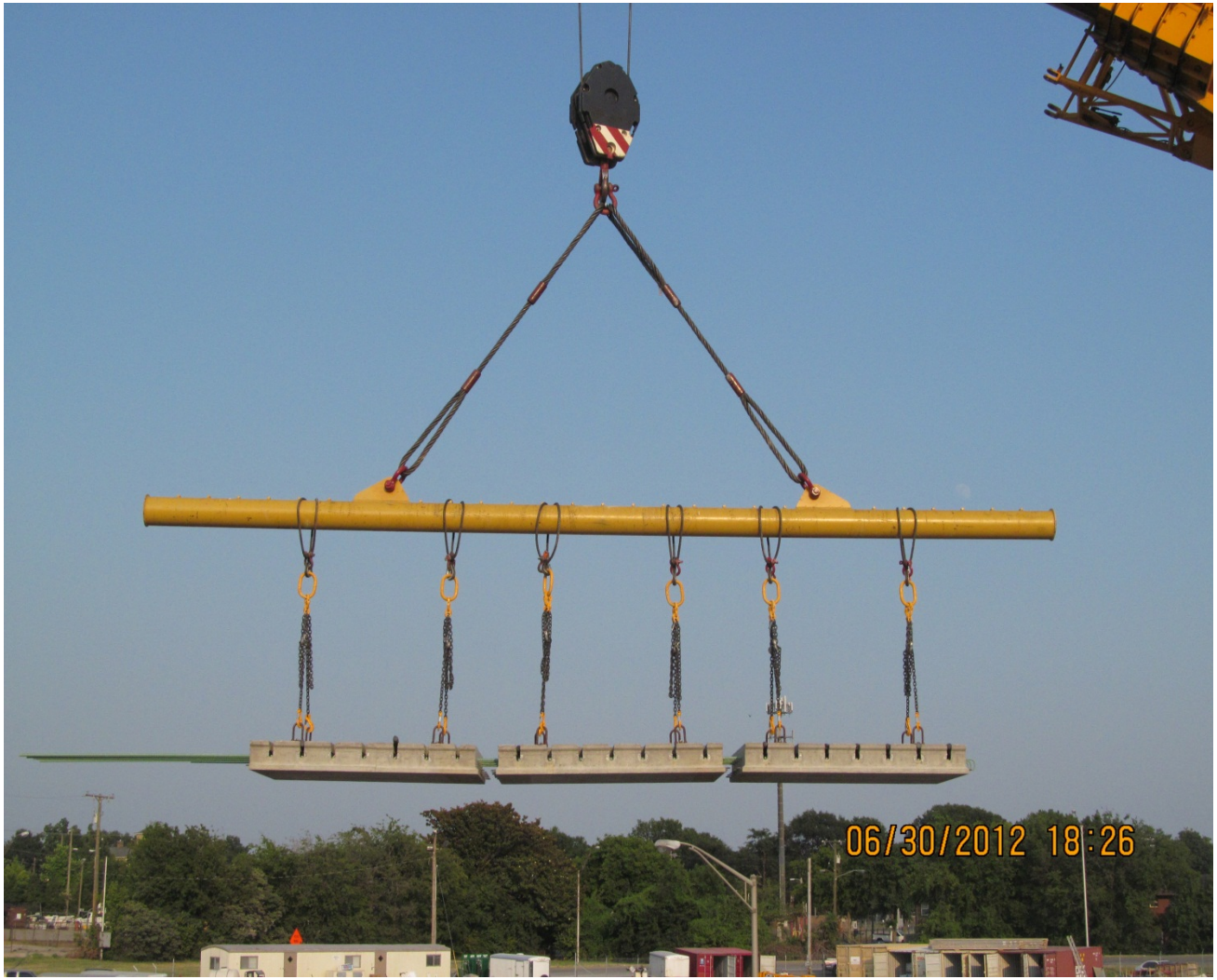
Downtown Deck Replacement Objectives

- Replace with full depth panels on weekends
- All lanes must be operational during work week- (Monday thru Friday)
- Value lane closures (work on several bridges)
- Gauge/Record how much time it takes for each task for future projects
- Use prestressed panels for quality (minimize cracks)
- Deck continuity (similar reinforcing steel as conventional decks)
- Simplify connections and minimize the number of connections
- Close I-24 for safety and efficiency

