Complexity in the Urban Environment
What Complicates a project, from conception through construction?

October, 2016

CUY-87-4.24
Buckeye-Woodhill-Shaker
Bridge Replacement Over
The Greater Cleveland
Regional Transit Authority
Project Timeline
Initial Design

July, 1999
Awarded to Michael Baker International

July, 2000
Constructability Review Workshop

Early 2000
Notice to Proceed Survey And Design
1999

- Y2K?
- Columbine shootings – Colorado
- Lance Armstrong won his 1st of 7 Tour de France
- Sponge Bob Square Pants debuts
Project Management Lessons

- Quality Record Keeping
- Coordination
- Plan / Anticipate the Work
- Recognize known ‘unknowns’
  - Field adjusted utilities
  - Schedule slides
  - Resource availability
- Change happens
Constructability Review Workshop
Firms Involved with the Project

- **Sponsor**
  - ODOT

- **Stakeholders**
  - FHWA
  - City of Cleveland
  - GCRTA

- **Designers**
  - Michael Baker
  - Ralph Tyler
  - BBC & M

- **Utilities**
  - AT&T
  - Dominion
  - First Energy

- **Contractors**
  - Great Lakes Construction
  - Kokosing Construction
  - ARCO National
  - Ruhlin Company
  - S.E. Johnson
  - Ohio Contractors Association
Initial Design

- July, 1999: Awarded to Michael Baker International
- July, 2000: Constructability Review Workshop
- April 22, 2002: Stage 3 Plans Submittal
- Early 2000: Notice to Proceed Survey And Design
- July 8, 2001: Stage 1 And Stage 2 Roadway Plan Submittal
- July 22, 2002: Final Tracings on Waterline Plans
2002

- NASA’s Mars Odyssey finds water on Mars
- The European Union adopts the Euro as the standard currency
- American Idol debuts
- George W Bush enacts the Homeland Security Act
Funding Halt - Fast Forward to 2009

2009
Update Plans to 2008 Specs

2010
Delay in Schedule
- RTA station will now be constructed first
- Adjust bridge plans

2011
Update Plans
- 2010 Standards
- Latest RTA Station Plans
2011 Update
Changes 2009 to 2013

2009
Update Plans to 2008 Specs

2010
Change in Schedule
-RTA station will now be constructed first
-Adjust bridge plans

2011
Update Plans
-2010 Standards
-Latest RTA Station Plans

April, 2013
Project Awarded

2009 - 2013
Changes in Leadership
Change in Leadership

- Project Manager for ODOT changed 4 times
- Project Manager for Michael Baker changed 2 times
- Major Sub closed in December, 2012
Design Challenges
The Bridge

- 5-point intersection
  - Buckeye, Woodhill, Shaker EB, and Shaker WB all meet on the bridge
- Over active commuter rail
- Bridge width nearly 3 times the span length
- Raising local road elevation by 3.3 feet
  - Impacting walkways and nearby structures
- Superelevation transitions required across the bridge deck
The Bridge
Existing Culvert

Existing utilities are ‘buried’ between top of box culvert and pavement.

January, 2011
The Bridge
Existing Bridge

January, 2011
Utilities

- 42 Inch Diameter Siphon Sewer
- 2 – 30 Inch Diameter Waterlines
- 1 – 12 Inch Diameter Waterline
- 6 Inch Diameter Gas

Electrical
- Cleveland Electric Illuminating Company (CEI) Lines
- Cleveland Public Power (CPP) Lines

AT&T Telecommunications Line
Section Cut - Rear Approach
Section Cut Forward Approach
Utilities – Waterline

Sacrificial Structure Design

Sacrificial Pipe Supports to keep the 30” Waterlines in Service throughout Construction
Utilities – Waterline

Sacrificial Structure Design

March, 2015

April, 2015

April, 2015
Movement of Traffic

- 5 phase MOT
  - Temporary pedestrian bridge over GCRTA tracks
  - Temporary roadway
  - Temporary signals
  - Global detours for vehicular traffic
Movement of Traffic

Pedestrian Bridge
Temporary Pavement

MOT Phase 1
Project Management Lessons

- The Unknowns are out there
- Focus on Problem Solving & Working Together

- Change Happens !!
Planned Sequence of Construction
Existing Conditions

TOP OF WEARING SURFACE
30" WATERLINE

CATENARY (TYP.)

EXISTING CONCRETE FRAME

EXISTING STRUCTURE
Waterline Installation

STEP 1 AND STEP 2

30" WATERLINE

WATERLINE SUPPORT STRUCTURE

SACRIFICIAL WATERLINE SUPPORT FOUNDATION
Drilled Shafts

STEP 3

3. Install abutment drilled shafts as noted in the plans. Provide protection of utilities and coordinate temporary and permanent relocations.
Remove ‘earth’

**STEP 4 AND STEP 5**

4. REMOVE EXISTING PARAPETS, SIDEWALKS, WEARING SURFACE, AND FILL TO TOP OF EXISTING CONCRETE FRAME. (AS SHOWN ON SHEET 12/51)

