Innovative Design and Construction Solutions for an Innovative Project Delivery
INTRODUCTIONS AND PRESENTATION OVERVIEW

Bill Maddex
CEO

PORTSMOUTH GATEWAY GROUP
STATE ROUTE 823

ACS
INFRASTRUCTURE DEVELOPMENT
Bill Maddex, CEO, Portsmouth Gateway Group

Tom Barnitz, Project Manager, ODOT

Hugo Fontirroig, Project Manager, Dragados USA

Chad Ratkovich, Project Manager, Beaver Excavating Co.
1. Project Overview

2. P3 Project Specifications and Innovation Log

3. Profile Optimization during Bid Phase

4. Incorporating Technology into Field Applications

5. Panel Questions and Answers
PROJECT OVERVIEW, SPECIFICATIONS AND INNOVATION

Tom Barnitz, PE
Project Manager
- Project Location
  - Rural community in Scioto County
  - 90 miles south of Columbus, OH
  - 100 miles east of Cincinnati, OH
APPALACHIAN MOUNTAIN RANGE
The Appalachian Highway System is designed to:

- Generate economic development;
- Connect Appalachia highways to Interstate system;
- Improve Regional & National market access to Appalachia.

Completes Appalachian Highway in Ohio

Reduces current 26 mile travel time by avoiding:

- 30 traffic signals, 80 intersections, 500 driveways

Improves safety and congestion
PROJECT SCOPE

- Largest single project ODOT has ever done ($429M) – First P3
- 16-mile, 4-lane, limited access with concrete median barrier
- Crosses NS and CSX Railroads
- 5 Interchanges, 22 bridges and 26 MSE retaining walls, ~80 culverts
- Mountainous terrain - High fill embankments (187’), Rock Cuts (204’)
- Massive Earthwork: >20M Cubic Yards of Excavation, 95% rock
- Developer Maintained Facilities - (Mainline & Ramps)
- Locally Maintained Facilities (US 23, US 52, County and Twp Roads)
Final Acceptance Date

Financial Close

NTP: Design Work start

Commencement of Construction

Substantial Completion Date

Final Acceptance Date

Consort Period: 3 years – 8 months

Operating Period: 35 years

End of Term Dec. 2053

Funding of Handback Reserve

April 2015

June 2015

Dec. 2018

120 days

2 years
Financial Close
April 2015

Commencement of Construction
June 2015
2016

Desgin

Utilities

Wick Drains

Culverts

Excavation – Segment 1

Excavation – Segment 2

Excavation – Segment 3

Excavation – Segment 4

Subgrade

Pavement

Structures

Finishes

Substantial Completion
Dec 2018

Final Acceptance
April 2019

Current

SCHEDULE

DESIGN COMPLETE - 100%

CONSTRUCTION COMPLETE - 42%

April 2015

2016

2017

2018

2019

June 2015

April 2016

June 2016

April 2017

June 2017

April 2018

June 2018

April 2019

Current
1) DBFOM – Design Build Finance Operate Maintain

2) Developer hires Independent Quality Firm (IQF) – accepts Work and performs QA

3) ODOT performs Contract Administration and Quality Oversight

4) After construction, Developer earns fixed price Availability Payment for 35 years
   a. Facility must perform to pre-established performance specifications
   b. Non-Compliance Event deductions

5) Developer will “own” what they build for 35 years;
   a. Routine maintenance (e.g. roadside sweeping, mowing, etc)
   b. Major rehab (e.g. pavement resurfacing, bridge repair, etc)

6) After 35 years of operations, developer hands back roadway to ODOT in good condition or suffers deductions

7) ODOT will perform Snow Plowing and initial Emergency Response
Specification Types

1) Prescriptive Specifications
   - detailed material and construction installation requirements (ex. – ODOT CMS)

2) Proprietary Specifications
   - one or a few specific pre-approved products is required (ex. - guardrail, signal controller)

3) Performance Based Specifications
   - specifies the operational requirements of a component or installation (ex. – design, construct and maintain structures to carry, at a minimum, the design load and the Ohio legal loads)
Traditionally:
Design-Bid-Build (DBB)

"Alternative Delivery":
Design-Build (DB)

Public Private
Partnership (P3)

