# USACE Corps of Engineers Virtual Design Modeling Autodesk Civil 3D Template

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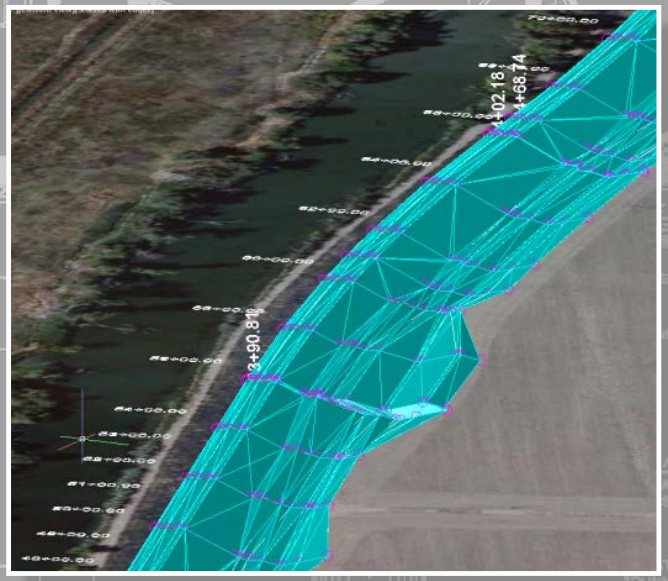
**ERDC-ITL – CAD/BIM Technology Center**

**April 2018**



David Johnson, ERDC, CAD/BIM Technology Center
Eugene Hubbell - USACE POA
Patrick O'Connor, Charles Byerley, Kyle Smallegan – USACE SAM
Daniel Nelson – USACE NAP
Leo Lavayen – Advanced Solutions, Inc.

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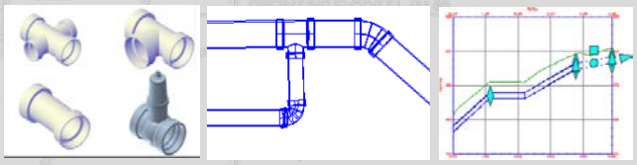
# CIM – CIVIL INFORMATION MODELING

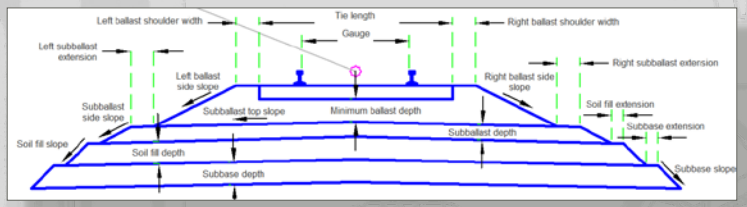
**Real Objects**:

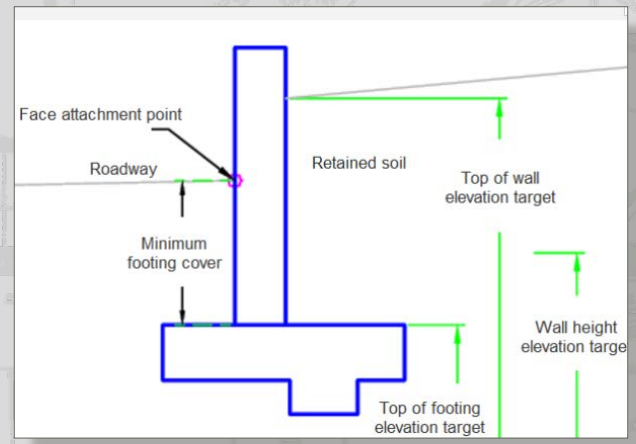
- Levees
- Channels
- Floodwalls
- Roads
- Pipes

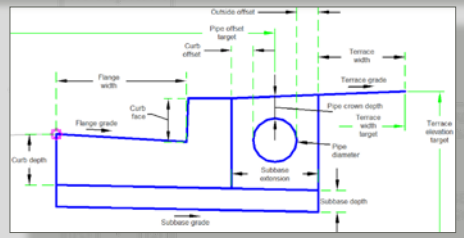


**CIM Objects**:

- Levees
- Channels
- Floodwalls
- Berms
- Retaining Wall
- Roads
- Railroads
- Pressure Piping



**With the process of advanced Modeling, you are modeling with Objects that behave like real world objects**

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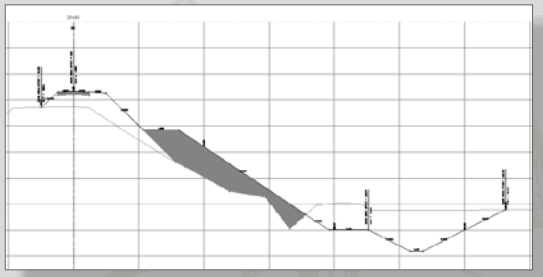
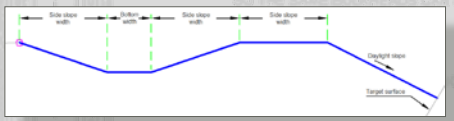
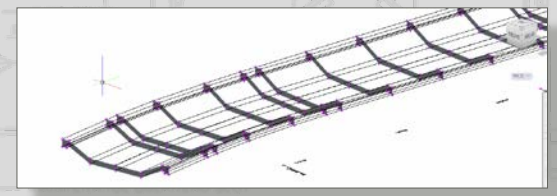
# CIM: THE POWER OF SYSTEMS

The power of Advanced Modeling CIM is its ability to use the Objects in “Systems”

- Channel System
  - The Alignment – path of the channel
  - The Profile –
    - Existing
      - what the channel vertical elevation is currently
      - Follows existing 3D surface elevations
      - Relationship to the existing ground surfaces
    - Designed
      - what the channel vertical elevation (depth) needs to be
  - The Section/Assembly –
    - the required depth and min/max slopes of the channel sides
  - The Corridor –
    - Assign Section of channel to follow Alignment
    - Allow channel object to connect to existing grade based on rules:
      - Min/max slopes, distances







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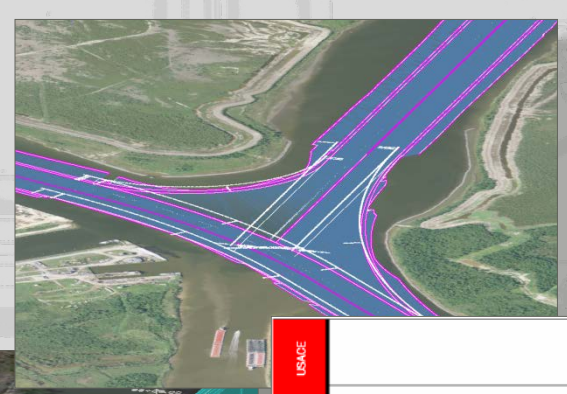
# CIVILIZING BIM- *USACE CIVIL 3D TEMPLATE*

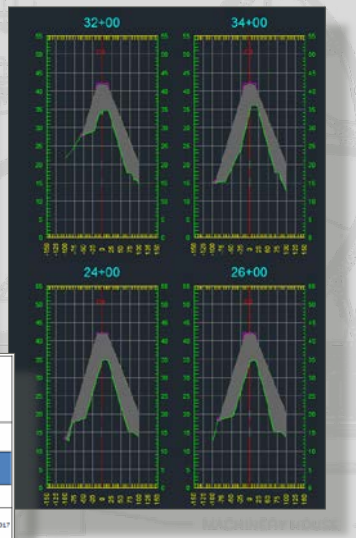
*-thanks to Steve Hutsell*

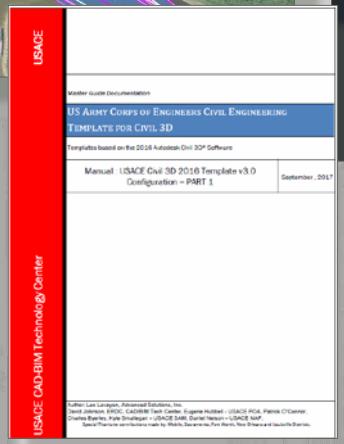
USACE Template with Styles set for object modeling and national standards compliance.

