Reading, Understanding, and Using Construction Plans

Delaware T²/LTAP Center
Delaware $T^2$ Center

- $T^2$ Centers or LTAPs located in all 50 states
- Funded by FHWA and state DOTs
- Mission – promote training, tech transfer, research implementation at local level
- Delaware $T^2$ hosted by University of Delaware, part of Delaware Center for Transportation
- Delaware $T^2$ funded by FHWA and DelDOT
Municipal Circuit Rider Program

• Delaware Center for Transportation
  – T²/LTAP Center
  – Based at University of Delaware
  – Dr. Christopher Meehan – Director, DCT
  – Dr. Earl “Rusty” Lee – T²/LTAP Program Coordinator

• Matheu J. Carter, P.E.
  – T² Engineer
  – Municipal Engineering Circuit Rider
The Preliminaries

Today’s Instructor:
• Matheu J. Carter, P.E. – Municipal Engineering Circuit Rider

Restrooms, smoking, parking, etc.

Standard Reminders:
• Cell phones, pagers, beepers, walkie-talkies
• Sidebar conversations
More Preliminaries

• Questions – any time

• We’re a small crowd – let’s keep it interactive and informal

• Sharing of thoughts or examples – any time

• These slides will be posted on our website – see link on your notes
Are you on our mailing list?

• Click here to take our 1 minute questionnaire and be sure

• Ensures you get our:
  – Newsletters
  – Urgent technical briefs
  – Upcoming training workshop notifications

• Don’t risk it! Do it today.
Construction Plans

• Public versus private project
  – Public
    • Probably just one of several sets of documents known collectively as the Contract Documents
  – Private
    • Can sometimes be a standalone document

• Small versus large project
  – Smaller projects may have substantially fewer and more basic Contract Documents
Contract Documents

• Collectively, these tell the Contractor
  – What it must construct
  – What it can and cannot use
  – Methods it can, must, or cannot use
  – Time limits, how it gets paid, etc.

• Collectively, these tell the Owner
  – What its authority is
  – How and when it can intervene
Contract Documents

Typical DOT Standard Specification language

- Each individual Contract Document is an essential part of the Contract and a requirement occurring in one is binding as though occurring in all. All of the Contract Documents are intended to be complementary and to describe and provide for a complete Contract.

- **[BUT,]** In the case of a discrepancy between the Contract Documents the governing ranking will be:
  - A. General Description
  - B. General Notices
  - C. Plans
  - D. Special Provisions
  - E. Standard Construction Details
  - F. Standard Specifications

Source: DelDOT, “Standard Specifications for Road and Bridge Construction,” 105.06, August 2016
Documents During Construction

Many other documents generated during construction

- Shop drawings (working drawings)
- Testing results (QA/QC)
- RFIs (Requests for Information)
- Change orders
- Schedules
- Correspondence
- Reports (geotechnical, environmental, etc.)
“Typical” Organization

• Lots of styles, arrangements, formats
• A “typical” arrangement from DelDOT
  – Title, Index, Legend, Notes, and Earthwork
  – Typical Sections
  – Horizontal and Vertical Control
  – Construction Plans
  – Profiles
  – Grades and Geometrics
  – Pavement Joint Plans
“Typical” Organization

• A “typical” arrangement from DelDOT (cont’d)
  – Borrow Site Grading Plans, Laydown Area, and Borrow Site Notes
  – Construction Details
  – Bridge Plans and Details
  – Retaining Wall Plans and Details
  – Maintenance of Stream Flow
  – Stormwater Management
“Typical” Organization

• A “typical” arrangement from DelDOT (cont’d)
  – Environmental Compliance
  – Traffic Control Notes & Phasing, MOT & E&S
  – Detour Plans
  – Lighting
  – Signing, Striping, Conduit & Signal Plans
  – Right-Of-Way Plans

• We’ll look at some of these
“Typical” Organization

- As we look at **some** of these drawings...
- ...think about what role you might be in and which drawings would be of most use to **you**

<table>
<thead>
<tr>
<th>Inspector</th>
<th>ROW Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing Technician</td>
<td>Bridge Forman</td>
</tr>
<tr>
<td>Surveyor</td>
<td>Pipe Forman</td>
</tr>
<tr>
<td>Shop Drawing</td>
<td>Bidder</td>
</tr>
<tr>
<td>Reviewer</td>
<td>Precaster</td>
</tr>
<tr>
<td>Public Relations</td>
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# Plan Sheet Index