Public
Agency

Prescriptive
Specifications

Construction

Private
Organization

Prescriptive
Specifications

Design and
Construction

Prescriptive
Specifications

Performance
Specifications

Design, Construction,
Operate, and Maintain

Contract Length
1-5 years
1-5 years
20-30 years
- ODOT’s Contract required Developer to prepare their own prescriptive specifications to build the project. Cannot use ODOT CMS, must be their own specification signed and sealed by Engineer Registered in Ohio

### Locally-Maintained Facilities (LMF)

<table>
<thead>
<tr>
<th>Author</th>
<th>Design &amp; Construction Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODOT</td>
<td>Prescriptive Specs (ODOT CMS)</td>
</tr>
<tr>
<td>Developer</td>
<td>---</td>
</tr>
</tbody>
</table>

### Developer-Maintained Facilities (DMF) (SR 823 Mainline and Ramps)

<table>
<thead>
<tr>
<th>Author</th>
<th>Design &amp; Construction Period</th>
<th>Operating and Maintenance Period (35 yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODOT</td>
<td>---</td>
<td>ODOT Performance Criteria/Specs</td>
</tr>
<tr>
<td>Developer</td>
<td>Prescriptive Specs (Contract Spec Book)</td>
<td>---</td>
</tr>
</tbody>
</table>
Subject Matter Expert teams identified for each Maintenance Element

Teams consisted of ODOT senior staff and consultants

Many meetings from July to November 2013

Maintenance Performance criteria/specs prepared to describe asset performance

Developer suffers monthly monetary deductions for Elements that have defects

Set time periods to remedy defects – depending upon severity

Maintenance Elements:

1. Structures
2. Pavement
3. Drainage Systems
4. Markings & Delineators
5. Guard Rails and Barriers
6. Signs
7. Electrical Systems
8. Fences and Walls
9. Vegetated Areas
10. Geotechnical
11. Damage to Project Facilities
12. Customer Services
13. Monitoring and Clearance of Obstructions, Debris, Litter
## SAMPLE PERFORMANCE CRITERIA

<table>
<thead>
<tr>
<th>REF</th>
<th>ELEMENT</th>
<th>GENERAL REQUIREMENT</th>
<th>DEFECT REMEDY PERIOD</th>
<th>MAINTENANCE PERFORMANCE REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cat 1 Immediate Action</td>
<td>Cat. 2 Permanent Repair</td>
<td>MEASUREMENT CRITERIA*</td>
</tr>
<tr>
<td>1</td>
<td><strong>STRUCTURES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>Structures - inspection</td>
<td>Inspection of Structures to meet NBIS requirements</td>
<td></td>
<td>Results of inspections delivered to Department.¹</td>
</tr>
<tr>
<td>1.1</td>
<td>Structures – General</td>
<td>Maintain structures to a specified Condition Rating level in accordance with national and ODOT requirements</td>
<td>48 hrs</td>
<td>12 months</td>
</tr>
<tr>
<td>1.2</td>
<td>Structures – General</td>
<td>Maintain structures to carry, at a minimum, the design loads (HL-93 LL) and the Ohio legal loads (Figure 903 of 2004 BDM)</td>
<td>48 hrs</td>
<td>12 months</td>
</tr>
</tbody>
</table>
Innovation – definition: something new or different

1. Semi-integral bridge abutments on single row of pile
2. MSE walls without top edge coping
3. 18” to 36” Shot rock Roadbed for pavement subgrade; CBR=15; 7” Asphalt Concrete
4. MSE wall construction directly on unconsolidated subgrade soils
5. Horizontal strip drains with 12” soil cover layer over wick drains
6. Low-friction sleeve around bridge piling
7. Non-epoxy reinforcing steel in structure foundations
8. Universal use of stay-in-place forms
9. Redesigned median barrier drains
10. Elimination of road underdrains
PROFILE OPTIMIZATION DURING BID PHASE

Hugo Fontirroig
Project Manager
PROJECT GOALS

Safety  Quality  Environmental  DBE  Schedule  Cost

Award based on Financial Proposal  =>  Award based on Construction Cost

- 47% Earthworks
- 23% Structures
- 17% Roadway
- 12% Others

Cost Optimization  =>  Design optimization  =>  Earthworks optimization

PROJECT GOALS

Award based on Financial Proposal  =>  Award based on Construction Cost

- 47% Earthworks
- 23% Structures
- 17% Roadway
- 12% Others

Cost Optimization  =>  Design optimization  =>  Earthworks optimization
Earthworks optimization \[\rightarrow\] Slopes optimization \[\rightarrow\] Increases geotechnical risk

Profile optimization \[\rightarrow\] Reduces geotechnical risk

Excavation and fill, earthworks balances, hauling distances, waste areas and borrow areas, clearing and grubbing operations, culvert lengths, environmental impact, geotechnical risk...