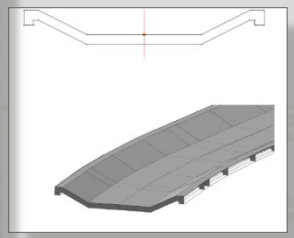
Includes :

- .DWT Template
- Support files
  - .LIN - Linestyles
  - Pipes Catalog
  - .STB & .CTB
  - .SHX – SHAPE files
  - Survey File sample
- Manuals





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# VIRTUAL MODELING TEMPLATE FOR CIVIL

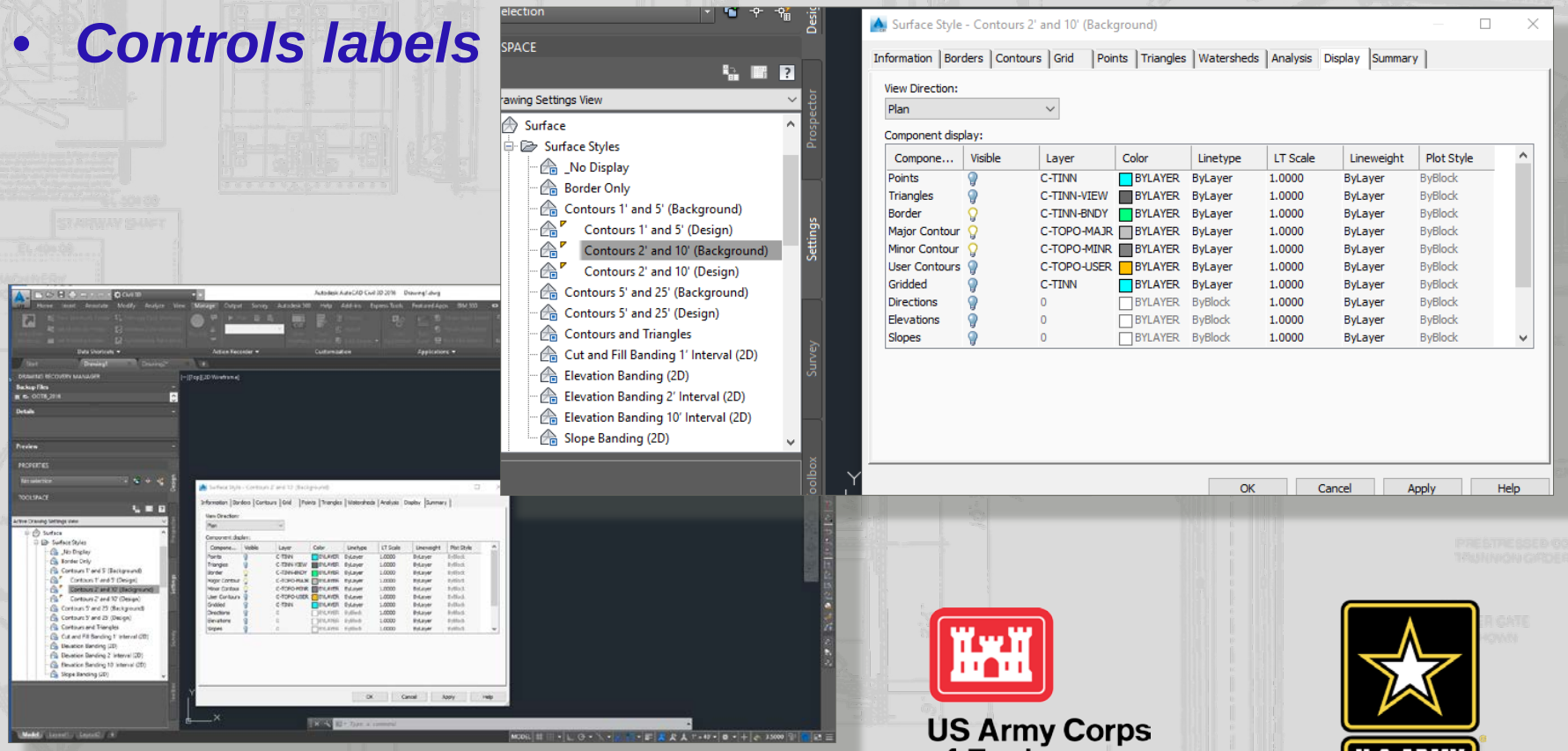
**Civil Object Configurations:**

- Alignment Styles
- Profile Styles
- Section Styles
- Surface Styles
- Sample Lines
- Corridor Styles
- Point Styles
- Survey
- Pipe Styles
- Piping Networks

# CIVIL 3D STYLES – the Heart of C3D

## Civil 3D is controlled by *Styles Settings*

- ***Sets display information***
- ***Controls layers***
- ***Controls labels***

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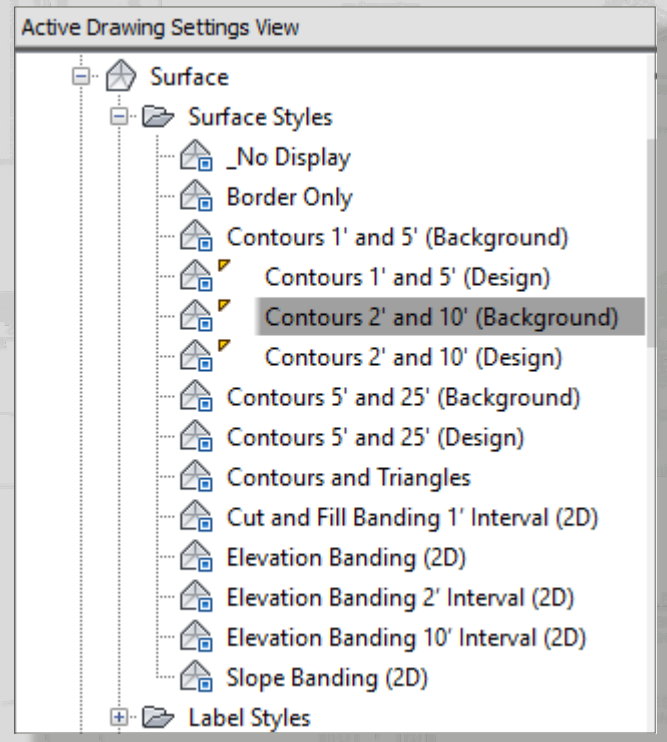
# CIVIL 3D STYLES – the Heart of C3D

## *Object Style Settings*

- *Each Object has style settings set up:*
  - *Point Styles*
  - *Surface Styles*
  - *Point Cloud Styles*
  - *Alignment Styles*
  - *Profile Styles*
  - *Section Styles*
  - *Corridor Styles*

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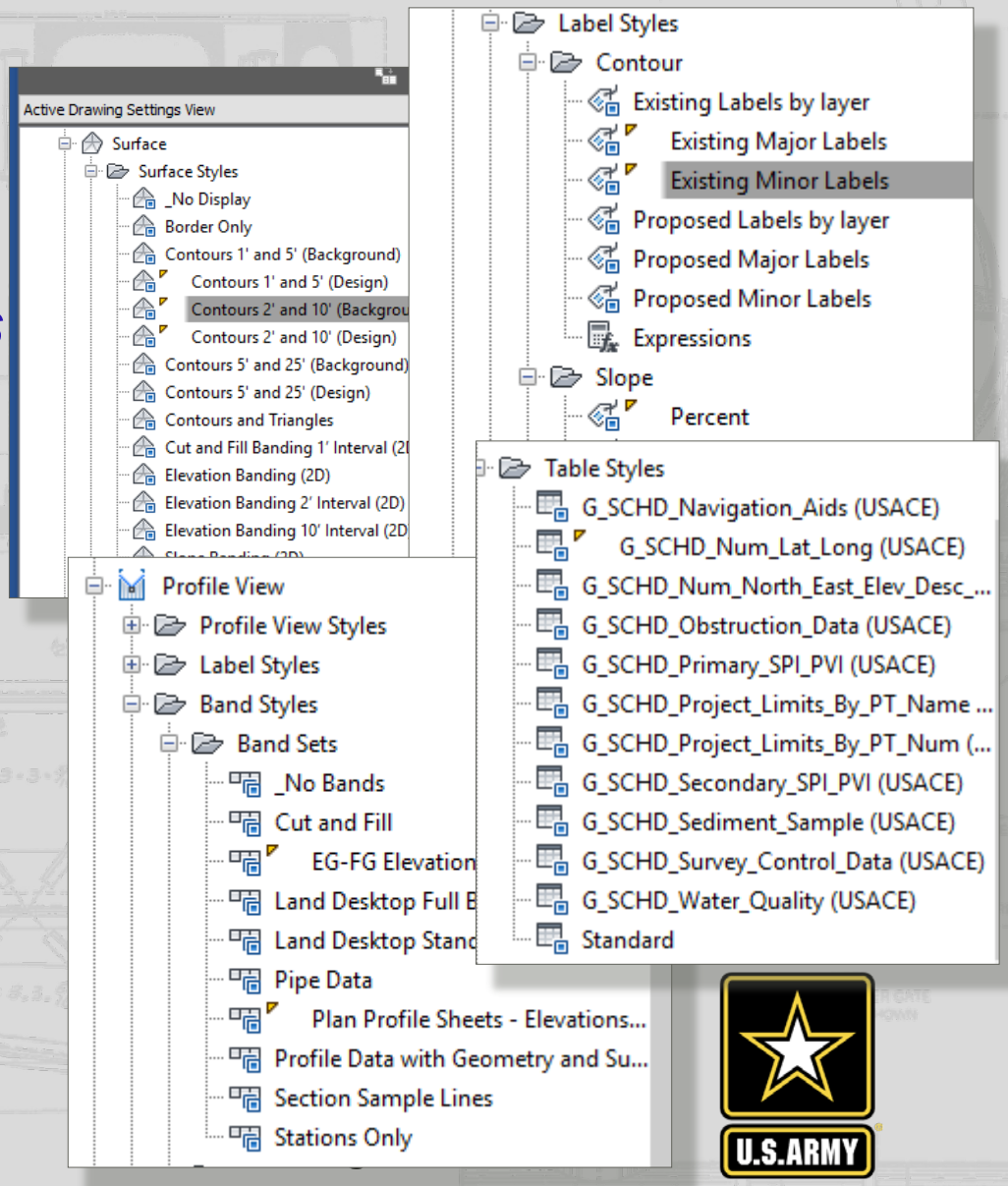
# CIVIL 3D STYLES – the Heart of C3D