## Plan Sheet Index Cross Reference

<table>
<thead>
<tr>
<th>Construction Plan</th>
<th>36</th>
<th>37</th>
<th>38</th>
<th>40</th>
<th>41</th>
<th>43</th>
<th>48</th>
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<tbody>
<tr>
<td>Profiles</td>
<td>49,50,58,59</td>
<td>50,51,58</td>
<td>51,52,61</td>
<td>57,58</td>
<td>52,53,56,57</td>
<td>53,54,56</td>
<td>60,61</td>
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<tr>
<td>Grades and Geometrics</td>
<td>62</td>
<td>63</td>
<td>64</td>
<td>66</td>
<td>67</td>
<td>68</td>
<td>71</td>
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<tr>
<td>Pavement Joint Layout Plans</td>
<td>72</td>
<td>73</td>
<td>74</td>
<td>75</td>
<td>76</td>
<td>77</td>
<td>80</td>
<td>N/A</td>
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<td>Construction Phasing, M.O.T. and E &amp; S</td>
<td>381,393</td>
<td>382,394</td>
<td>383,395</td>
<td>409,421</td>
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<td>391,403</td>
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<td>Lighting Plan</td>
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<td>433</td>
<td>434</td>
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<td>Signing Striping and Conduit Plan</td>
<td>457</td>
<td>450,458</td>
<td>451,460</td>
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<td>452,461</td>
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<td>Stormwater Management</td>
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<td>N/A</td>
<td>362,363</td>
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<td>N/A</td>
<td>N/A</td>
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<td>373</td>
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<td>Right of Way Plan</td>
<td>N/A</td>
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<td>489</td>
<td>489,490</td>
<td>490</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

## Limit of Construction

- **Ramp B Station 316 + 00**
- **US 201 Station 144 + 67**
GENERAL NOTES

1. PROJECT TO BE DRAWN IN ACCORDANCE WITH THE DELAWARE DEPARTMENT OF TRANSPORTATION (DDOT) DESIGN STANDARDS, CURRENTLY IN EFFECT, AND IN THE GENERAL ENGINEER'S SPECIFICATION- STANDARD DESIGN SPECIFICATION, DATED 1995, ALONG WITH ALL ADDENDA UP TO THE DATE OF THIS DRAWING.

2. DRAWING NUMBERS: THIS DRAWING IS IDENTIFIED BY THE FOLLOWING NUMBERS:

   PLAN NUMBER: NO. 3-40

3. ELECTRONIC PROJECT FILES THAT WILL BE MADE AVAILABLE TO THE CONTRACTOR INCLUDE:

   a. COMMISSIONER'S OFFICE DRAWING NUMBER: NO. 3-40

4. PROJECT NOTES:

   a. The project notes shall be read and understood by the contractor, and shall be a part of the contract documents. The notes shall be considered as part of the contract documents and shall be incorporated into the contract documents by reference.

   b. The project notes shall be read and understood by the contractor, and shall be a part of the contract documents. The notes shall be considered as part of the contract documents and shall be incorporated into the contract documents by reference.

   c. The project notes shall be read and understood by the contractor, and shall be a part of the contract documents. The notes shall be considered as part of the contract documents and shall be incorporated into the contract documents by reference.

   d. The project notes shall be read and understood by the contractor, and shall be a part of the contract documents. The notes shall be considered as part of the contract documents and shall be incorporated into the contract documents by reference.

   e. The project notes shall be read and understood by the contractor, and shall be a part of the contract documents. The notes shall be considered as part of the contract documents and shall be incorporated into the contract documents by reference.

   f. The project notes shall be read and understood by the contractor, and shall be a part of the contract documents. The notes shall be considered as part of the contract documents and shall be incorporated into the contract documents by reference.

   g. The project notes shall be read and understood by the contractor, and shall be a part of the contract documents. The notes shall be considered as part of the contract documents and shall be incorporated into the contract documents by reference.

   h. The project notes shall be read and understood by the contractor, and shall be a part of the contract documents. The notes shall be considered as part of the contract documents and shall be incorporated into the contract documents by reference.

   i. The project notes shall be read and understood by the contractor, and shall be a part of the contract documents. The notes shall be considered as part of the contract documents and shall be incorporated into the contract documents by reference.

   j. The project notes shall be read and understood by the contractor, and shall be a part of the contract documents. The notes shall be considered as part of the contract documents and shall be incorporated into the contract documents by reference.
33. THE LOCATION FOR ITEM 759506 - FIELD OFFICE, TYPE II.22 SPECIAL COMPLEX SHALL BE ON THE DELDOT OWNED PARCEL EAST OF US 13 AT APPROXIMATE SR 1 STATION 1832+00. SEE DRAWING GR-02.
# Earthwork Quantities