I-24 Panel Layout



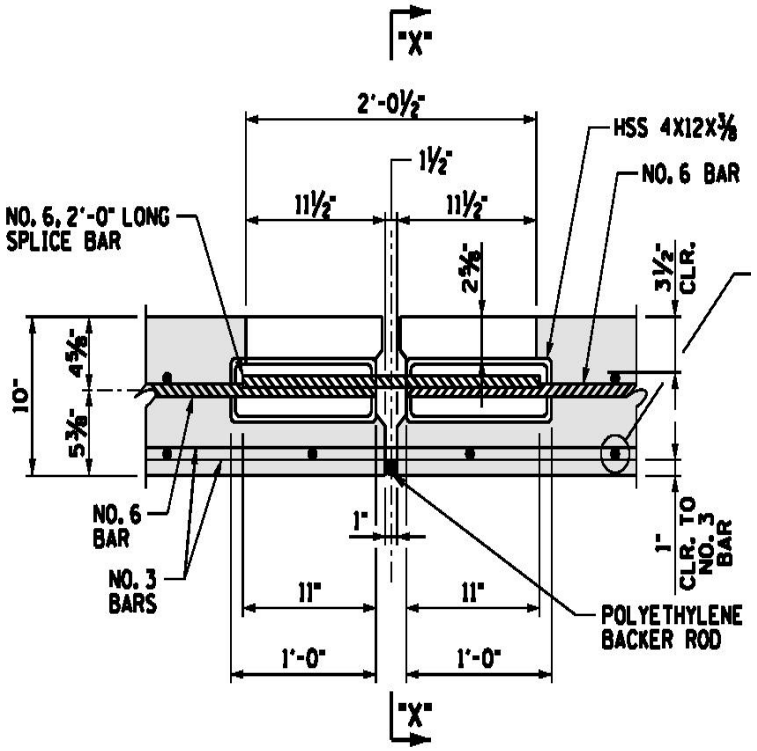
Three Bay Panel



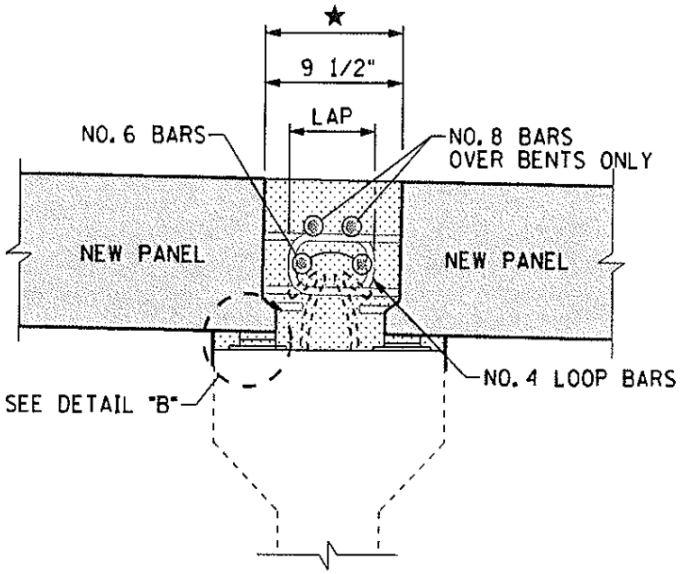
Two Bay Panel

Panel-to-panel connection detail – NCHRP 584

(For Longitudinal Reinforcement)