## *Styles Settings*

- *Different style Types:*
  - *Surface Styles*
  - *Profile View Styles*
  - *Label Styles*
    - *Contour*
    - *Slope*
    - *Navigation Aids*
    - *Obstruction Data*
    - *Project Limits*
  - *Band Styles*
  - *Table Styles*

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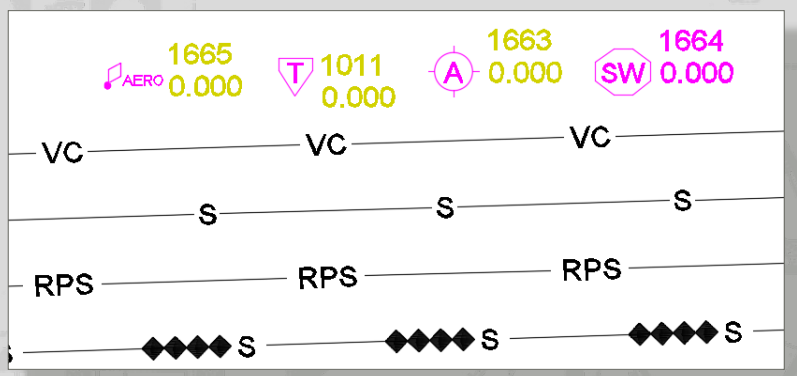
# USACE CIVIL 3D SETTINGS

## Annotation Settings




- Default Civil 3D Annotation:
  - Set as *Arial* Style
    - *Arial* font
    - Non-annotative
      - *Note: Civil 3D will adjust non-annotative text based on the view scale*
    - Height = 0’-0”
    - This keeps standard requirements as well as makes a simple check of making sure *Arial* style is *Arial* font
- Tables, Labels, Point styles
  - ‘*Arial*’ Style
- Line Styles

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# USACE CIVIL 3D SETTINGS

## Dimension Settings

- **Civil 3D Dimension Styles:**
  - **AEC_Civil_Arrow**
    - Arrow – closed /filled marker
    - Text height : 0.1”
    - Precision - 0.00 (hundredths)
    - Primary units – Decimal
  - **AEC_Civil_Slash**
    - Architectural tick - slash marker
    - Text height : 0.1”
    - Precision - 0.00 (hundredths)
    - Primary units – Decimal

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# ABBREVIATIONS

Shortcut Abbreviations set:

| Alignment Geometry Point Text | |
|---|---|
| Station Equation Increasing | Increasing |
| Curve Mid Point | Mid |
| Reverse Curve-Curve Intersect | PRC |
| Spiral-Tangent Intersect | ST |
| Alignment End | EP |
| Tangent-Curve Intersect | PC |
| Compound Curve-Curve Intersect | PCC |
| Alignment Beginning | BP |
| Curve-Spiral Intersect | CS |
| Tangent-Tangent Intersect | PI |
| Spiral-Spiral Intersect | SS |
| Reverse Spiral Intersect | SPI |
| Curve-Tangent Intersect | PT |
| Spiral-Curve Intersect | SC |
| Station Equation Decreasing | Decreasing |
| Tangent-Spiral Intersect | TS |

| Profile | |
|---|---|
| Profile Start | BVP |
| Profile End | EVP |
| Point Of Vertical Intersection | PVI |
| Grade Break | BREAK |
| Vertical Tangent-Curve Intersect | BVC |
| Vertical Tangent-Curve Intersect Station | BVCS |
| Vertical Tangent-Curve Intersect Elevation | BVCE |
| Vertical Curve-Tangent Intersect | EVC |
| Vertical Curve-Tangent Intersect Station | EVCS |
| Vertical Curve-Tangent Intersect Elevation | EVCE |
| Vertical Compound Curve Intersect | VCC |
| Vertical Compound Curve Intersect Station | VCCS |
| Vertical Compound Curve Intersect Elevation | VCCE |
| Vertical Reverse Curve Intersect | VRC |
| Vertical Reverse Curve Intersect Station | VRCS |
| Vertical Reverse Curve Intersect Elevation | VRCE |
| High Point | HP |
| Low Point | LP |
| Curve Coefficient | K |
| Grade Change | A |
| Overall High Point | Overall HP |
| Overall Low Point | Overall LP |

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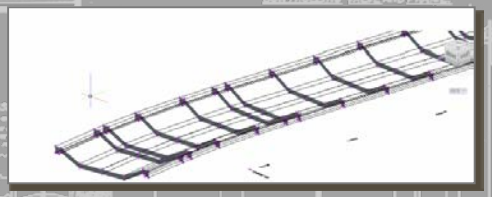
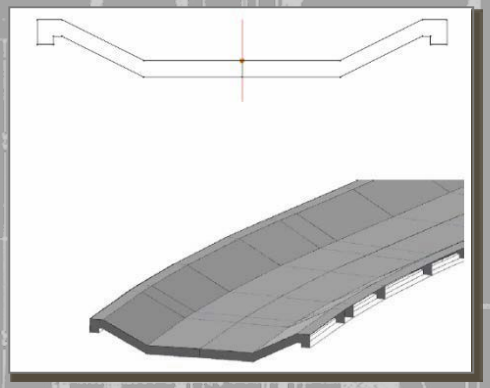
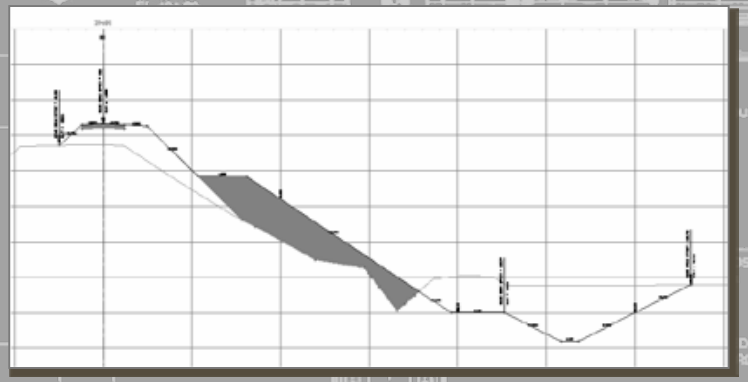
# CIVIL 3D VIRTUAL OBJECTS





## Civil 3D Object Settings



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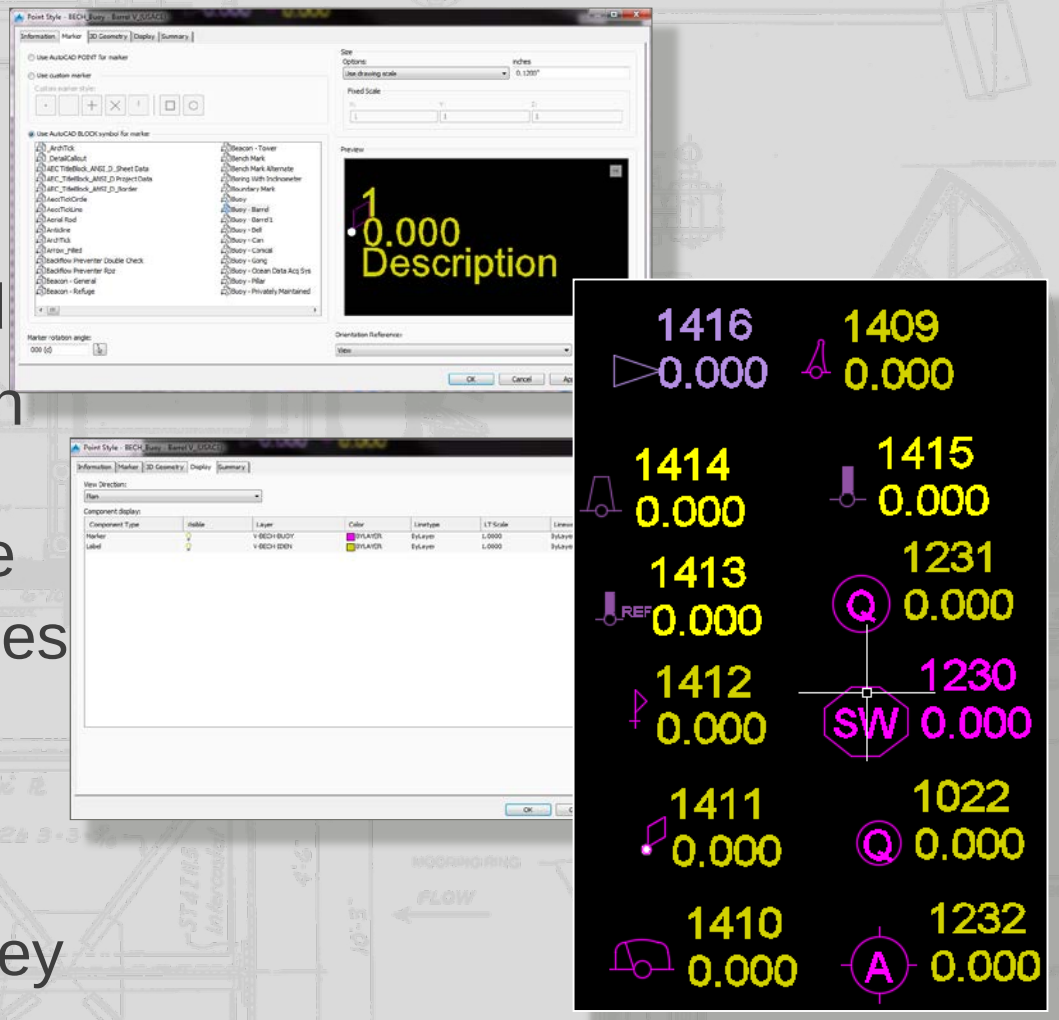
# POINT STYLES

