Using CAD Data in ArcGIS
Jeff Reinhart, Phil Sanchez
Agenda

- Overview of ArcGIS CAD Support
- Using CAD Datasets in ArcMap
- Loading CAD features into the Geodatabase
- Geoprocessing CAD Data
- Exporting GIS features to CAD drawings
- Using GIS Data in CAD
CAD/GIS Integration Presentations This Week

- Two more offerings of this session: Wed @ 10:30 & Fri @ 9
- Several 20 minute CAD sessions on Thursday, July 14:

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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 in the Geospatial context

- CAD drawings are a large source of GIS data
- Surveying
- Cadastre
- Civil engineering
- Architecture
- Landscape Architecture
- Planning
ArcGIS CAD Data Support

• 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 2012
  - MicroStation DGN: Up to V8

• All CAD Geoprocessing tools available at all license levels
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/GIS Interoperability Scenarios

- CAD user who needs to...
  - View GIS data in CAD
  - Edit GIS data in CAD
  - Provide drawings to GIS users
**CAD Datasets in ArcGIS**

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Attributes</th>
</tr>
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<tr>
<td>CAD entity geometry organized into feature classes</td>
<td>CAD properties, tags, and database links are stored in attribute tables</td>
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<tr>
<th>Coordinate System</th>
<th>World File</th>
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<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>
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Contents of a CAD Dataset

- **City.dwg**
  - **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.
Using CAD Datasets in ArcMap
Search & Add

- CAD drawings can be found using the Search tool
- CAD drawings can be added directly to ArcMap
  - No conversion required
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
  - Aspect ratio always maintained
  - Cannot skew or ‘rubber sheet’ CAD drawing

• Transformation managed by World Files
  - World file must use CAD file name prefix
  - Simple text file containing coordinates
  - Must also reside in same folder as CAD drawing
Georeferencing Toolbar

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

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

- Use Definition Queries to create subsets
  - Saved in the .MXD or .LYR
  - Expressions can be saved to .EXP files for reuse
CAD Properties as Feature Attributes

- Common CAD properties
  - Color, level, linetype, handle, line weight, etc…

- User defined data
  - Tags and Attributes

- CAD attributes support queries
  - Display
  - Geoprocessing input
  - Conversion
DGN Tags and DWG Block Attributes

- Effective way for attaching information to elements and entities
- Tags and Block Attributes are represented as Fields
- Tag Values = Attribute Values
CAD Feature Rendering

- CAD map style in Categories
- Color, Linetype, and Lineweight properties mapped to ArcMap symbols
- Text styles mapped to True Type fonts
- Supports common AutoCAD and MicroStation line types
Demo: Using CAD Datasets in ArcMap
Loading CAD Data into the Geodatabase
Loading CAD Data to the Geodatabase

- 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

• New conversion tool introduced at ArcGIS 10

• Designed for bulk loading CAD datasets into a Geodatabase
  - Works at the dataset level

• Combines Copy Features, Merge and Import CAD Annotation into single tool
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
Demo: Loading CAD Data into the Geodatabase
Exporting Geodatabase Features to CAD
Exporting Geodatabase Features to CAD

• Allows GIS users to share Geodatabase content with CAD users
  - Project collaboration
  - Contractual obligations

• Supported by Geoprocessing’s Export to CAD tool
  - Simply drag and drop layers into tool and export
  - Leverage Geodatabase information to control export

• Use Export to CAD to adhere to CAD standards using…
  - Fields and attributes
  - Seed/template files
Exporting Scenarios

- Single feature class to a single CAD drawing
- Multiple feature classes to a single CAD drawing
- Single feature class to multiple CAD drawings
- Multiple feature classes to multiple CAD drawings
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
Attribute Driven Export

• Use Fields and their attributes to control how elements and entities are generated

• Key areas:
  - Entity types, geometry
  - Elevation
  - Blocks/Cells and attributes
  - Text styles and position
  - Document names and paths
Seed & Template Files

- Blank template used to define a new file
- Seed file allows the default symbology of the seed drawing will be used
- Used to control Blocks or Cell definitions utilized by Export to CAD

- Microstation requires a seed file for design file creation
- Microstation seed file topics for Export to CAD
  - Design plane, appropriate dimensions, units and origin
Demo: Exporting Geodatabase features to CAD

Export to CAD
Using Map Services in CAD
ArcGIS Server & Map Services

• Share your GIS resources across an enterprise and across the Web

• A Map service is the way that you publish maps to the Web using ArcGIS

• Makes maps, features, and attribute data available inside many types of client applications
  - AutoCAD through ArcGIS for AutoCAD
  - MicroStation through WMS
Accessing WMS in MicroStation