5. REMOVE LOW STRENGTH MORTAR TO BOTTOM OF PROPOSED ABUTMENT CAP ELEVATION TO EXPOSE SOLDIER PILE.
Install Pile Lagging and Bracing

STEP 6 AND STEP 7

6. Place temporary soldier pile bracing.

7. Place lagging as fill is removed maintaining balanced fill heights within two courses of lagging on either side of the existing concrete frame. Remove portions of existing retaining walls as lagging progresses (existing retaining walls not shown, see sheet 13/51). Backfill lagging with pea gravel.
Install Abutment Cap

**STEP 8**

8. Construct reinforced concrete abutment cap as shown in the plans. Install supports for the 2 - 30" waterlines.

Backfill below waterline with low strength mortar, install waterline support bearings, and cut waterline support structures and remove portions as indicated in the plans.
Install Bearings and Beams

STEP 9 AND STEP 10

9. INSTALL FIXED ELASTOMERIC BEARINGS, STEEL BEAMS AND CROSSFRAMES BEFORE REMOVING TEMPORARY SOLDIER PILE BRACING.

10. CONSTRUCT NEW SEMI-INTEGRAL DIAPHRAGMS.
Remove Existing Bridge

AS LAGGING PROGRESSES (EXISTING RETAINING WALLS NOT SHOWN, SEE SHEET 13/51). BACKFILL LAGGING WITH PEA GRAV

RELOCATED CAT

PROVIDES WO PROTECTION

RELOCATED IN TEMPOR

STEP 11 AND STEP 12

VIDE TRACK OUTAGE. GCRTA SHALL DE-ENERGIZE AND TEMPORARILY RELOCATE CATER TO INSTALL TEMPORARY UTILITY TRENCHES AND PVC DUCTS AND GCRTA TO RE
Construction Issues

- Demolition Acceleration
- RTA Track Impacts/Mitigation Efforts
- Temp/Permanent Catenary Supports
- Frequent theft/burglaries

13-0151; PID 10787; CUY-87-4.24 Part1/2
Demolition Acceleration

- Plan used struts against the existing structure and demolition under new bridge
- Deflection of soldiers without new steel?
- Temp Catenary support?
- RTA closure
- Track Protection without structure
Track Protection
Roof Demo and Haul Out
Breaking it up...
Hauled Out and cleaning up
Getting RTA Back Open
RTA Track Impacts/Mitigation Efforts

- Event #1 – 7/9/14
- Activity – Slot opened for installation of D.S. on rear side.
- Impact – minor leaching of sediment and water through chamber
Event #1
Event #1
RTA Track Impacts/Mitigation Efforts

- Event #2 – 7/27/14
- Activity – Slot opened for installation of D.S. on fwd side
- Impact – weekend closure of RTA rail service and....
Event #2

13-0151; PID 10787; CUY-87-4.24 Part1/2
Event #2
Event #2
Event #2
RTA Track Impacts/Mitigation Efforts

- Event #3 – 8/13/14
- Activity – Hole on Shaker EB to facilitate D.S. Construction
- Impact – Another closure of RTA rail service
Event #3
Event #3
Event #3

13-0151; PID 10787; CUY-87-4.24 Part1/2
Now what?

另一个中断服务不能被容忍。一个更永久-临时的修复是必要的。

更多增量的临时措施
Temporary Measures While Problem was more fully explored
RTA Track Impacts/Mitigation Efforts

- **Event #4 – 8/20/14**
- **Activity** – Hole on Shaker EB to facilitate D.S. Construction
- **Impact** – BARELY avoided another closure of RTA rail service
Event #4

- Only event that occurred during the day
- Became brutally clear at this point the issue we were dealing with
- Focus was on project stormwater prior to this
- After, it became that the root causes was systemic failure of the drainage in the area
...now what?

- Assuming drainage is overrun, what is the drainage area?
- We know it’s a lot, but how much water?
- What were pre-construction flow conditions?
- Still another year of bridge construction
  - Water goes across the structure – essentially an aqueduct
  - What about when it is completely gone?
Collection of Storm Water

After analysis, needed to collect and slowly free 500,000 gal of water!

Where do you put it?
- Looked at temp storage silos on street and pumping
- Would need 2-jet engine fueled 16” fire pumps to meet gal/min demand
- Residential neighborhood, limited space, $$$
Retention Basin
Retention Basin (Lake Milroy)
Retention Basin (Lake Milroy)
Temp/Permanent Catenary Supports

Bridge Demo Acceleration

- 6-Day RTA closure
- Needed to reconnect catenary after bridge demo
- Original plan had demo occurring after new bridge was constructed and catenary re-attached to new bridge
- With bridge not there yet, needed a temp support
Temp Catenary Support

- Needed a full design for construction in 30 days
- No details/standards available
- Looked at scaffolding support
- Concerns about designing for cable break
- Meant to be temporary, but left as permanent
Temp Catenary Support

13-0151; PID 10787; CUY-87-4.24 Part1/2
Temp Catenary Support Installation
Temp Catenary Done
Frequent theft/burglaries

- Field office broken into first weekend there
- Broken into half a dozen times after that
- Utility worker truck stolen with police car sitting behind it
- Frequent open carry (firearms) experienced
Final Product