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ArcGIS® for AutoCAD® 250

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Introduction

Esri's ArcGIS® for AutoCAD® is a free, downloadable plug-in to AutoCAD that provides interoperability between AutoCAD and ArcGIS. With ArcGIS for AutoCAD, users gain easy access to free and premium geographic information system (GIS) maps hosted on ArcGIS℠ Online, as well as enterprise GIS maps published by ArcGIS Server, from within the AutoCAD drafting environment.

ArcGIS for AutoCAD provides the ability to prepare attributes for GIS layers for use with the ArcGIS platform. This functionality is executed within AutoCAD and complies with existing CAD standards.

Esri's ArcGIS for AutoCAD has extended the software to provide an interface to the ArcGIS system and support interoperability between AutoCAD and ArcGIS.

Who Uses ArcGIS for AutoCAD?

Using GIS Maps in CAD

ArcGIS for AutoCAD is used by private engineering firms; public works departments; electric, water, and gas utilities; mining, pipeline, and oil exploration firms; site designers; and a host of other professionals that work in AutoCAD and want to gain access to the wealth of mapping information stored in ArcGIS. These professionals also use ArcGIS for AutoCAD to gain access to maps available for free in the Internet cloud from such sources as ArcGIS Online.

Creating GIS Data in CAD

ArcGIS for AutoCAD users are also typified by consultants, developers, and designers working in AutoCAD and seeking to utilize data exported from ArcGIS. Conversely, they are also creating attributed GIS layers within AutoCAD files ready for direct use in the ArcGIS system.

Benefits of ArcGIS for AutoCAD

Connecting to the "Right" GIS

Using ArcGIS for AutoCAD allows AutoCAD users access to the ArcGIS system. This system comprises the world's premier GIS technology. Rather than inventing or interfacing with some alternative GIS, users can implement ArcGIS for AutoCAD to access ArcGIS and a wealth of maps, data, and GIS technology provided and managed in the pervasive ArcGIS system.

ArcGIS for AutoCAD provides relevant GIS tools for those that need access in AutoCAD. Not all GIS functionality may be appropriate for a handheld device such as a smartphone, and not all ArcGIS functionality is appropriate in the CAD environment. ArcGIS for AutoCAD provides simple GIS schema management tools and access to maps. This, combined with the extensive collection of geometric tools available in AutoCAD, produces an effective means to generate GIS content and take advantage of GIS for better, more informed design.

A Common Operating Picture

AutoCAD users save time by accessing GIS basemaps directly in their drafting environments when working on projects that require information about that infrastructure and other design constraints stored in the GIS system. AutoCAD users are connected to the up-to-date view of the GIS, because the GIS itself is providing the maps.

Streamlined Data Flow

Draftspersons working with the data management tools of ArcGIS for AutoCAD can embed GIS information in their AutoCAD files for future GIS users. This means that AutoCAD files can be drafted with existing CAD standards and workflows, then GIS professionals can use those same drawings and understand their GIS content without the need for interpretation, conversion, or translation. This reduces ambiguity, increases data quality, and improves the efficiency with which data flows within an organization or between different organizations that work with both ArcGIS and AutoCAD.

Key Features of ArcGIS for AutoCAD

Maps and Imagery for Context

Imagery is an efficient way to gain a wealth of information about a project area. Maps and imagery in AutoCAD add powerful visual context to clarify the conditions and characteristics of a project site. One of the primary uses of ArcGIS for AutoCAD is to allow users to easily add maps and imagery to the AutoCAD design/drafting environment. These maps may be served over the Internet from the cloud. Other maps may be accessed and used from within an organization's enterprise network, making the treasure trove of GIS information managed by ArcGIS Server available to the AutoCAD users in the organization.

Authoritative Maps for Design Constraints

Maps generated to tell stories, provide domain-specific information, describe geographic features, depict infrastructure locations and their physical properties, and outline transportation systems or landownership can become authoritative references to projects. With these interactive maps in their drawing sessions, users have a way to constantly reference this information regarding constraints to design efforts.

Interoperability between ArcGIS and AutoCAD

Improvements to the way ArcGIS software reads and writes AutoCAD files allow attributed GIS feature layers to be stored inside a standard AutoCAD DWG™ file. ArcGIS Desktop applications, like ArcMap™ and Esri's free ArcGIS for AutoCAD plug-in, can read and write this style of data, making interoperability and file sharing between ArcGIS and AutoCAD greatly simplified and superior to using an intermediate file such as a shapefile.