Included Point Styles

- Point Marker assigned
- Layer settings assigned
- Symbols are scaled with the view scale-
  - Change view scale
  - Marker size changes
  - Marker text scales correctly
- Can be assigned to imported survey point key
  - Automatic linking

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# USACE CIVIL 3D TABLES

## Consistent Settings

‘Tables’ format is set:

G_SCHD_Slope_Arrow_Table (USACE)

G_SCHD_User_Defined_Contour_Table (USACE)

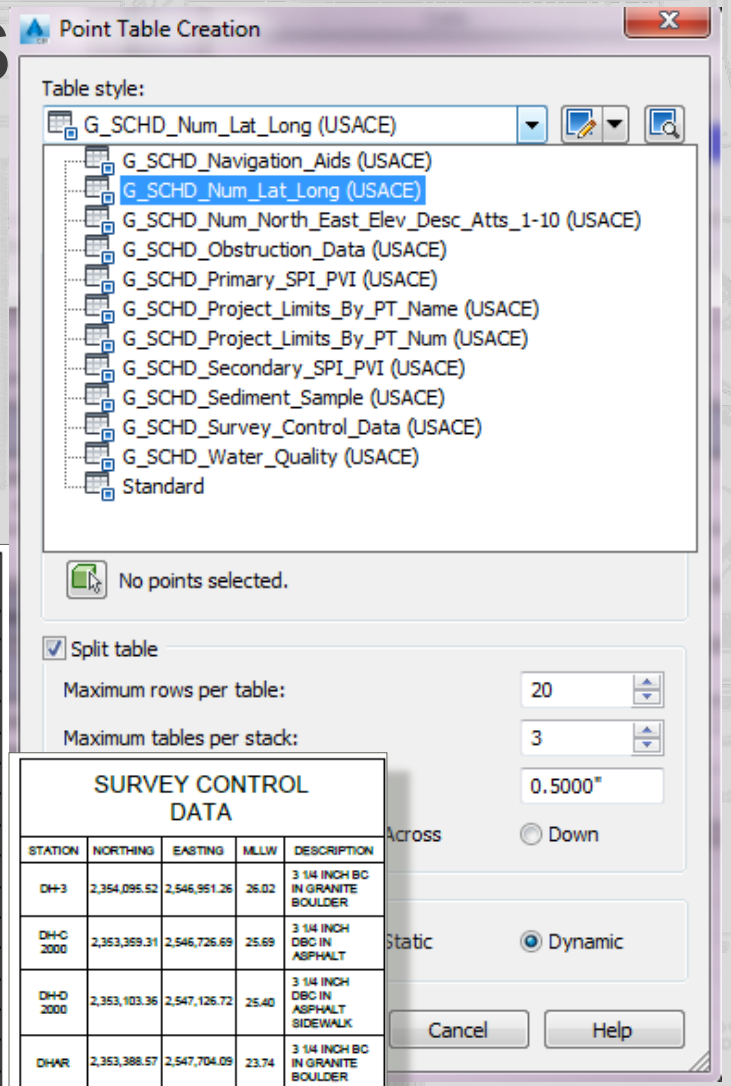
G_SCHD_Watershead_Table (USACE)

G_SCHD_Direction_Table (USACE)

G_SCHD_Elevation_Table (USACE)

G_SCHD_Contour_Table (USACE)

G_SCHD_Slope_Table (USACE)




SECONDARY SPI/PVI

| NAME | NORTHING | EASTING |
|---|---|---|
| GC-08 | 2,354,324.08 | 2,549,301.13 |
| GC-10 | 2,354,187.72 | 2,549,441.23 |
| GC-12 | 2,354,051.31 | 2,549,587.49 |
| GC-14 | 2,353,914.90 | 2,549,733.76 |
| GC-25 | 2,354,338.90 | 2,549,718.98 |
| GC-27 | 2,354,192.59 | 2,549,588.73 |
| GC-28 | 2,354,046.38 | 2,549,446.16 |
| GC-30 | 2,353,900.12 | 2,549,309.75 |
| GC-55 | 2,354,616.65 | 2,549,567.79 |
| GC-56 | 2,354,475.31 | 2,549,572.72 |
| GC-57 | 2,354,333.98 | 2,549,577.64 |
| GC-58 | 2,354,275.62 | 2,549,933.45 |
| GC-59 | 2,354,606.80 | 2,549,285.12 |
| GC-60 | 2,354,465.41 | 2,549,296.21 |
| GC-61 | 2,353,987.98 | 2,549,808.12 |
| GC-62 | 2,354,319.20 | 2,549,153.64 |
| GC-63 | 2,354,314.28 | 2,549,012.30 |
| GC-64 | 2,354,041.46 | 2,549,304.82 |
| GC-65 | 2,354,036.53 | 2,549,163.49 |
| GC-66 | 2,354,031.61 | 2,549,022.15 |
| GC-67 | 2,353,841.77 | 2,549,665.55 |
| GC-68 | 2,353,690.58 | 2,549,387.80 |

SURVEY CONTROL DATA

| STATION | NORTHING | EASTING | MLLW | DESCRIPTION |
|---|---|---|---|---|
| DH-3 | 2,354,095.52 | 2,546,951.26 | 26.02 | 3 1/4 INCH BC IN GRANITE BOULDER |
| DH-C 2000 | 2,353,359.31 | 2,546,726.69 | 25.69 | 3 1/4 INCH DBC IN ASPHALT |
| DH-D 2000 | 2,353,103.36 | 2,547,126.72 | 25.40 | 3 1/4 INCH DBC IN ASPHALT SIDEWALK |
| DHAR | 2,353,388.57 | 2,547,704.09 | 23.74 | 3 1/4 INCH BC IN GRANITE BOULDER |
| DL-1 1978 | 2,353,650.68 | 2,547,782.85 | 64.37 | USACE SBC FLAGPOLE IN CONCRETE |
| RAMP 1975 | 2,353,048.30 | 2,547,438.98 | 23.02 | USACE SBC W. SIDE RAMP END PVMT. |

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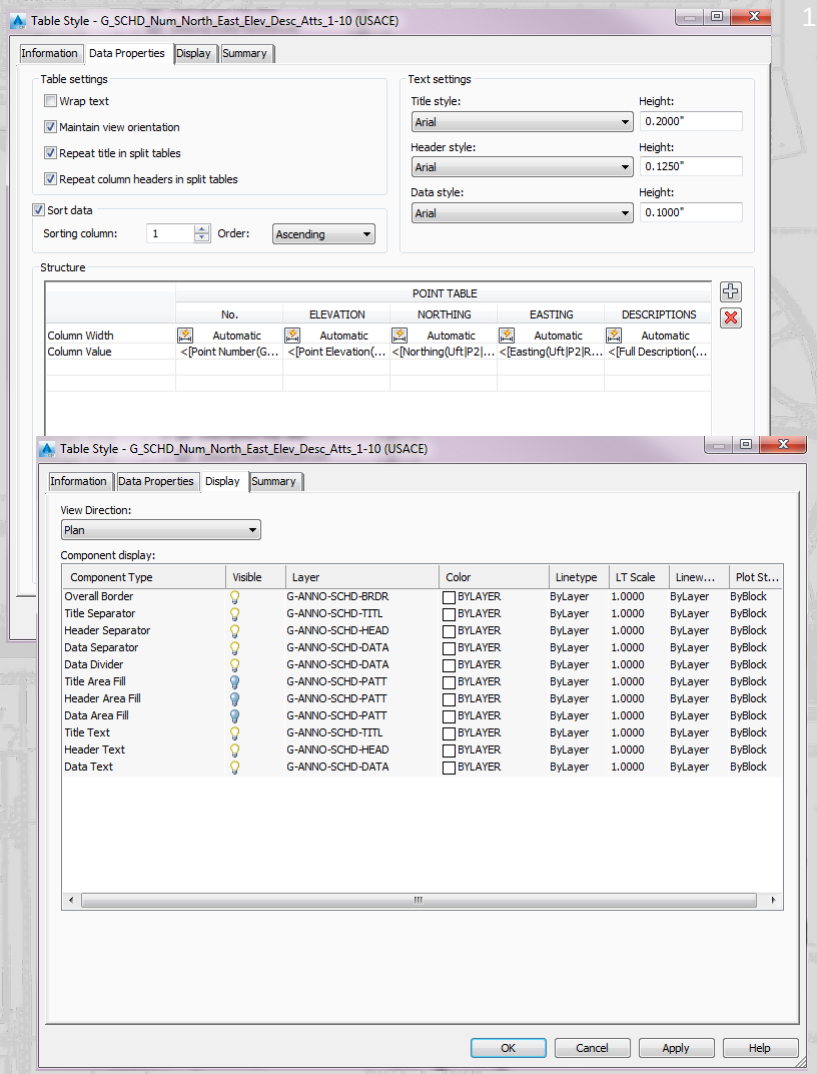
# TABLE SETTINGS