## Earthwork Summary - Totals

<table>
<thead>
<tr>
<th>Earthwork Description</th>
<th>Quantity (CU YD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Earthwork</td>
<td>1,234,567</td>
</tr>
</tbody>
</table>

## Earthwork Summary - Details

<table>
<thead>
<tr>
<th>Earthwork Description</th>
<th>Quantity (CU YD)</th>
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</thead>
<tbody>
<tr>
<td>Total Earthwork</td>
<td>1,234,567</td>
</tr>
</tbody>
</table>

## Earthwork Summary - Additional Quantities

<table>
<thead>
<tr>
<th>Earthwork Description</th>
<th>Quantity (CU YD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Earthwork</td>
<td>1,234,567</td>
</tr>
</tbody>
</table>

## Earthwork Summary - Notes

- All earthwork quantities are rounded to the nearest 100 cubic yards.
- Additional notes and specifications are provided in the project documentation.

---

**Note:** All earthwork quantities are subject to change based on site conditions and project requirements.

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**Additional Details:**

- The project includes earthwork for highway construction.
- The earthwork is categorized into different types based on material and location.
- Special considerations are noted for soil compaction and drainage improvements.

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**Contact Information:**

- Project Manager: John Doe
- Contact Email: john.doe@delaware.gov
- Phone: 123-456-7890

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**Documentation:**

- Project Manual
- Earthwork Specifications
- Construction Drawings

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**Project Timeline:**

- Estimated Completion: June 30, 2023
- Construction Period: April 1, 2023 - June 30, 2023

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**Safety Measures:**

- Site Safety Plan
- High Visibility Gear
- Environmental Stewardship Plan

---

**Project Location:**

- Delaware Department of Transportation
- 123 Main Street, Dover, DE 19901
# Earthwork Quantities

## Earthwork Summary - Totals

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity (Cu.Y.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Excavation and Embankment Quantity (Item 202000)</td>
<td>228,400 Cu.Y.</td>
</tr>
<tr>
<td>Less Material Required for SWM Embankment</td>
<td>30 Cu.Y.</td>
</tr>
<tr>
<td>Plus Excavation and Backfilling for Structures</td>
<td>2,710 Cu.Y.</td>
</tr>
<tr>
<td>Plus Excavation Incidental to Structural Items</td>
<td>4,186 Cu.Y.</td>
</tr>
<tr>
<td>Plus Excavation and Backfilling for Pipe Trenches</td>
<td>4,718 Cu.Y.</td>
</tr>
<tr>
<td>Plus Channel Excavation</td>
<td>6 Cu.Y.</td>
</tr>
<tr>
<td>Plus Excavation from Lateral or Longitudinal Ditches</td>
<td>0 Cu.Y.</td>
</tr>
<tr>
<td>Plus Excavation from Installation of Underdrains</td>
<td>1,903 Cu.Y.</td>
</tr>
<tr>
<td><strong>Less Topsoil Removed in Cut and Fill</strong></td>
<td>16,256 Cu.Y.</td>
</tr>
<tr>
<td>Less Topsoil Removed Outside of Cross Section Template for Haul Road</td>
<td>310 Cu.Y.</td>
</tr>
<tr>
<td>Less Topsoil Removed from Storm Water Management Ponds</td>
<td>1,460 Cu.Y.</td>
</tr>
<tr>
<td>Less Topsoil Removed from Borrow Sites</td>
<td>3,014 Cu.Y.</td>
</tr>
<tr>
<td>Less Unsuitable Excavation</td>
<td>232 Cu.Y.</td>
</tr>
<tr>
<td>Less Unsuitable Material Removed from SWM Facility</td>
<td>6,847 Cu.Y.</td>
</tr>
<tr>
<td>Less Material Used for Borrow Type A**</td>
<td>22,342 Cu.Y.</td>
</tr>
<tr>
<td>Less Material Used for Borrow Type D**</td>
<td>6,766 Cu.Y.</td>
</tr>
<tr>
<td>Less Material Used for Borrow Type B</td>
<td>0 Cu.Y.</td>
</tr>
<tr>
<td>Less Material Used for Borrow Type C**</td>
<td>10,208 Cu.Y.</td>
</tr>
<tr>
<td><strong>Total Excavation Available for Borrow, Type F</strong></td>
<td>174,362 Cu.Y.</td>
</tr>
</tbody>
</table>

**Note:** Soil test results in the vicinity of the ramp Q diversion ditch indicate the presence of materials suited for borrow, types A, C, and D. Borrow, type A capping required.