Using Map Services

Map services in ArcGIS for AutoCAD are dynamic maps that appear as images displayed behind the graphics in the drawing session. More than just images, however, these maps are created dynamically by an ArcGIS server based on the current state of the GIS data. ArcGIS for AutoCAD users see the current view of the GIS, and it is the GIS that is creating the map. The features on the map can also be queried for their database attributes, giving AutoCAD users the ability to interrogate the drawings for the voltage of an underground electric line or the rim elevation of a manhole depicted on a map, for example. Maps are accurately positioned in the drawing and can be controlled to optimize the visual display, content layers, and frequency of updating based on the performance of the connection to the maps being served.

Coordinate Systems

The coordinate systems of maps can vary based on their intended use. Because the earth is roughly a sphere, and most maps require a two-dimensional representation on a digital display screen or as a printed map, coordinate systems have been developed to

geometrically express the entire globe or some region of the globe in two dimensions. The different techniques used to project the 3D surface into a 2D plane introduce various distortions. To minimize distortions of shape or area, or distance in a specific area, a coordinate system is defined for that area of interest. Commonly, when a map depicts a large area, a particular distortion is allowed in order to minimize other distortions. When a map covers just a local city or township, it is more useful to maintain it in a projected coordinate system that seeks to minimize all distortions.

By definition, geometric distortions are magnified as the user moves farther out from the center of the area in which a projected coordinate system was defined. One way to visualize the issue is to take a small piece of paper and flatten it against a globe; this is relatively easy. Taking a large piece of paper and wrapping it around a larger area on a globe results in the paper getting wrinkled and folded; that is an example of the necessary distortions.

It is common for a map on the Internet that covers the entire globe to have a global coordinate system (GCS) whose coordinates are defined with latitude and longitude. Authors of CAD drawings will select the appropriate coordinate system based on their own needs. Most drawings in CAD are drawn in State Plane, universal transverse Mercator (UTM), or some other projected coordinate system in either feet or meters, because they usually depict design projects in a localized area, and there is a desire to minimize all geometric distortions. ArcGIS for AutoCAD allows users to specify the coordinate system of a drawing before they add maps to it so that if maps are served in some other coordinate system (such as GCS), ArcGIS for AutoCAD will understand how they should be positioned correctly in the drawing session. By default, not specifying the coordinate system of a drawing will cause the program to automatically assign the coordinate system of the drawing to any map that is added. Users not desiring this are encouraged to always identify which coordinate system they are working in first before adding maps.

Assigning Coordinate Systems

AutoCAD files don't inherently store a coordinate system definition. Although an AutoCAD file may have been drawn using the coordinate values of a particular coordinate system, ArcGIS users benefit from an understanding of what the coordinates in the drawing mean by identifying their mathematical definitions. ArcGIS for AutoCAD and ArcGIS recognize coordinate systems and can incorporate data from various coordinate systems into an integrated view. Other AutoCAD add-on applications, such as AutoCAD Map 3D, might have their own methods of working with coordinate systems, but they are neither integrated with standard AutoCAD nor supported by ArcGIS for AutoCAD or ArcGIS.

ArcGIS for AutoCAD includes thousands of nominal coordinate system definitions to choose from to display the coordinate system used in an AutoCAD file. When an AutoCAD drawing has a coordinate system definition, the meaning of the coordinates and the maps' intended position on the globe are implicitly understood. Furthermore, when ArcGIS for AutoCAD accesses content from the ArcGIS system, such as a map from the Web, this content will be properly positioned even when maps are defined using some other coordinate system.

Finding Maps

A significant part of the ArcGIS system involves the publishing and discovery of maps. Esri maintains a useful set of maps that can be easily added to any drawing with a single click. These maps include street maps, topography, and imagery information for the entire globe. To add any of these maps from ArcGIS Online to a drawing, users simply select the Esri Maps button on the ArcGIS for AutoCAD ribbon interface.

ArcGIS Online

ArcGIS Online supports sharing and finding map information from a variety of sources and the GIS community at large. The search capability of ArcGIS Online allows users to search for relevant content shared by the global community of GIS users or share secure GIS information only for a particular enterprise or collaborative effort. ArcGIS Online will become a progressively more important part of ArcGIS for AutoCAD and the ArcGIS system.

Adding Maps

Adding a map to an AutoCAD drawing requires only the selection of a thumbnail image of one of the useful maps from the Esri Maps gallery; the thumbnail representation is accessible from the prominent button on the ribbon interface. The selected map is added and positioned accurately in the current drawing session.