Table Objects:

- Read information from model
- Extract data and format the data based on table settings
- Layers assigned to separate components
- Data settings can be changed for specific table requirements

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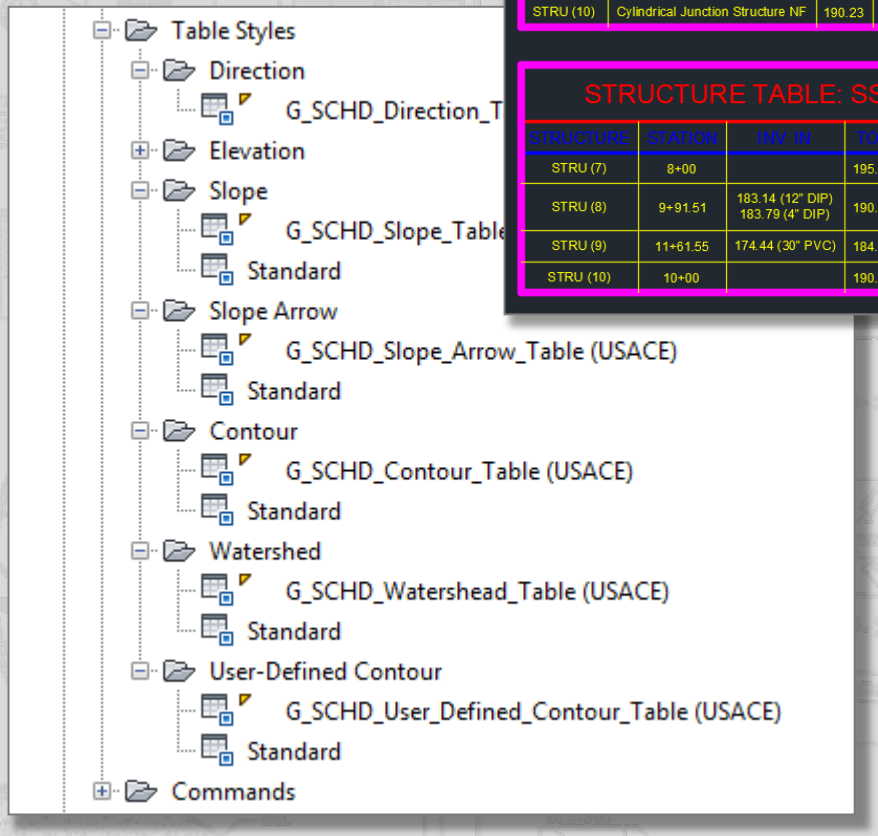
# USACE CIVIL 3D TABLES

## Tables are Objects




**DRAINAGE STRUCTURE TABLE: SSWR-A**

| STR. NO. | TYPE | T.C. | F.L. (OUTFALL) | NORTHING | EASTING |
|---|---|---|---|---|---|
| STRU (7) | Cylindrical Junction Structure NF | 195.43 | 188.34 | 3757187.68 | 11821384.89 |
| STRU (8) | Cylindrical Junction Structure NF | 190.80 | 181.87 | 3757014.10 | 11821466.26 |
| STRU (9) | Cylindrical Junction Structure NF | 184.14 | | 3756858.00 | 11821533.71 |
| STRU (10) | Cylindrical Junction Structure NF | 190.23 | 183.86 | 3757010.61 | 11821480.00 |

**DRAINAGE PIPE TABLE: SSWR-A**

| PIPE NO. | TYPE | LENGTH (FT.) | F.L. U.S. | F.L. D.S. | SLOPE (FT/FT) | DESIGN FLOW (C.F.S.) |
|---|---|---|---|---|---|---|
| PIPE (6) | 12" DIP | 191.70' | 188.34 | 183.14 | 2.72% | 0.000 |
| PIPE (7) | 30" PVC | 170.05' | 181.87 | 174.44 | 4.37% | 0.000 |
| PIPE (8) | 4" DIP | 14.17' | 183.86 | 183.79 | 0.48% | 0.000 |

**STRUCTURE TABLE: SSWR-A**

| STRUCTURE | STATION | INV. IN | TOP | INV. OUT |
|---|---|---|---|---|
| STRU (7) | 8+00 | | 195.43 | 188.34 (12" DIP) |
| STRU (8) | 9+91.51 | 183.14 (12" DIP)<br>183.79 (4" DIP) | 190.80 | 181.87 (30" PVC) |
| STRU (9) | 11+61.55 | 174.44 (30" PVC) | 184.14 | |
| STRU (10) | 10+00 | | 190.23 | 183.86 (4" DIP) |

**PIPE TABLE: SSWR-A**

| PIPE | SIZE | MATERIAL | LENGTH | SLOPE |
|---|---|---|---|---|
| PIPE (6) | 12" | DIP | 191.70' | 2.72% |
| PIPE (7) | 30" | PVC | 170.05' | 4.37% |
| PIPE (8) | 4" | DIP | 14.17' | 0.48% |

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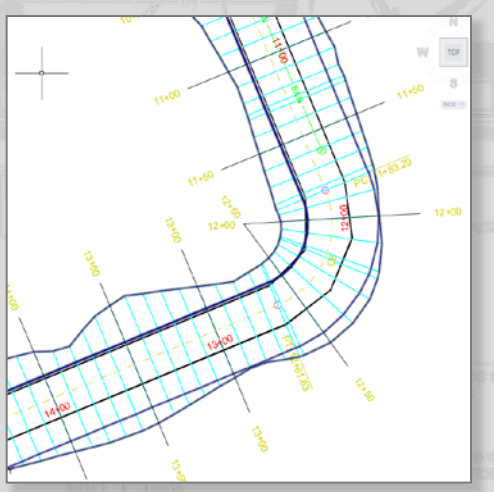
# ALIGNMENTS

Alignment Objects

- Various types of objects
  - Roads
  - Pipe networks
  - Channels
  - Levees
- Alignment Components
  - Offset
  - Curb return
- Label styles for alignments
- Table Styles

- Alignment Label Styles
  - Stations – Minor, Major
  - Station Offset
  - Line, Curve, Spiral
  - Tangent Intersection



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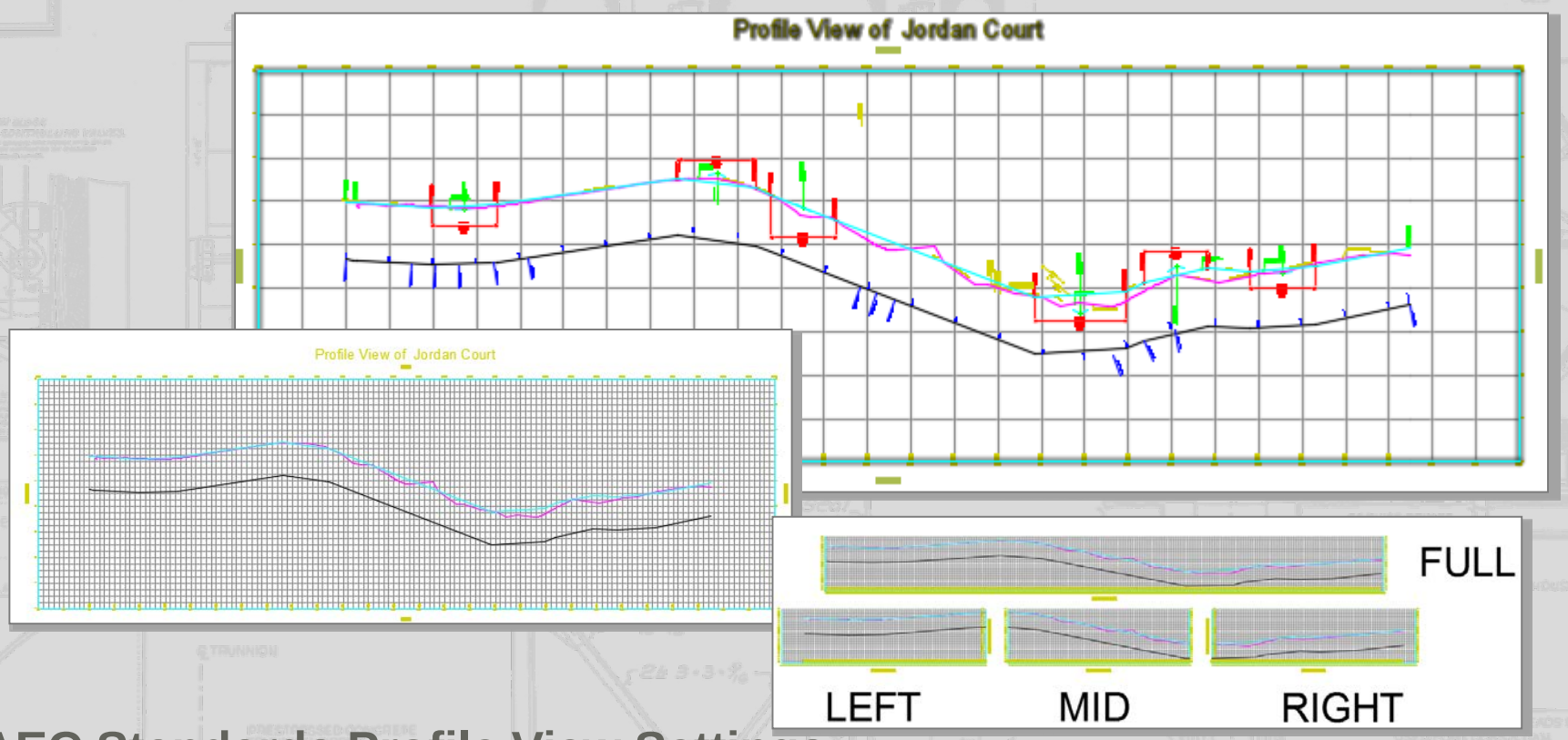
# PROFILES