Panel To Panel Connection



SECTION F-F

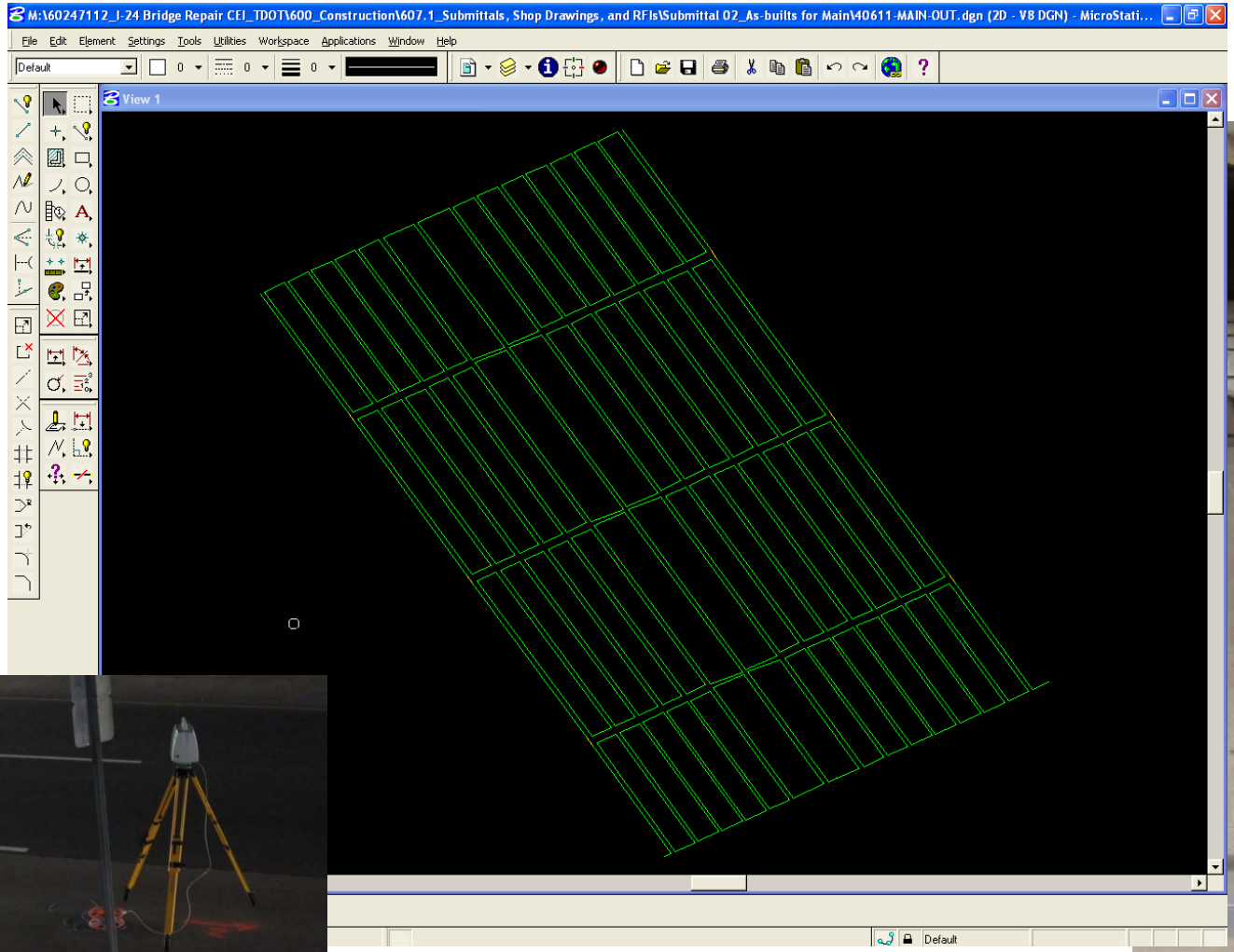
SHOWING JOINT OVER TYPE III BEAM BETWEEN NEW PANELS PRIOR TO CLOSURE POUR

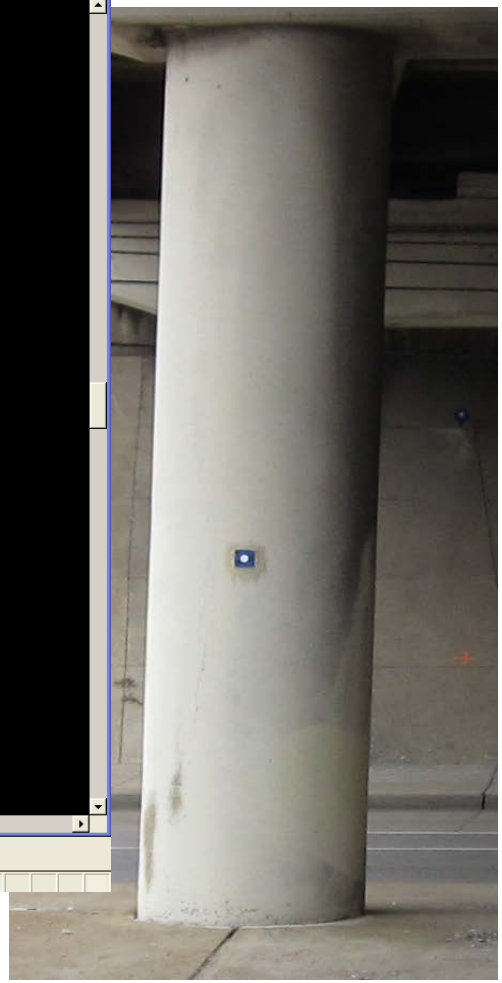
Preconstruction Planning/TEAM Meetings

Team/Progress Meetings

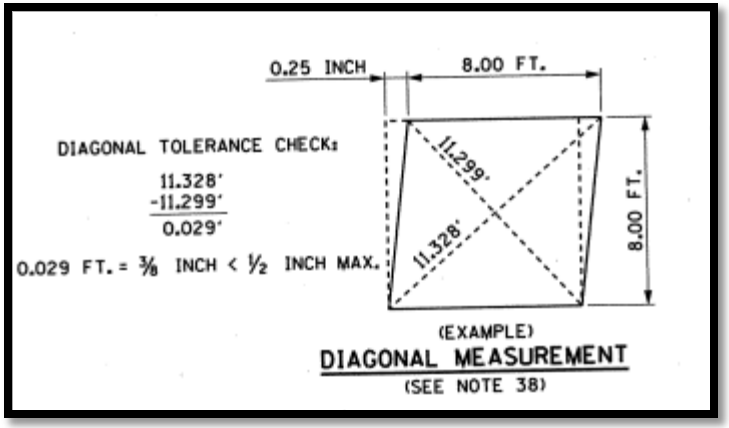
- The Team concept was implemented from the beginning
- Conducted weekly progress meetings months prior to the first panel placement. Averaged 2 hours. Continued through duration
  - Establish Project Timeline/Weekend Schedule
  - Establish Contractor's P.O.A – (Plan of Attack)