Optionally, using the Add Map function found on the Map Service Management panel lets users connect to a specific GIS server by entering its URL and browsing to the desired map.

Any map can be added to a list of favorite maps for quick recall in other drawings with a single click from the favorites list, which is also provided as a button on the ArcGIS for AutoCAD main ribbon interface.

Query Maps

Maps in a drawing add a wealth of information by their simple visual context. The type of soils, the location of buildings and other infrastructure from imagery, or the location of underground utilities can be determined by simply adding finished maps to a drawing. When ArcGIS Server administrators publish their maps, they have the option to publish attribute information that describes the various features included in the maps. The Identify tool of ArcGIS for AutoCAD allows users to query the attributes of features on these maps to check, for instance, the invert elevation of a sewer pipe, the voltage of an underground power line, or the metadata of a survey control point.

Map Behavior

When a new map is added to an ArcGIS for AutoCAD session, it is placed on the bottom of the drawing stack and positioned correctly based on the coordinate system of the drawing. It is added to its own AutoCAD layer as a dynamic custom AutoCAD entity. Connections to the dynamic map services are stored in the drawing when the drawing is saved, and connections to those included map services are reestablished when a drawing is closed and reopened with ArcGIS for AutoCAD.

The order in which multiple maps are drawn on top of one another can be controlled by pushing the selected map to the back of the drawing stack using a tool on the Map Service Management interface.

By default, maps will cover the current drawing view extents, and a new version of the map will be generated when the drawing view is significantly changed. This dynamic drawing behavior ensures that imagery and maps cover the entire view display with an appropriate level of detail. Based on the performance of map retrieval from the map server, users may want to suspend the default dynamic drawing behavior of a map and control the refreshing of the map on demand. The performance speed with which maps appear from servers over the World Wide Web can vary dramatically, whereas maps served from within a local area network typically appear more quickly.

Users can suspend the display of individual maps included in a drawing by toggling the display of the maps on and off using the visibility property of a map. Visibility is controlled from the Map Service Management interface in ArcGIS for AutoCAD.

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Maps and Transparency

Because there can be more than one map in a drawing, users may want to see content from several maps together. Maps can be published by the ArcGIS Server administrator with white space that appears transparent. The transparency property in AutoCAD allows users to set the transparency of the AutoCAD layer on which a map is displayed. Controlling the transparency and drawing order provides a wide variety of composite map results to fit a particular use.

Take Map Snapshots

A snapshot of any dynamic map added to ArcGIS for AutoCAD can be converted to a standard AutoCAD raster reference entity in a drawing. This disconnected map is positioned correctly in the drawing, and a raster image is stored locally on the disk. These disconnected maps cannot be queried for attributes; they are simple raster snapshots of a dynamic map service.

Creating GIS Layers

ArcGIS Desktop can directly use CAD files as GIS layers in a map or as input to GIS analysis tools. The default behavior of ArcGIS Desktop when reading CAD files is to treat the AutoCAD or MicroStation files as a folder of feature layers organized based on the criterion of geometric type: POINT, POLYLINE, POLYGON, MULTIPATCH, and ANNOTATION. CAD data is used in ArcGIS like any other GIS content.

The CAD POLYLINE feature class contains all the linear entities in a CAD file. All the CAD entities with a single coordinate geometry are included in the CAD POINT feature class. Similarly, all the polygonal entities are represented in the CAD POLYGON feature class.

CAD data can be added to an ArcGIS map or used as input to analysis tools in the same manner as other layers from an Esri® geodatabase or a shapefile.

CAD drawing authors organize their drawings in various ways; most common is to organize a drawing based on a series of named CAD layers. Sometimes CAD files are organized using CAD layers, whereby an entire system of similar data is isolated on a single AutoCAD layer. Other times, various objects that might be considered two different GIS datasets might be on the same layer but distinguished by a different color or line style. Still others that might be considered one GIS dataset might be spread out on multiple CAD layers.

History: CAD in ArcGIS Desktop

Historically, to make CAD files more usable as GIS content, it has been common for users of ArcMap to add a CAD feature class as a layer in a map, then create a subset of those geometries by using a definition query. Knowledge of how the CAD file is organized is necessary for the ArcMap users to filter the contents of the CAD files to isolate the desired subset as useful GIS features. The criterion for how the drawing should be filtered is some combination of the CAD graphic properties that were used by the drawing's author to distinguish one group of CAD entities from another. The commonly used graphic properties used to distinguish one set of data from another are the CAD layer name, color, block name, and line style. There is a host of other graphic properties that can also be used.