**Challenge**

16 miles of vertical alignment

1,800 complex cross sections

600 borings

Only one month to propose the final vertical alignment so the Technical Proposal Design can be finalized on time
Solution

Automate cross sections based on the geotechnical information available in order to iterate as many alignments as necessary in a short period of time.

Each profile iteration should have its accurate yardage and mass diagram.

Process

Three kind of materials: Soil/soft rock, medium rock, hard rock.

Create different material surfaces based on the 600 borings logs and the different materials.

Create Cross section patterns based on each different materials and its elevation.
35 profile iterations, including detailed earthwork quantity and mass diagrams in less than a week

- Hauling distance: 40%
- Excavation: 20%
- Wick Drains: 31%
- Waste Areas: 24%
- Footprint Impact: 8%
Surface

Old Profile (Reference Design)
New Profile (Technical Proposal)

Hauling Distance

22'
39'
35'
Reduction of Waste Areas

Old Profile (Reference Design)

New Profile (Technical Proposal)

Surface

20' – 40'

610+00  620+00  630+00  640+00  650+00  660+00  670+00  680+00  690+00  700+00  710+00  720+00  730+00  740+00  750+00  760+00  770+00
INCORPORATING TECHNOLOGY INTO FIELD APPLICATIONS

Chad Ratkovich
Project Manager
Development of 3D Models from Design Files

Incorporation of Models into Grade Checking Devices / Machine Control

Utilization of Onsite Wireless Network

Quantity verification through Aerial Survey (drone and fixed-wing)
• Begin with Design Linework and Cross Sections
• Utilize Plan Typical Sections to Develop Model Surface
• Adjust Transitions to Meet Geotechnical Recommendations
• Review with Project Supervision
STARTING POINT - .DGN CROSS SECTION FILE FROM DESIGNERS
UTILIZE DESIGNER CROSS-SECTIONS, PLAN TYPICAL SECTIONS TO DEVELOP TRANSITIONS AND MODEL SURFACE
REVIEW MODEL WITH SOLID FACES, CLEAN UP TRANSITIONS, DISCUSS WITH SUPERVISION
INCORPORATION OF MODELS IN GRADE CHECKING DEVICES / MACHINE CONTROL
- Upload via USB to GPS Rovers or Machine Control
- Allows Foreman to Assist with General Layout
- Provides for Grade Verification in Mass Excavation Spread
- Gives Direct Feedback to Operator and Limits Rework
- Significant Safety Benefit
- Still Requires Experienced Operators / Supervision
MODEL PLAN VIEW FROM MACHINE CONTROL / GRADE CHECKER (ROVER)

Portsmouth JV

[Image of a screen showing a plan view with fill and depth measurements]

Fill: 6.564
Dsn Elv: 921.964
R. Sta: 13+73.133
R. Off: -9.792 usft

Measure
BULLDOZER CAB VIEW
BULLDOZER CAB VIEW

Portsmouth JV
UTILIZATION OF ONSITE WIFI NETWORK

Portsmouth JV

DRAGADOS USA

823
**UTILIZATION OF ONSITE WIFI NETWORK**

- Towers Consist of Solar Panels, Batteries, Rajant Radio (Node), Dual Frequency Antennae
- 22 Individual Towers Provided
- Each Machine / Truck with Radio Increases Strength of Network
- Allows for Base Station Corrections to be Broadcast to Machine Control
- Provides Access to Internet for Field Crews, Supervision, Inspection, Etc…
- Real-Time, Live Monitoring Cameras
TRADITIONAL WIRELESS NETWORKS

- **Infrastructure node (Wi-Fi Access Point)**
- **2.4 GHz Client**
- **Mobile Equipment (Wi-Fi Client)**
- **5.8 GHz Backhaul**
QUANTITY VERIFICATION THROUGH AERIAL SURVEY
QUESTIONS ?

www.PGG823.com

Southern Ohio Veterans Memorial Highway

SR-823/SOVHM