## AEC Standards Profile View Settings

- Layer and label settings are built in
- Assign style

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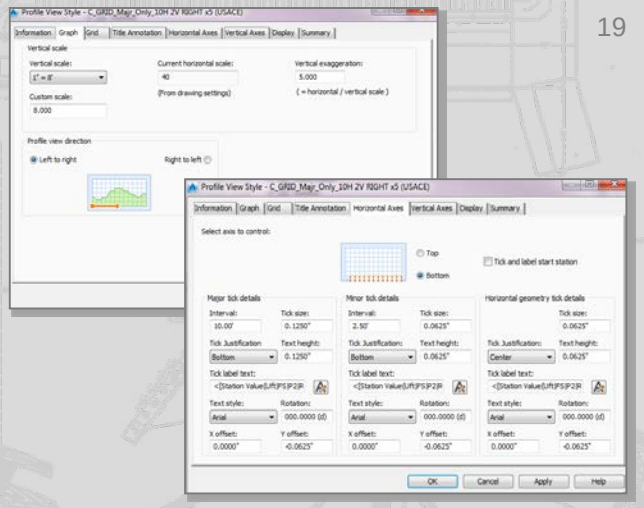
# PROFILES



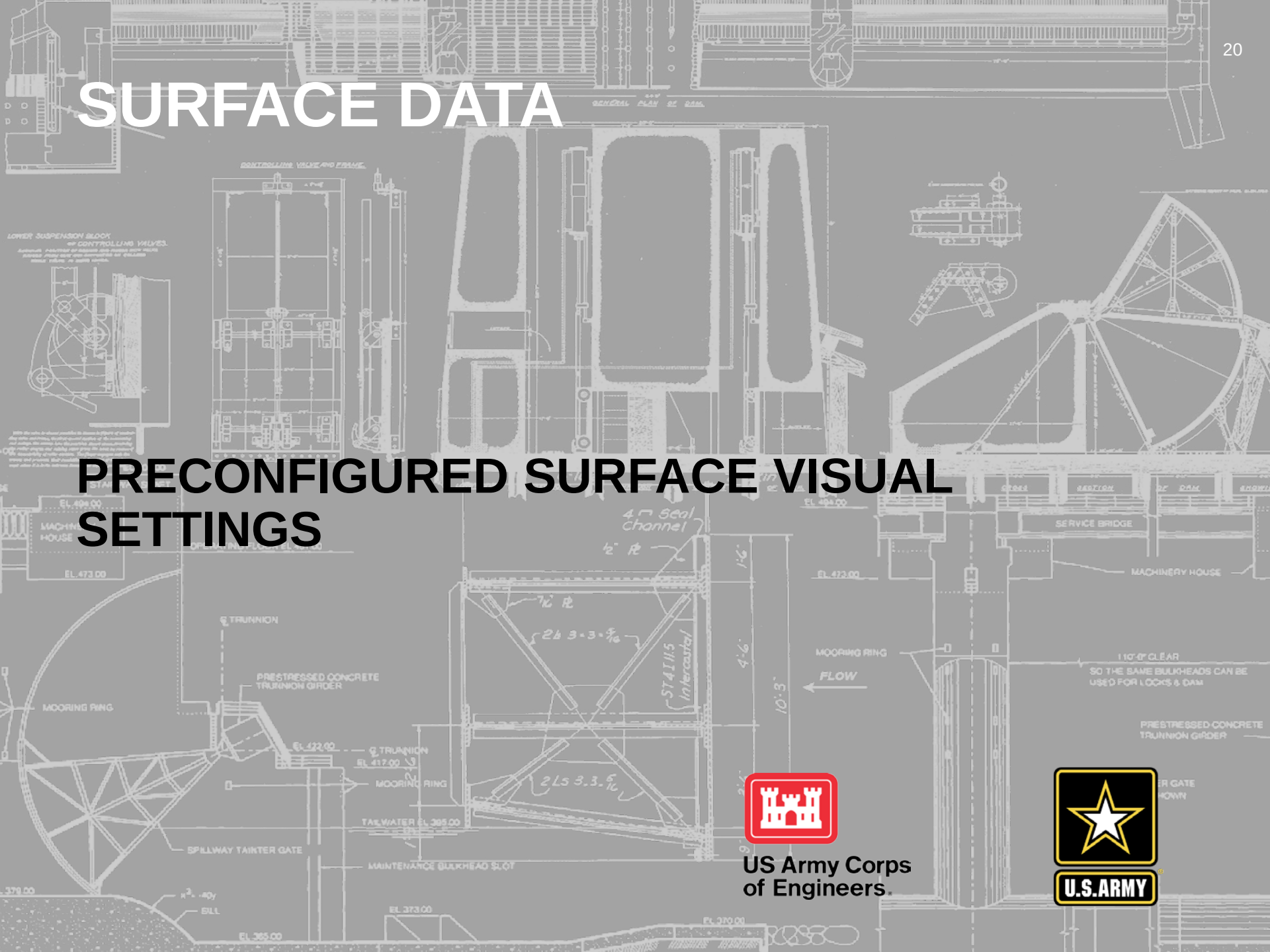
## AEC Standards Profile View Settings

- Profile Styles can be assigned to a profile
- Copy and Modify for different uses if needed
- Graph, Grid, Title Annotation, Horizontal & Vertical Axes, Display

| PROFILE | DESCRIPTION |
|---|---|
| C_GIRD_Projection (USACE) | Object Display - As Drawn |
| C_GRID_STA_Ex_Only_Majr_Minr (USACE) | Station & Ex ONLY @ Major & Minor Grids 0.5" height box Rememeber to set Profile 1 in Profile View Properties **Ex text is Hard Coded Italic** |
| C_GRID_STA_Ex_Only_Majr_ONLY (USACE) | Station & Ex ONLY @ Major Grids ONLY 0.5" height box Rememeber to set Profile 1 in Profile View Properties **Ex text is Hard Coded Italic** |
| C_GRID_STA_FG_Offset_Majr_Minr (USACE) | EXTRA "FG" 3rd ROW - Profile 2 @ Major & Minor Grids 0.5" height box - set to NO PLOT **Band Offest will Have to be shifted -.5 Offset ** |
| C_GRID_STA_FG_Offset_Majr_ONLY (USACE) | EXTRA "FG" 3rd ROW - Profile 2 @ Major ONLY Grids 0.5" height box - set to NO PLOT **Band Offest will Have to be shifted -.5 Offset ** |
| C_GRID_STA_Only_Majr_Only (USACE) | Station ONLY @ Major Grids ONLY 0.5" height box **For Use when NO Bands are Necessary** |

# SURFACE DATA

## PRECONFIGURED SURFACE VISUAL SETTINGS

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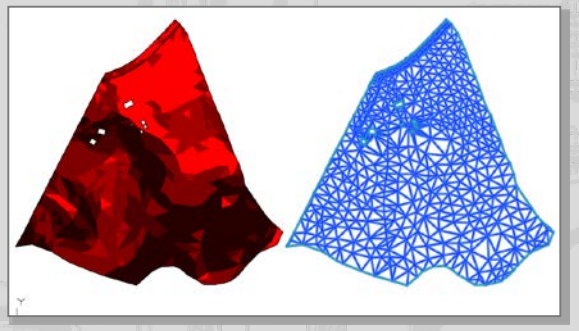
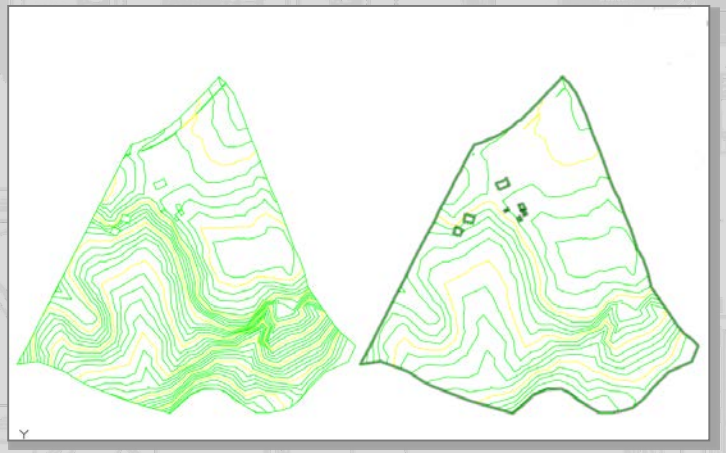
# SURFACE STYLES