  - Establish a streamlined process for RFIs, Submittals, and Shop Drawings (16 Submittals and 279 Shop Drawings)
  - Approved Shop Drawings to begin casting panels
  - Implementation of Traffic Control
  - Try to prepare for the unexpected……What if scenarios?
  - Discussed field arrangements/equipment/staffing to allow for changing weather conditions
  - Identify and study products that are being used for closure and connection pours. **Contractor used MTSU to help evaluated mix design and the time required to achieve 3000psi.**

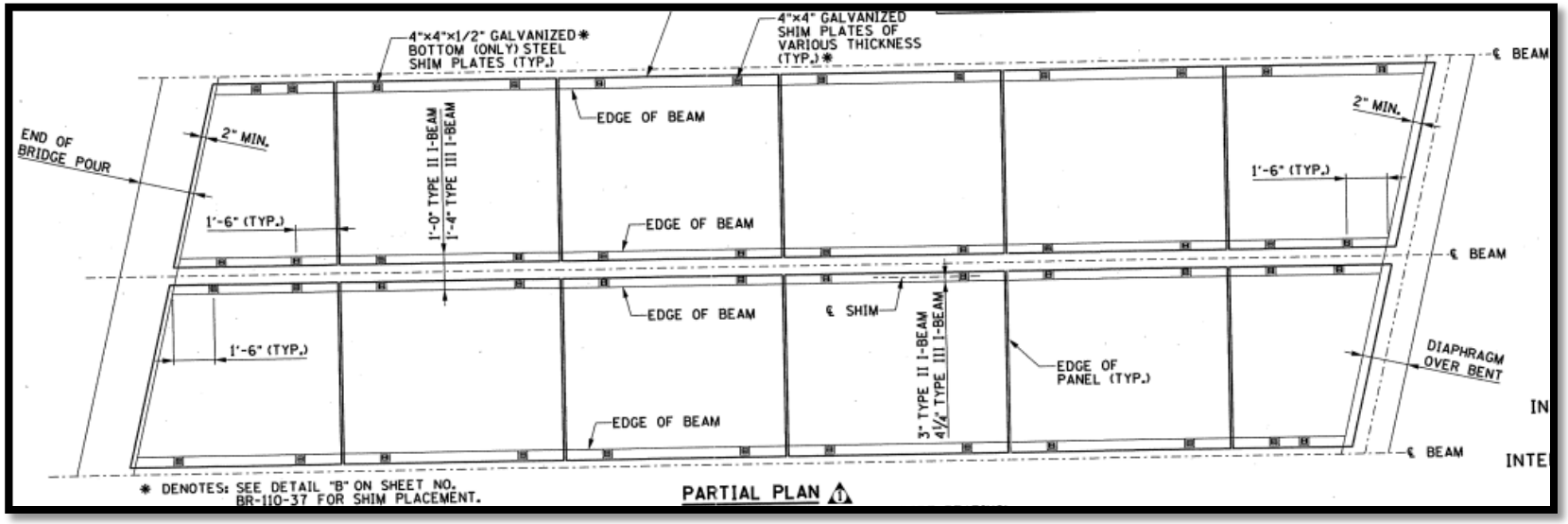
Line and Grade Data to be submitted as *.dgn