- MicroStation V8 has built-in WMS capabilities
  - Supported at XM and V8i
- V8i uses Raster Manager for connection
- Enables MicroStation users to access map services for context
ArcGIS for AutoCAD

• Plug-in application for AutoCAD
  - Currently supports AutoCAD format 2010 - 2012
  - Download available at esri.com

• Provides ability for users to
  - Access ESRI Map Services (including ArcGIS Online) in AutoCAD
  - View map service feature attributes
  - Organize and attribute CAD drawings for use in ArcGIS
Maps & Imagery for Site Context

Basemaps

Map Services

CAD Drawings

GIS content in AutoCAD

AutoCAD
Adding Map Services

- Add map services from…
  - Favorite Maps
  - ArcGIS.com
  - Server URL

- Maps are projected to coordinate system defined in drawing
Map Service Palette

• Map service display and behavior manager
  - Visibility
  - Dynamic

• Reports map and drawing’s coordinate system

• Map service layer display controls
Identify Map Features

• Map service must support query

• Reports map service feature attributes in dialog

• Drag rectangle around features
Demo: Using Map Services in CAD

WMS in MicroStation
ArcGIS for AutoCAD
ArcGIS for AutoCAD: CAD-Defined Feature Classes
CAD-Defined Feature Classes

AutoCAD DWG

CAD Line Entity

CAD Standard Properties

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<tr>
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<th>Value</th>
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<tr>
<td>Layer</td>
<td>Mains</td>
</tr>
<tr>
<td>Color</td>
<td>Yellow</td>
</tr>
<tr>
<td>Linetype</td>
<td>Continuous</td>
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Feature Class Schema & Attributes

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
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<tbody>
<tr>
<td>Material</td>
<td>PVC</td>
</tr>
<tr>
<td>Diameter</td>
<td>20”</td>
</tr>
<tr>
<td>Length</td>
<td>25’</td>
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CAD-Defined Feature Classes in CAD Dataset

- **City.dwg**
  - **Annotation**: Text, tags, and attribute definitions
  - **Multipatch**: Polygons and is useful for 3D representation
  - **Parcels**: CAD-defined polygon feature class that represents parcels
  - **Point**: Points, blocks, and cells
  - **Polygon**: Closed areas such as polygons, ellipses, and circles
  - **Polyline**: Lines, polylines, and arcs
  - **Roads**: CAD-defined polyline feature class that represents roads

- **City.prj**: Projection files define a coordinate system for a CAD dataset. They are recommended but not required.
Feature Class Creation

1. Import schema or create new
2. Create filter
3. Add fields, default values
Attribute Editing

• Feature attributes modified by CAD operator

• Standard AutoCAD Properties Palette
  - Quick Properties

• Single and multiple feature editing
Interoperability with ArcGIS Desktop

• ArcGIS desktop (9.3 or higher) reads and writes GIS schema created by ArcGIS for AutoCAD.

• When you add a CAD-defined feature class to ArcMap, ArcScene, or ArcGlobe, it is organized as you defined it with ArcGIS for AutoCAD.
CAD Standards for GIS

• Coordinate location
  - Drawn in real-world coordinates

• Logical layer and level organization
  - Entities and elements should be on proper layers (i.e., manholes on ‘Manhole’ layer)

• Geometry connectivity
  - Closed line segments to define polygons

• Model Space versus Paper Space (AutoCAD)
  - ArcGIS only recognizes entities in model space, not paper space
  - Paper Space is graphics (e.g. title blocks, legends, notes, etc)
Resources

- CAD Integration Resource Center & Help System
  - [http://resources.arcgis.com/content/cadintegration/10.0/about](http://resources.arcgis.com/content/cadintegration/10.0/about)
  - Help, Samples, Downloads, Blogs

- Working with CAD Data - Instructor Led Course

- Working with CAD in ArcGIS – Live Training Seminar

Summary & Road Ahead

• Various ways to work with CAD data in ArcGIS
  - Direct Read
  - Load into the Geodatabase
  - Exporting to CAD

• New ArcGIS for AutoCAD Build 300 version coming early fall 2011
  - Feature Services
  - Image Services
**CAD/GIS Technical Presentations**

- **Additional CAD technical sessions on Thursday:**

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Closing

• We’re at the Geodatabase Management Product Island all week
  - Questions, Demos, Workflow discussion

• Please complete the online evaluation

• Thank you for attending!