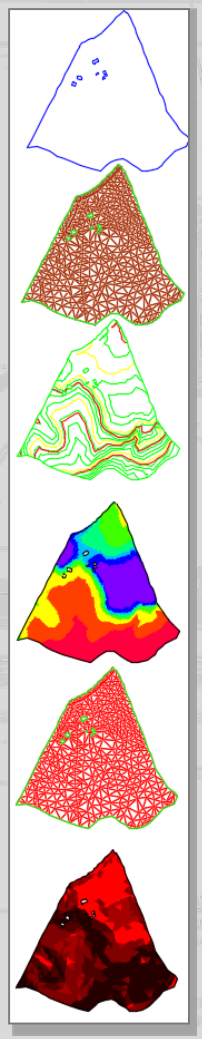
Create surface from survey, point cloud

Assign visual appearance

- Contours
- Analysis – Slopes
- Analysis – Elevation
- Hydrography
- Watershed
- TIN – Blue lines
- 3D Styles







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# USACE MOBILE DISTRICT IMPLEMENTATION PROJECT

**Take the USACE Civil 3D template and apply this to an actual project using design data provided**

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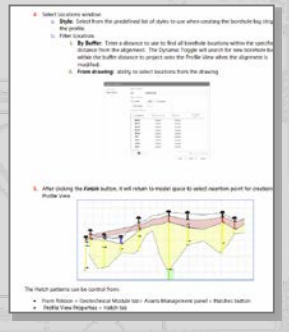
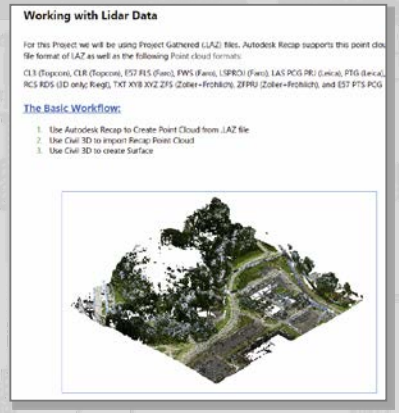
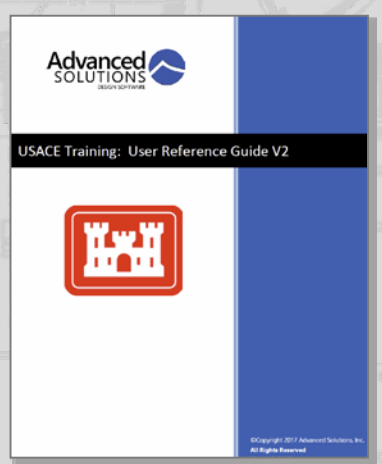
# DEMONSTRATION OF THE DESIGN PROCESS

- Objectives:
  - Use the ***USACE Civil 3D Template***
  - Use an existing design project as a base
  - Demonstrate the **Workflow** recommended to produce a design and construction documents
    - Project set-up
    - Shortcuts
    - Best practices



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# THE DEMO OF THE DESIGN PROCESS

- Work processes demonstrated:
  - Basic project set-up processes
    - Shortcuts
  - Survey
  - Geotechnical
  - GIS data incorporation
- Data used:
  - XML Surface data (from XML text file)
  - LIDAR surface data
  - GIS Shape files
  - CAD Data

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# THE CIM OBJECTS

- CIM Civil Objects demonstrated:
  - ALIGNMENTS
  - PROFILES
  - CORRIDORS
- Civil processes demonstrated:
  - Create Surfaces
    - Existing
    - Proposed
  - Grading
  - Geotechnical
  - Building Pad
  - Sidewalks

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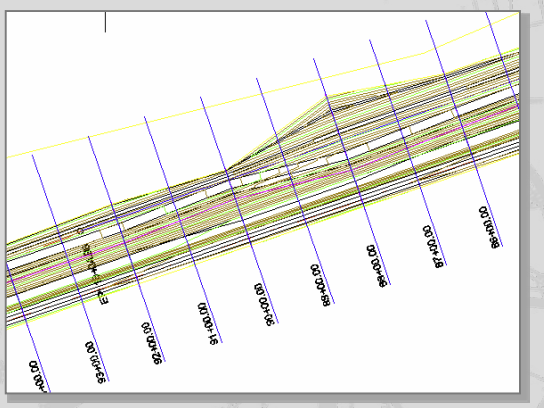
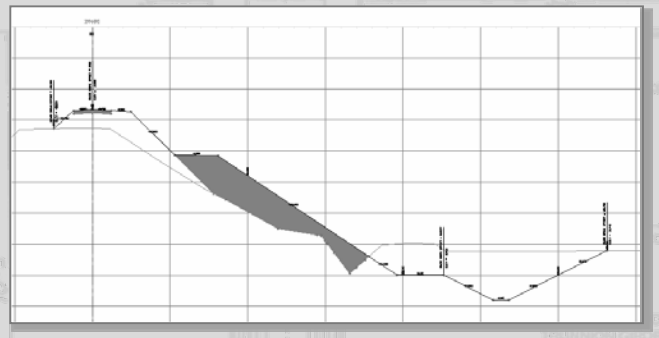
# BIM PROCESSES

- SURVEY Data:
  - Import data
  - Apply Point styles
- Create Alignments
- Create Profiles
  - Existing grades
  - Proposed grades
- Create Corridors
- Create Sections
  - Existing
  - Proposed





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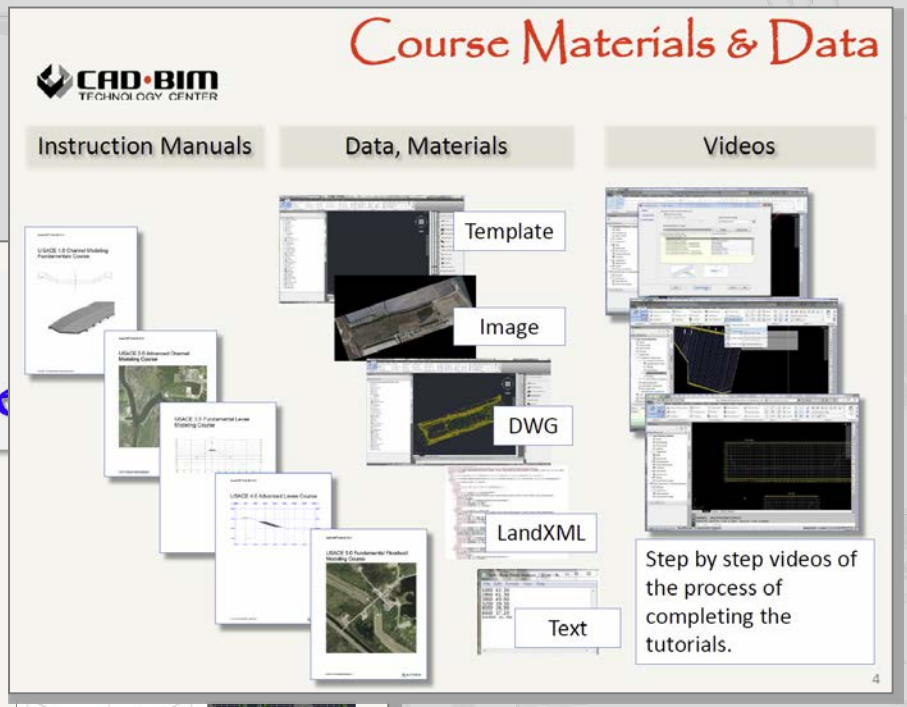
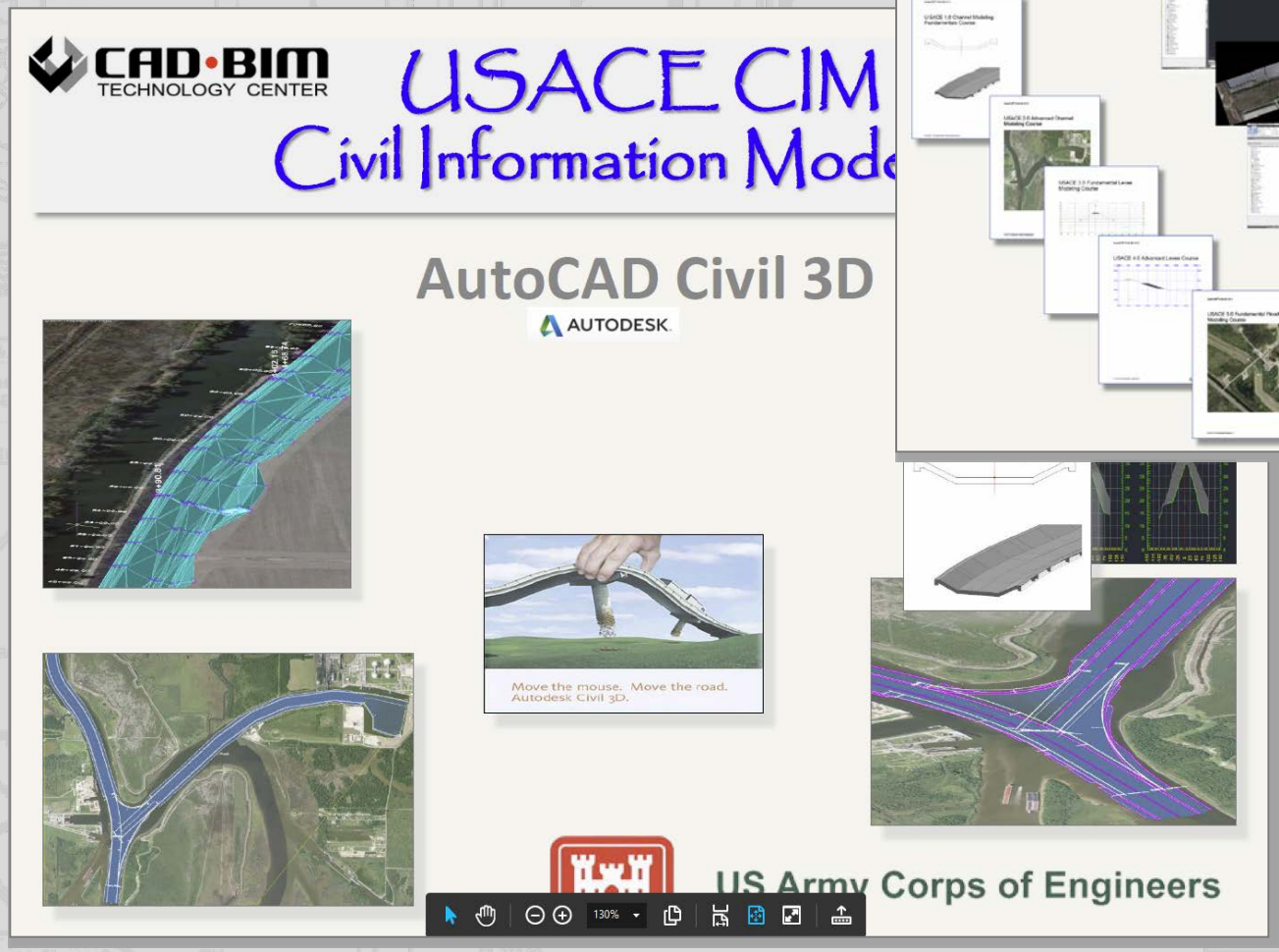
# CIVIL 3D TRAINING SITE : USACE