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity (Cu.Y.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borrow, Type A for Capping</td>
<td>19,877 Cu.Y.</td>
</tr>
<tr>
<td>Less Topsoil placed on fill slopes</td>
<td>1,252 Cu.Y.</td>
</tr>
<tr>
<td><strong>Subtotal Borrow, Type A Capping Required</strong></td>
<td>18,618 Cu.Y.</td>
</tr>
<tr>
<td>Plus Capping Required x Adjustment Factor (0.20)</td>
<td>3,724 Cu.Y.</td>
</tr>
<tr>
<td><strong>Subtotal Adjusted Borrow, Type A Required</strong></td>
<td>22,342 Cu.Y.</td>
</tr>
</tbody>
</table>
Typical Sections

A little context

• Type A Borrow
• Soil cement
  – Type D Borrow
  – Portland Cement
  – Water
• PTB
  – AASHTO M43, 57 stone
  – Portland cement or asphalt cement
# Typical Sections

AASHTO M43, 57 stone

<table>
<thead>
<tr>
<th>Size Number</th>
<th>Nominal Size, Square Openings</th>
<th>Amounts Finer Than Each Laboratory Sieve (Square Openings), Mass. %</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>100 mm (4 in.)</td>
<td>90 mm (3/8 in.)</td>
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<tr>
<td>-------------</td>
<td>-----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
<td>90 to 100</td>
</tr>
<tr>
<td>2</td>
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<td>24</td>
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<td>--</td>
<td>--</td>
</tr>
<tr>
<td>10</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
Horizontal and Vertical Control
## CIRCULAR CURVE NO. 7 - US 301 NB

| PC (11038) | STATION | 880+67.33 | 883+12.74 | 885+58.00 |
| CC (11039) | NO. 301  | 883+12.74 | 886+00.00 | 886+00.00 |
| PT (11040) | EASTING | 559248.086 | 559943.448 | 559738.581 |
| | NORTHING | 559355.099 | 559355.099 | 559355.099 |
| | RADIUS | 8060.0000 | 8060.0000 | 8060.0000 |
| | DESIGN SPEED (mph) | 60.0000 | 60.0000 | 60.0000 |
| | SUPERELEVATION | 2.0000% | 2.0000% | 2.0000% |
| | DELTA | 3° 29' 16.8478'' Left | 3° 29' 16.8478'' Left | 3° 29' 16.8478'' Left |
| | DEGREE OF CURVATURE (ARC) | 0° 42' 39.1167'' | 0° 42' 39.1167'' | 0° 42' 39.1167'' |
| | LENGTH | 490.8712 | 490.8712 | 490.8712 |
| | TANGENT | 245.4114 | 245.4114 | 245.4114 |
| | CHORD | 490.5954 | 490.5954 | 490.5954 |
| | MIDDLE ORTHOGONAL | 3.7336 | 3.7336 | 3.7336 |
| | EXTERNAL | 3.7336 | 3.7336 | 3.7336 |
| | TANGENT DIRECTION | N 0° 45' 39.3753'' E | N 0° 45' 39.3753'' E | N 0° 45' 39.3753'' E |
| | RADIAL DIRECTION | S 89° 14' 20.6248'' E | S 89° 14' 20.6248'' E | S 89° 14' 20.6248'' E |
| | CHORD DIRECTION | N 0° 58' 59.0486'' W | N 0° 58' 59.0486'' W | N 0° 58' 59.0486'' W |
| | RADIAL DIRECTION | N 87° 16' 22.5275'' E | N 87° 16' 22.5275'' E | N 87° 16' 22.5275'' E |
| | TANGENT DIRECTION | N 2° 43' 37.4725'' W | N 2° 43' 37.4725'' W | N 2° 43' 37.4725'' W |

SEE SHEET HV-02 FOR CURVE 10 DATA

---

**TRAVERSE POINT #63 REBAR AND CAP**

**TRAVERSE POINT #64 REBAR AND CAP**
Construction Plans
Construction Plans
Construction Plans
Construction Plans
Grades and Geometrics
Construction Details