Arguably, the effort of interpreting the meaning of CAD entities and organizing those entities as useful GIS layers is and might remain a difficult or impossible task without a full understanding of how the drawing was authored or without implementing the data creation strategies in ArcGIS for AutoCAD. Although AutoCAD can be extended to store attribution of objects using various strategies, there has not existed a standard, reliable way to share attributes between ArcGIS and AutoCAD. Historically, a common means of attributing CAD files has been to include attributes on block inserts and putting text entities near or inside the boundaries of objects they are intended to describe. This is

acceptable for points but becomes more complicated for lines and polygons. It is possible to establish a spatial link between these text and feature objects in ArcGIS using spatial joining techniques, but there is always some level of ambiguity when one text object may be closer to another object than the one it is intended to describe, the text does not fit within the object, or the association of the text with the parent entity is otherwise unclear.

This ambiguity of interpreting CAD files as GIS content and the inability to reliably attach attributes to CAD entities has led Esri to create a better way to share attributed GIS layers between ArcGIS and AutoCAD.

Creating CAD Files with ArcGIS

When AutoCAD files are created by ArcGIS Desktop, the coordinate system definition is written, along with the geometries, into the CAD file. Named GIS layers are established in the AutoCAD file, and all the descriptive attributes inherent with the GIS layers are retained on the resultant AutoCAD entities. The result is an AutoCAD file that is fully CAD based while retaining an understanding of attributed collections of GIS features. The result is a representation of the GIS features in AutoCAD as AutoCAD entities along with the GIS schema associated with the original GIS data. The data fidelity and ease of creating and distributing attributed AutoCAD files in this way make sharing GIS data with AutoCAD users superior to other workflows that involve intermediate data files such as Esri shapefiles.

When an AutoCAD file created by ArcGIS is viewed in ArcGIS, the default view of the AutoCAD drawing as a folder of GIS layers is extended to include not only the default geometry-based filtering (POINT, POLYLINE, POLYGON, ANNOTATION, and MULTIPATCH) but also distinct subsets of information that represent the named attributed GIS layers, like WATERLINES, PARCELS, and ELECTRIC LINES, that were exported.

Creating GIS Layers in ArcGIS for AutoCAD

ArcGIS for AutoCAD has the ability to create named attributed GIS layers within AutoCAD files using simple AutoCAD entities. The ribbon interface allows users to define filtering criteria to establish which AutoCAD entities in the drawing are to be considered members of one GIS layer or another. The criteria for describing a filtering query are the AutoCAD graphic properties that are normally used by the drawing author to distinguish one set of entities from another. The techniques used to distinguish sets of data within drawings are effectively the CAD drafting standards.

The technique for defining the GIS interpretation of an existing or new AutoCAD file is a simple exercise of recording how the CAD standard should be interpreted by the GIS user. Seldom do all the AutoCAD entities of a drawing need to be members of one or another GIS layer. Defining just the GIS-relevant content allows complex drawings—often created for some use other than GIS—to be quickly understood by the ArcGIS user. Commonly, the primary intent of the drawing is to document how something is to be built. Even so, the important as-built changes need to be readily understood when the drawing is passed on to the GIS group.

ArcGIS for AutoCAD allows users to define subsets of the drawing as GIS layers. This provides a self-evident way to interpret the AutoCAD drawing as GIS content. GIS layers in ArcGIS for AutoCAD also provide a way to create attributed entities and specify the coordinate system used in the drawing. There is no need to purchase additional software to convert or share the data between ArcGIS and AutoCAD. The AutoCAD drawing files support GIS curves and annotation, whereas the shapefile method of sharing data does not.

Because the ArcGIS for AutoCAD GIS layer definition technique is a filtering process applied to the drawing, the CAD operator does not need to explicitly create GIS features. AutoCAD users simply draft as they normally would. In fact, if the GIS filtering definitions are already in the AutoCAD file, such as when they are included in a template drawing, AutoCAD draftspersons do not even need to have the ArcGIS for AutoCAD application to create entities considered as GIS features (although they would not be able to see or add attributes without the software). Any entities drawn satisfying a given filtering criteria would be understood by ArcGIS and ArcGIS for AutoCAD as members of a given GIS layer.

The tools in ArcGIS for AutoCAD can be used solely within AutoCAD to help organize and manage attributes within CAD drawings independent of any future use of those files by ArcGIS Desktop.

