CAD: Introduction to using CAD Data in ArcGIS

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What we will accomplish today

- Overview of ArcGIS CAD Support
- Georeferencing CAD data for ArcGIS
- How Mapping Specification for CAD can help
- Loading CAD features into a Geodatabase
- Creating CAD Data (Export to CAD)
- CAD data support in ArcGIS Pro 1.1
CAD/GIS Interoperability Scenarios

- ArcGIS user who needs to...
  - Display CAD data in maps
  - Load CAD data into their Geodatabase
  - Deliver GIS data in a CAD format
CAD in the Geospatial context

- CAD drawings are a large source of GIS data
  - Surveying
  - Cadastre
  - Civil engineering
  - Architecture
  - Landscape Architecture
  - Planning
  - Geodesign
CAD Drawings

- Geometry, text, and symbols
  - comprise CAD entities/elements
- Organized into layers or levels
- Symbology represents information
- Can have data attached to entities
CAD Datasets in ArcGIS

**Geometry**
- CAD entity geometry organized into feature classes

**Attributes**
- CAD properties, tags, and database links are stored in attribute tables

**Coordinate System**
- CAD data can be reprojected to overlay with other GIS layers

**World File**
- CAD drawings can be transformed from local coordinates to projected coordinates
Direct-read CAD datasets in ArcGIS
Translated on the fly as a virtual feature class
Contents of a CAD Dataset

City.dgn

- Annotation: Text, tags, and attribute definitions
- Multipatch: Polygons and is useful for 3D representation
- Point: Points, blocks, and cells
- Polygon: Closed areas such as polygons, ellipses, and circles
- Polyline: Lines, polylines, and arcs

City.prj

Projection files define a coordinate system for a CAD dataset. They are recommended but not required.
Display Control

- Turn layers off and on to control feature display
  - Saved in the .MXD or .LYR
  - Apply to the entire dataset
  - Restore back to original rendering
Filter CAD Features

• Isolate the CAD data you need to work with using…
  - Specific CAD Feature Classes
  - Drawing layer visibility
  - Definition Query

Filter CAD Features

- Use Definition Queries to create subsets
  - Saved in the .MXD or .LYR
  - Expressions can be saved to .EXP files for re-use
CAD Data Support in ArcGIS 10.3.1

- ESRI has long provided CAD support and integration tools

- Out of the box
  - No extension required

- Direct read
  - Conversion not required

- Current version support:
  - AutoCAD DWG/DXF: Up to 2016 (read/write)
  - MicroStation DGN: Up to V8i SELECT series 3
DEMO: Assigning coordinate systems and Georeferencing CAD in ArcGIS
Georeferencing Process

- Assigning a coordinate system
- Applying a transformation
- Stop Tracing
- Not all CAD datasets require these steps
Assigning Coordinate Systems

- Defined at the CAD Dataset level
- Catalog window’s Spatial Reference Properties dialog
Universal Projection and World Files

- **Universal World File**
  - ESRI_CAD.WLD
  - Applies identical transformation to all CAD files in workspace
  - Useful for set of tiled CAD drawings

- **Universal Projection File**
  - ESRI_CAD.PRJ
  - Applies same coordinate system to all CAD files in workspace
Georeferencing Toolbar

- Georeferencing toolbar – use mouse pointer to move layer and create control points in map
  - Rotate, Scale, and Shift tools
Georeferencing

- Two-point Similarity transformation method
  - Move, Rotate, and Scale
  - Aspect ratio always maintained
  - Cannot skew or ‘rubber sheet’ CAD drawing

- Transformation managed by World Files
  - ArcGIS is not modifying the CAD drawing

*NOT required for drawings that are drawn in real-world coordinate location.*
Georeferencing: World Files

- File based, two point transformation for CAD data
- Uses the .wld file extension
- Simple text file containing two lines with two pairs of coordinate values:
  
  <From X1, From Y1> <To X1, To Y1>
  <From X2, From Y2> <To X2, To Y2>
ArcGIS for AutoCAD 350 - Free Download from Esri

- Access to GIS content
  - Basemaps
  - Image services, Map Services
  - Location Services
  - LISP API

- Access to Feature Services
  - Direct editing GIS data
  - Subtype, domains

- Mapping Specification for CAD
Mapping Specification for CAD (MSC)
Provides improved interoperability between CAD and GIS

• Open source framework developed by ESRI
  - GIS feature classes + attributes
  - Coordinate systems

• Utilizes CAD data structures to define schema and store data

• Leveraged by ArcGIS Desktop CAD tools
  - CAD direct read/import tools
  - Export to CAD
CAD data structure in ArcGIS

- Subset feature class

- AutoCAD Query
  - Layer, color, linestyle
  - Etc

- Invisible in AutoCAD

- Better than a SHP file
CAD/GIS Interoperability Scenarios

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Loading CAD data in ArcGIS

- Add to Geodatabase feature classes or create new Geodatabase from CAD
  - As-built updates
  - Editing requirements
  - Advanced Geodatabase tasks (i.e., Geometric Networks, Topology, etc.)