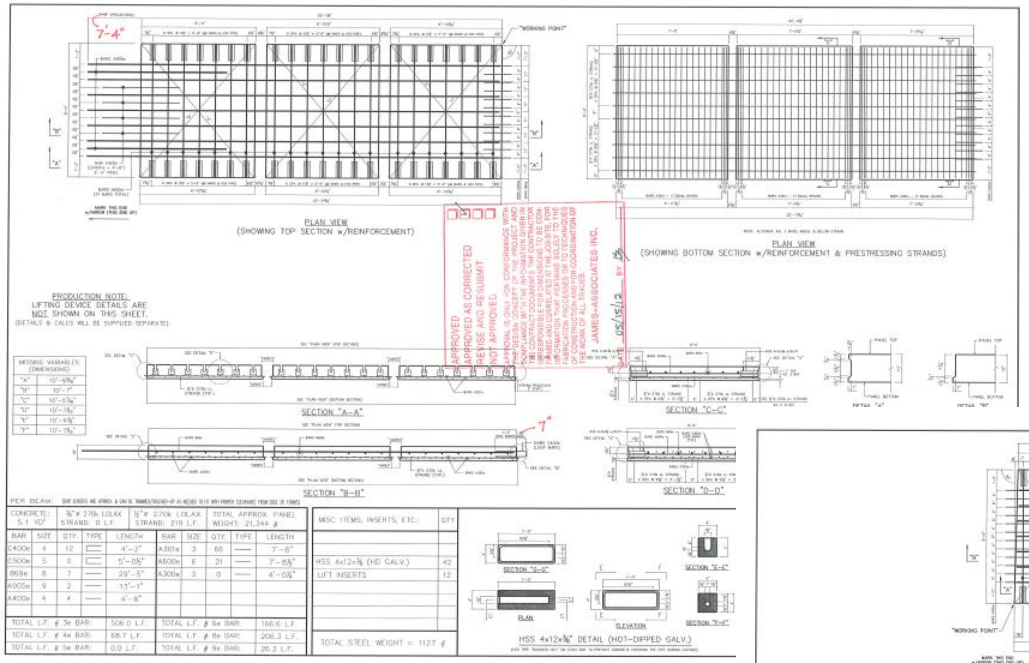


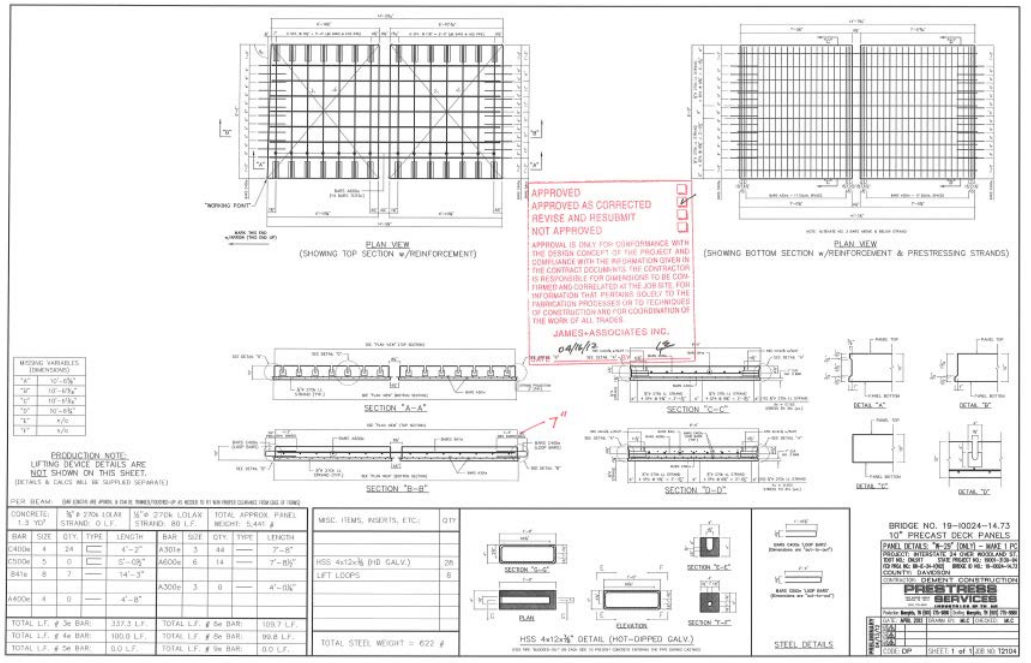
Panel Tolerances





Approved Panel Shop Drawings





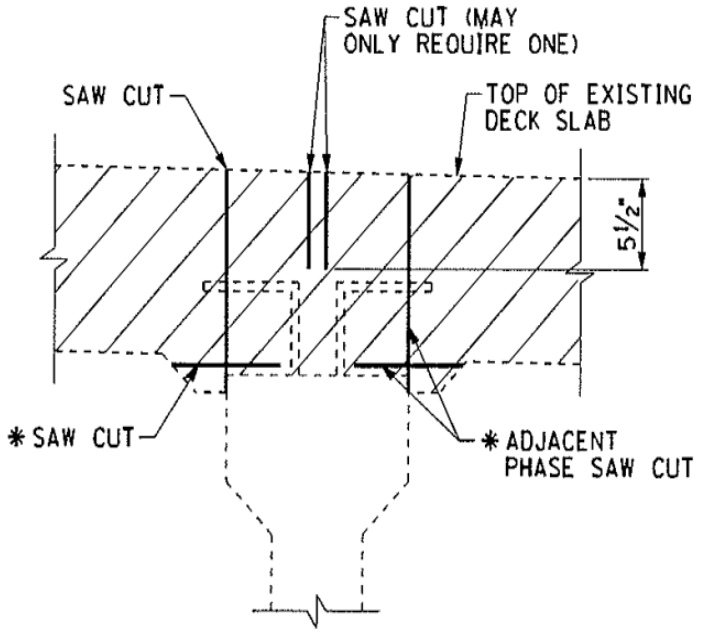
Construction of Panels

Panels were made in Memphis by Prestress Services. Pouring began on April 1, 2012.

Construction Phase

Deck Removal Concept

- Remove Bridge Deck Without Damaging the Existing Beams
- Salvage Existing Beam Stirrups
- Remove Bridge Deck Efficiently



DETAIL "I"

SHOWING APPROXIMATE LOCATIONS OF SAW CUTS DURING DEMOLITION OF EXISTING SLAB
SEE SECTIONS C-C AND F-F ON SHEET BR-110-37

Deck Removal Concept

Deck Removal Concept

Remove existing bridge deck using horizontal and vertical saw cuts

Removal of Existing Slab

- Existing slab conditions varied

Deck Removal Concept

Panel to Beam Connection

Incorporate existing beam stirrups with panel connection

Forming and Placement of Shims

- Contractor established top of panel grades

Panel Installation

•Panels arrive at site earlier in the week and dimensions are checked by AECOM and contractor prior to placement.

Planned Weekends for Panel Installation

*Weekend #1 was half of the normal weekend production

Panel Installation

- Panels are installed using a custom made spreader bar.

