Using CAD data in ArcGIS
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Agenda

• Overview of ArcGIS CAD Support
• Using CAD Datasets in ArcMap
• Georeferencing CAD data for ArcGIS
• Loading CAD features into a Geodatabase
• Geoprocessing with CAD Data
• Best practices for GIS/CAD interoperability
• Using ArcGIS for AutoCAD product
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

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD entity geometry organized into feature classes</td>
<td>CAD properties, tags, and database links are stored in attribute tables</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coordinate System</th>
<th>World File</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD data can be reprojected to overlay with other GIS layers</td>
<td>CAD drawings can be transformed from local coordinates to projected coordinates</td>
</tr>
</tbody>
</table>
Direct-read CAD datasets in ArcGIS

- Translated on the fly as virtual feature classes
CAD Data Support in ArcGIS

- 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 2015 (read only)
  - MicroStation DGN: Up to V8i SELECT series 3
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

- Use Definition Queries to create subsets
  - Saved in the .MXD or .LYR
  - Expressions can be saved to .EXP files for reuse
Filter CAD Features

• Isolate the CAD data you need to work with using…
  - Specific CAD Feature Classes
  - Drawing layer visibility
  - Definition Query
Displaying CAD in ArcGIS
What is CAD Georeferencing?

• The process of assigning a coordinate system and applying a transformation to a CAD dataset

• Not required to use CAD datasets in ArcGIS, but highly recommended as a best practice

• Not all CAD datasets require these steps
Agenda

- Demo: Assigning coordinate systems to CAD Datasets
- Demo: Repositioning CAD Datasets
- Overview of Georeferencing CAD Datasets
- Summary
Assigning coordinate systems to CAD datasets
Coordinate Systems - Overview

- CAD Datasets with defined Coordinate Systems reproject on-the-fly to align with other map layers
- Enables CAD Dataset to be used for spatial overlays and mapping
Assigning Coordinate Systems

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

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

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

• Reposition CAD datasets to align with GIS layers
  - Move, Rotate, & Scale
• Assign coordinate system for map reprojection
• NOT required for CAD drawings that are drawn in real-world coordinate location
Georeferencing Method

- **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
  - World file use CAD file name prefix
  - Must also reside in same folder
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>
Georeferencing Toolbar

- Georeferencing toolbar – use mouse pointer to move layer and create control points in map
  - Rotate, Scale, and Shift tools
Georeferencing CAD in ArcGIS
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
Campus Demo
Geoprocessing Scenarios

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

- CAD user who needs to...
  - View GIS data in CAD
  - Edit GIS data in CAD
  - Provide drawings to GIS users
Best Practices

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

• Export to CAD
  - template
  - Coffee and donuts
Data submittal Demo
Export to CAD

• Output features to native CAD format
  - DGN V8
  - DWG/DXF Release 14 to 2012
• Supports appending to existing CAD drawings
• Available at all license levels
• Creates Seed files
  - CAD feature Classes (MSC)
  - Fields and default values
  - Layers, color, linestyles, ….
Mapping Specification for CAD (MSC)

• Open source framework developed by ESRI for coding information in DWGs to define:
  - 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
• Provides improved interoperability between CAD and GIS
CAD data structure in ArcGIS

- Subset featureclass
- AutoCAD Query
  - Layer, color, linestyle
  - Etc
- Invisible in AutoCAD
- Better than a SHP file

City.dwg

- Annotation
  - Text, tags, and attribute definitions
- Multipatch
  - Polygons and is useful for 3D representation
- Parcels
  - MSC feature class that represents parcels (subset of polygons)
- Point
  - Points, blocks, and cells
- Polygon
  - Closed areas such as polygons, ellipses, and circles
- Polyline
  - Lines, polylines, and arcs
- Roads
  - MSC feature class that represents roads (subset of polylines)

Parcels.prj
ArcGIS for AutoCAD Plug-in

• **Streamline information sharing between GIS/CAD**
  - Access ArcGIS for Server Map Services and Image Services within AutoCAD
  - Location Services
  - Edit Enterprise Geodatabases through ArcGIS for Server Feature Services
  - Supports Domains and subtypes
  - New LISP API

• **Latest release (350) works with AutoCAD 2013-2015**
Why would my CAD users care?

- **Access to GIS content**
  - Basemaps
  - Image services
  - Location Services

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

- **It is Free**
Accessing Services in Microstation

- MicroStation V8i has built-in WMS capabilities
- Web Mapping Services Imagery
- Web Feature Services
Review.....

• Various ways to work with CAD data in ArcGIS
  - Direct read
  - Positioning your CAD file
  - Loading into Geodatabase
  - Exporting files to CAD formats

• Sample of Best practices for digital submission model

• ArcGIS for AutoCAD plug-in
CAD at UC 2014

- **Exhibit Hall – Geodatabase Management Island**
  - **TUESDAY**
    - 01:30 PM – CAD: Introduction to using CAD Data in ArcGIS (Room 09)
    - 03:15 PM – CAD: The ArcGIS for AutoCAD CAD Plug-In (Room 14 A)
  - **WEDNESDAY**
    - 02:00 PM – CAD: Lining Up CAD Data in ArcGIS (Exhibit Hall B1/B2)
    - 03:15 PM – CAD: The ArcGIS for AutoCAD CAD Plug-In (Room 14 A) (2nd offering)
  - **THURSDAY**
    - 08:30 AM – CAD: Introduction to using CAD Data in ArcGIS (Room 08) (2nd offering)
Resources

• CAD Integration Resource Center & Help System
  - Help, Videos, Samples, Downloads, Blogs

• Working with CAD Data - Instructor Led Course

• ArcGIS for AutoCAD – Live Training Seminar
  http://training.esri.com/Gateway/index.cfm?fa=seminars.viewDetails&course_id=182
Thank you...

- Thank you for attending
- Questions

- Please fill out the session survey:
  
  First Offering ID: 378/1163
  Second Offering ID: 378/1388

  Online – www.esri.com/ucsessionsurveys
  Paper – pick up and put in drop box