Online CAC training for USACE:

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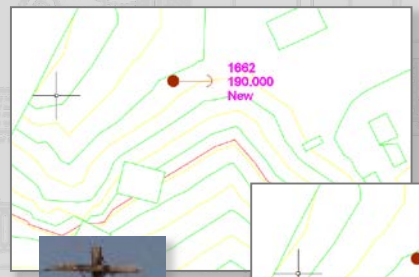
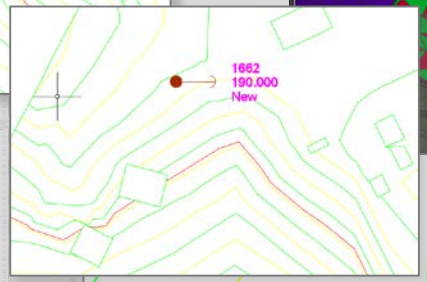
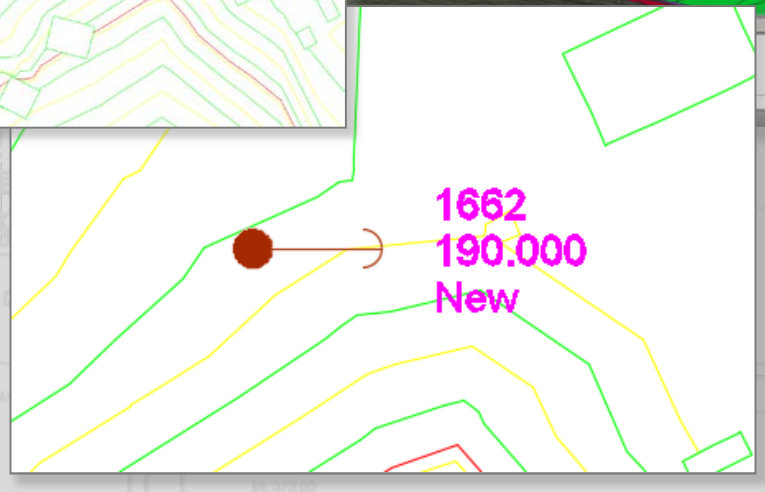
# SURVEY AUTOMATION

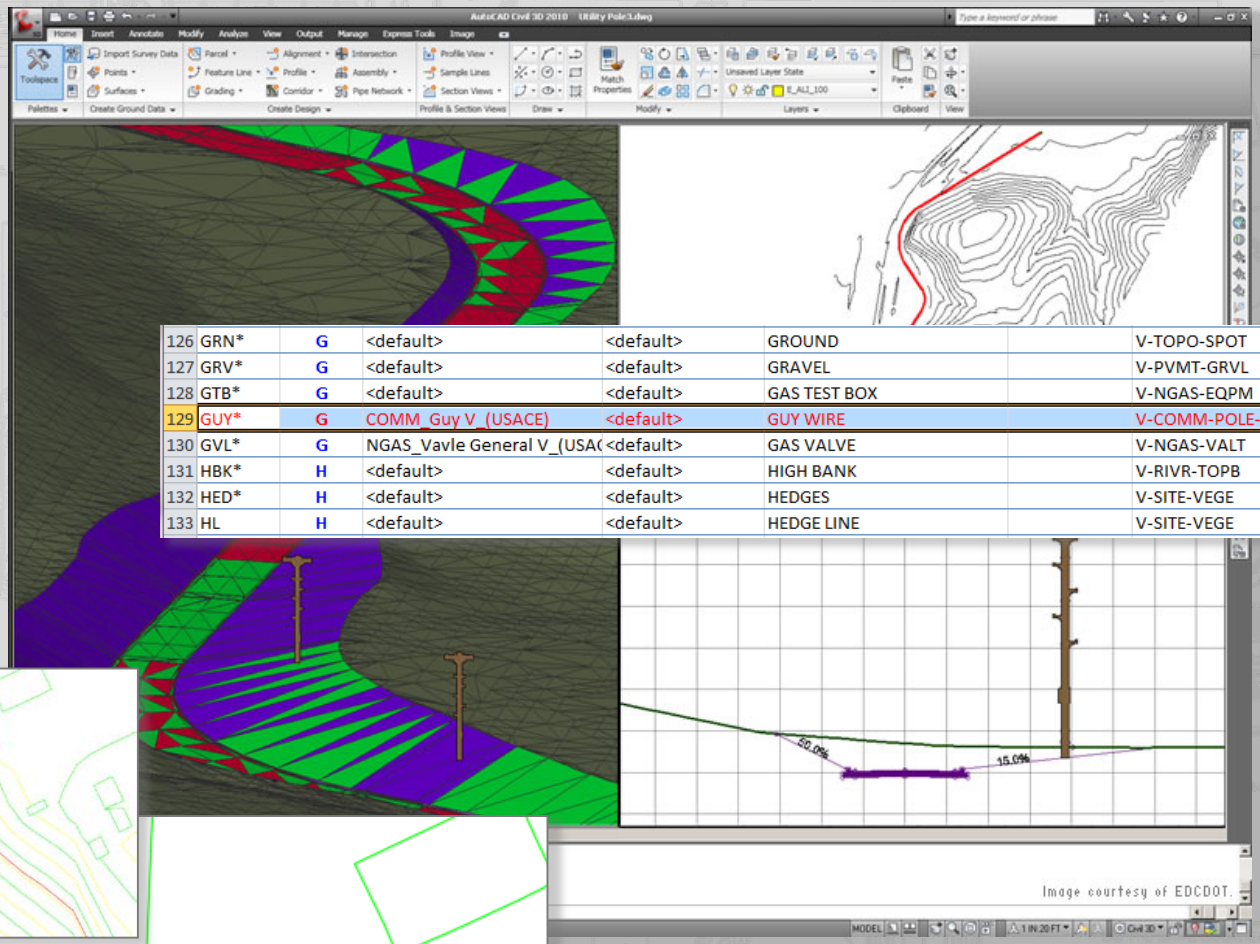
## From Site

- to Surveyor
- to Survey
- to DESIGN
- To CAD

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# ?? GOT QUESTIONS ??

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USACE Advanced Modeling - Civil 3D Team

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