Installing Reinforcement and Forming for Grouting Operations

- Contractor installs rebar and forms for grouting

Closure Pour Materials

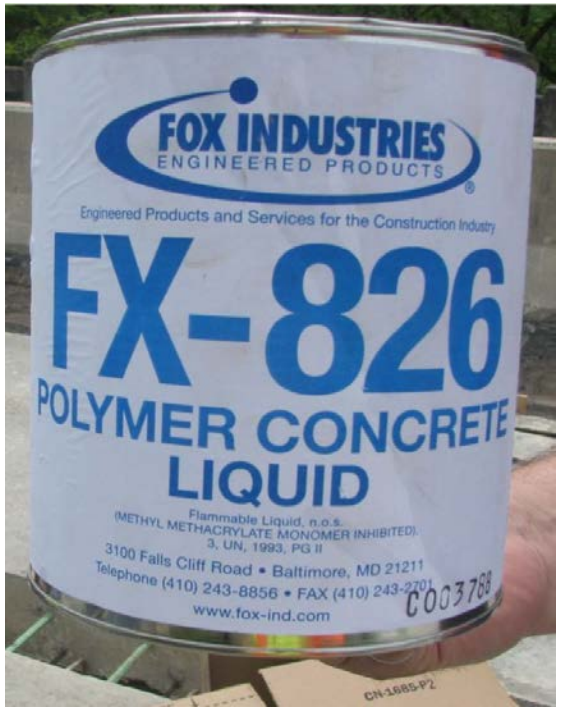
Selection of Durable Closure Pour Materials for Accelerated Bridge Construction

Peng Zhu[1] and Zhongguo John Ma[2]

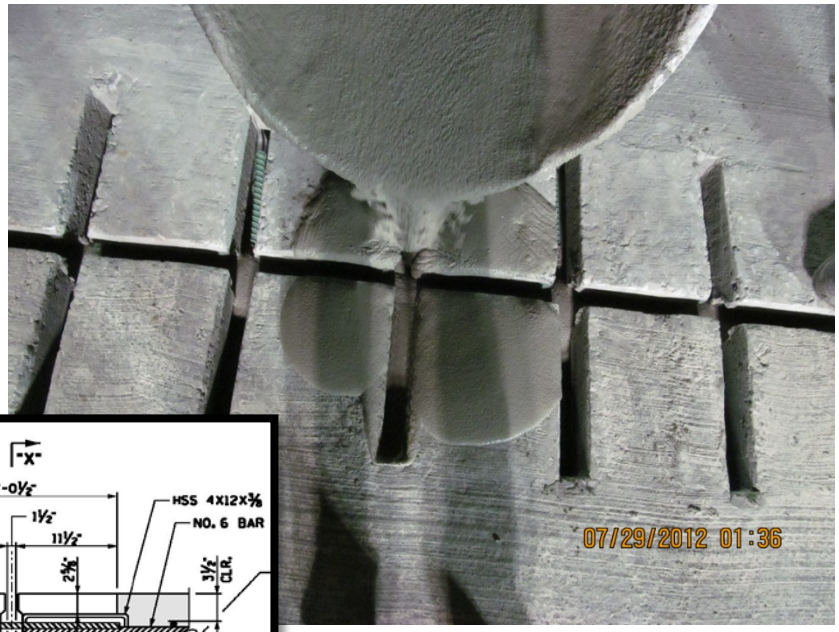
Abstract: With the public's demands for reduced construction time and traveling delays, full-depth precast bridge decks or decked bulb tees are being more widely used. When these systems are used, precast elements are brought to the construction site ready to be set in place and quickly joined together. Then, a concrete closure pour (CP) completes the connection. The selection of CP materials is critical. The procedure and methods for selecting durable CP materials are discussed in this paper. The accelerated construction is quantified as two categories: overnight cure of CP materials and 7-day cure of CP materials. For both categories, candidate materials are selected first based on literature review of published data as well as tests of compressive strength and flow and workability. Then, the performance criteria for selecting durable CP materials for both categories are developed based on durability tests of selected candidate materials.