- Conversion supported by the Geoprocessing framework and ArcMap tools

- Can be combined with other Geoprocessing functions
  - Spatial Joins
  - Geometry manipulation
CAD Conversion Tools

- **ArcMap**
  - Export Data
  - Copy & Paste (Edit session)

- **ArcToolbox – Geoprocessing**
  - Feature Class to Feature Class
  - Copy Features
  - Import CAD Annotation
CAD to Geodatabase

• Designed for bulk loading CAD datasets into a Geodatabase

  - Combines Copy Features, Merge and Import CAD Annotation into single tool

  - Works at the dataset level
Loading CAD data Demo: Campus example
Geoprocessing Scenarios

- CAD text inside polygons
  - 3744
  - 3745
  - 3746
- CAD text near lines
  - 12°
- Line segments to polygons
- CAD to Geodatabase
- Append to existing Geodatabase
- Merge with other layers
CAD/GIS Interoperability Scenarios

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Data Submittal Demo
Export to CAD

- Output features to native CAD format
  - DGN V8
  - DWG/DXF Release 14 to 2016 (ArcGIS 10.3.1)
- Supports appending to existing CAD drawings
- Creates Seed files
  - CAD feature Classes (MSC)
  - Fields and default values, layers color, linestyles...

*Available at all license levels
Reserved CAD Fields

• Reserved CAD fields
  - Fields understood by Export to CAD
  - Creates shared cells, blocks, layers, colors
  - Creates MSC feature classes, fields, field values.

• Resources in help system
Accessing Services in Microstation

- MicroStation V8i has built-in WMS capabilities
- Web Mapping Services Imagery
- Web Feature Services
- Bentley Map works with Esri File Geodatabase?
Best Practices

• Tips and best practices for CAD & GIS
  - Seed/template file
  - Layer standards (Plan ahead)
  - Coordinate systems
  - Drawing in proper locations
  - Only use Model Space

• Export to CAD
  - template
  - Coffee and donuts
Demo: CAD support in ArcGIS PRO 1.1
ArcGIS Pro 1.1 CAD improvements
Feature Layers organized by Level/layer

• Group layer created with the feature class name and a suffix "Group"

• Feature layers based on CAD layer/Level names
  - Feature Class will be included with layer visibility turned off
  - Feature Layers for each Level/layer geometric type

• Feature Layers can be used as input to GP tools
  - Maintains Layer color with conversion
  - Honor CAD layer level visibility
ArcGIS Pro 1.1 CAD improvements

Separate Feature Layers for Blocks and Shared Cells

- Group layer created with the feature class name and a suffix "Group"

- Feature layers based Shared Cells and Blocks
  - Microstations Shared Cells
  - AutoCAD Blocks

- Attributes values
  - schema of Shared Cell and Block only
  - Removed from CAD point feature class
ArcGIS Pro 1.1 CAD improvements
Automatic Labeling of Annotation Points and Convert on Add

- CAD file support is simple feature classes
  - ANNOTATION features are currently added as a POINTS
  - Labeling of CAD POINT
  - Standard with other data sources

- Convert on Add Option (off by default)
  - Automatically converts CAD data to GDB
  - Simplifies data migration of conversion
What did we cover today?

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## More CAD at UC

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<tr>
<td>CAD: Introduction to using CAD Data in ArcGIS</td>
<td>Tue 7/21/2015 08:30 AM - 09:45 AM</td>
<td>Room 03</td>
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<tr>
<td>CAD: The ArcGIS for AutoCAD CAD Plug in</td>
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<tr>
<td>CAD: The ArcGIS for AutoCAD CAD Plug in</td>
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Want to learn more?

• Documentation

• Related Esri Training and Tutorials
  - CAD in ArcGIS:

  ArcGIS FOR AUTOCAD training video’s:

• Additional Resources
  - Margaret Maher’s book “Lining up Data in ArcGIS”
Thank you...

- Please fill out the session survey in your mobile app
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