48"x48" DRAINAGE INLET ASSEMBLY

SECTION A-A

SECTION B-B

SECTION C-C

NOTES:
1. Fabricate and maintain inlet (resiliency restraint, grates, top units, etc.) as per plans and drawings. See standard No. 204 for drainpipe details. See standard No. 123 for drain, frame, and concrete details.
2. Use rebar reinforcement (SRB-16) as shown. See standard No. 118 for drain, frame, and concrete details.
3. Drainage inlet assembly shall be used to fill the gap between the drainage inlet frame.
Nominal weight: 8’-7” x 9’-6” x 116’-6” = 9,499.6 CF x 150 #/CF = 1.4 million pounds = 712 ton
Bridge Plans

Bridge 1-433
Pier 2
A conventional pier
Bridge Plans

Bridge 1-433
Pier 3
The second “straddle bent”
Stormwater Plans
Stormwater Plans
This is SW 401 from the profile sheet we just saw...but I don’t see it labeled as such.
Traffic Control Plans

• Very detailed plans
• Lots and lots of notes
• Signs and pavement markings shown overtop of construction plans
• Traffic phasing
Detour Plan
Signing, Striping, ... Plans
Right of Way
Right of Way
Right of Way
## Right of Way

<table>
<thead>
<tr>
<th>Right of Way</th>
<th>Property</th>
<th>Date of Record</th>
<th>Title Source</th>
<th>Description</th>
<th>Platinum</th>
<th>Gold</th>
<th>Silver</th>
<th>Bronze</th>
<th>Color</th>
<th>Percent</th>
<th>Note</th>
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<tbody>
<tr>
<td>US 301</td>
<td>11/15/2012</td>
<td>11/15/12</td>
<td>DEPARTMENT OF TRANSPORTATION</td>
<td>3.5 ACRES</td>
<td>99%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
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</table>

---

**Delaware Department of Transportation**

NOT TO SCALE

**US 301 & SR 1 INTERCHANGE**

**DATA AND TABULATION SHEET**

[Logo] Delaware T/LTAP
How We Use the Plans

• We’ll use a box culvert example to illustrate how we use various parts of the Contract Drawings and the Working Drawings (shop drawings).
Box Culvert Example
Box Culvert Example

- Endwall 404
- Pipe P465
- Manhole 414
- ~Sta. 1012+75?
- On Ramp Q
Box Culvert Example

• Endwall 404
• Pipe P465
• Manhole 414
• What’s this?
  – Special Detail?
  – Sheet DT-14?
  – That’s on the Construction Details

<table>
<thead>
<tr>
<th>DRAINAGE PIPE SCHEDULE</th>
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<tbody>
<tr>
<td>NO.</td>
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</tr>
<tr>
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</tr>
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<tr>
<td>483</td>
</tr>
</tbody>
</table>

* SEE CONTRACT SPECIAL PROVISIONS.

<table>
<thead>
<tr>
<th>MANHOLE SCHEDULE</th>
</tr>
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<tbody>
<tr>
<td>NO.</td>
</tr>
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</tr>
<tr>
<td>412</td>
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<tr>
<td>414</td>
</tr>
</tbody>
</table>

* SEE SPECIAL DETAIL, SHEET DT-15.

<table>
<thead>
<tr>
<th>ENDWALL SCHEDULE</th>
</tr>
</thead>
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<td>NO.</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>404</td>
</tr>
</tbody>
</table>

* SEE SPECIAL DETAIL, SHEET DT-14
Box Culvert Example
Box Culvert Example

- More like Sta. 1012+40?
- Existing and proposed grades
- Soil boring close by – Sta. 1012+36.48
Endwall 404...We’ve been looking for you

Box Culvert Example
Box Culvert Example

- 3’-2” x 22’ footer
  - 1’-3” thick/deep
- Twin boxes
  - 2’ H x 4’ W
  - Skewed 87°58’19”
Box Culvert Example

- 12” GAB
- Some rebar detail
Box Culvert Example
Box Culvert Example

• Let’s compare the Contract Drawings to the Shop Drawings
  – Shared culpability? Gillespie Precast submits to Tutor Perini submits to WRA submits to RK&K
  • Who sealed it?
  – Level of detail in shop drawing versus plans
Box Culvert Example

• Think of shop drawings like this
  – Contractor (subcontractor, precaster, vendor)
    • We looked at your plans and specifications and this is what we plan to deliver to you; we assert that it is compliant with your requirements
  – Owner (Owner’s representative)
    • Agreed

• Once this exchange is complete, the shop drawing becomes the standard for acceptance
Questions?

Matheu J. Carter, P.E.
Delaware Center for Transportation
Delaware T2/LTAP Center
355 DuPont Hall
University of Delaware
matheu@udel.edu