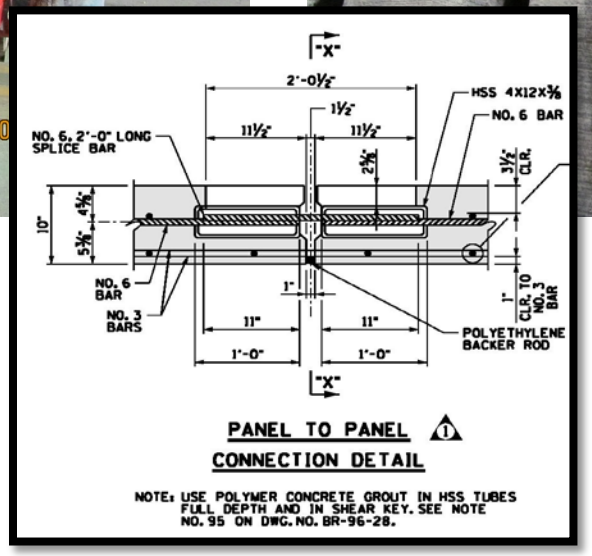
Grouting Operations

- Contractor elected to use the polymer concrete grout FX-826 (6500 psi @ 1 HR) by Fox Industries for panel to panel connections.



Grouting Operations





Performing Closure Pours

- Contractor used Set 45 HW with pea gravel extender for remaining closure pours. Required strength 3000 psi < 8 HRS

Performing Closure Pours

- AECOM made 4” x 6” compressive strength cylinders to be broken prior to opening traffic. Values averaged about 4200psi

Completed Installation

The Weekends

The Weekends

- **Weekend 1 -** The contractor removes the existing asphalt surface on I-24E and performing some bridge substructure repairs.
- **Weekends 2 through 12** - The contractor removes existing bridge deck and places new precast panels. The number of panels placed varied from 17 to 32 for each weekend.
- **Weekend 13** - The contractor completes the asphalt overlay and shifts traffic into final configuration.

The Weekends

- April 20-22 – Contractor will remove existing asphalt surface on I-24.
- April 27-29 – COUNTY MUSIC MARATHON, NO INTERSTATE CLOSURES
- May 4-6 – Contractor will remove existing bridge deck and place new panels
- May 11-13 – Contractor will remove existing bridge deck and place new panels
- May 18-20 – Contractor will remove existing bridge deck and place new panels
- May 25-27 – MEMORIAL DAY WEEKEND, NO INTERSTATE CLOSURES
- June 1-3 – Contractor will remove existing bridge deck and place new panels
- June 7-10 – CMA FEST, NO INTERSTATE CLOSURES
- June 15-17 – Contractor will remove existing bridge deck and place new panels
- June 22-24 – Kenny Chesney/Tim McGraw Concert, NO INTERSTATE CLOSURES
- June 29 – July 1 – Contractor will remove existing bridge deck and place new panels
- July 6-8 – Contractor will remove existing bridge deck and place new panels
- July 13-15 – Contractor will remove existing bridge deck and place new panels
- July 20-22 – Contractor will remove existing bridge deck and place new panels
- July 27-29 – Contractor will remove existing bridge deck and place new panels
- Aug. 3-5 – Contractor will remove existing bridge deck and place new panels
- August 24-26 – Contractor will complete the final asphalt overlay and shift traffic into final configuration.
- August 31 – Anticipated completion

Typical Weekend Schedule

- Friday (9 pm – 10 pm) -1 HR- Install traffic control devices to close I-24
- Friday into Saturday (11 pm – Noon) - 13 HRS - Saw cut and remove existing bridge deck
- Saturday (Noon- 5 pm) - 5 HRS - Set shims and form the closure pours
- Saturday (5 pm- 2 am) - 9 HRS - Set precast panels
- Sunday (2 am – 1 pm) – 11 HRS - Grouting and closure pours for panels
- Sunday into Monday (1 pm – 3 am) -15 HRS - Curing, install barrier rail, stripe, etc…..
- Monday (3am- 5am) – 2 HRS - Remove traffic control items to reopen I-24

Weekend consisted of 60 continuous hours*

Lessoned Learned

Lessons Learned

- Allow for ample notification to local businesses and communities prior to construction
- Allow ample time for panel fabrication and submittals approval
- Coordinate for early delivery of panels to site by installation sequence
- Allow time in schedule for inclement weather
- Complete all under bridge saw cutting prior to first installation weekend
- The value of preconstruction planning/meetings
- The need of redundant equipment and back-up plans
- Learning curve of panel installation and sequencing
- Allow time for additional construction task not related to panels

Thank You – Questions ??