Working with Attributes

Any number of user-defined attributes can be associated with the entities qualifying for a feature class in ArcGIS for AutoCAD. These attributes can be real numbers, text, or integers and have a logical name and default value. Any entity that qualifies as a member of a given feature class as described by its filtering criteria can hold the attributes. Those attributes are defined using ArcGIS for AutoCAD and/or are established when data is exported from ArcGIS into an AutoCAD file.

The standard property panel of AutoCAD is extended by ArcGIS for AutoCAD to display and edit these user-defined attribute values. Therefore, the means to edit the attribute values of a feature is simply to edit the properties found on the entity with the extended property panel of AutoCAD.

GIS Data Models

GIS layers can be defined using the tools provided in ArcGIS for AutoCAD, and schema information is automatically generated in AutoCAD files when ArcGIS creates or appends to AutoCAD files. Therefore, it is possible to easily work with schema information based on industry-standard schemas from the GIS system either by encoding the schema using ArcGIS for AutoCAD or using ArcGIS to export sample data—or even blank datasets—into an AutoCAD file as a way to transfer the schema into a format for use in ArcGIS for AutoCAD.

CAD Standards

It is considered best practice to define feature classes in ArcGIS for AutoCAD based on a single distinct AutoCAD layer, then draw member entities on that layer. However, there are any number of reasons why this simple approach may need to be expanded. When existing workflows require it, the filtering criteria for the definition of a feature class can include various graphic properties in combination, such that membership can be established based on the inclusion of one of several AutoCAD layers or the combination of a layer and a color or line style. That said, the best choice is to follow the common wisdom—simple is better.

The flexibility of the filtering criteria to define membership of features in a feature class is powerful and can be worth the added complexity, because it affords the opportunity to draft CAD files to existing CAD standards while at the same time establishing a GIS view of those same entities. The GIS view can be created without changing the method in which drawings are created or their layering or symbolic representation. Users can employ the National CAD Standard with its layer naming convention and still create simple GIS layers with their own GIS grouping and naming conventions.

There is seldom a one-to-one correspondence between the way data is drawn in AutoCAD and the way it needs to be organized in a GIS system. Convention might dictate that water lines be drawn on three different AutoCAD layers based on their use,

material, or diameter, for example, but when considered as GIS features, they should be combined as a single dataset. Conversely, some objects typically drafted on the same layer in AutoCAD might need to be separated into multiple GIS feature classes. In such cases, a combination of other graphic properties, such as color or block name, needs to be used in the filtering criteria to distinguish between the entities.

Esri Industry Data Models

The Esri vision is to build many industry-specific data models. The basic goals are to simplify the process of implementing new projects and promote and support standards that exist in user communities. Academic and industry leaders collaborate with Esri to create and design data model templates that can be used with one GIS platform. The result is a set of data model structures that can be implemented for each of the industries and scientific disciplines that Esri serves. The many different data model examples allow users to download information about the model. Some examples include sample data and diagrams of the attributes and relationships. Some, like the water data model, also include a sample AutoCAD drawing.

There is nothing technically different between a feature class in an AutoCAD file generated from exporting existing GIS data to AutoCAD using ArcGIS and a schema created from scratch from within ArcGIS for AutoCAD. Esri industry-standard data models contain a suggested GIS schema for a particular use. Within ArcGIS, they are a definition of the suggested geometry and attributes to model a particular set or system of data for a given use. The industry data models listed on Esri.com were generated from a collaboration of customers and Esri professional services groups as a template or suggestion for best practices. These data models have been found by many to function as a good starting place when implementing a geographic information system managing a particular type of data such as parcels, water systems, hydrology, or a host of other industry-specific domains.

Note: Although not all the geometric types or database relationships included in an Esri industry-standard GIS data model are supported in the ArcGIS for AutoCAD plug-in, much can be accomplished in the way of interoperability when GIS data represented as attributed feature classes of points, lines, areas, and text can be created and manipulated using the software. There is an appropriate use of CAD integration with the ArcGIS system that falls short of what might be called "ArcGIS *within* AutoCAD" and is closer to "ArcGIS *for* AutoCAD."

Importing Schemas

Another source of schema definitions for use in ArcGIS for AutoCAD is other AutoCAD files in which the GIS schema is already defined. ArcGIS for AutoCAD allows users to import the schema definitions included in one AutoCAD file into their specified AutoCAD file. This helps avoid the redundant work of redefining an existing schema for a similarly constructed drawing or adapting an existing schema to a drawing constructed with a different CAD standard. In such cases, the attribute definitions and feature class names will be the same, but the filtering criteria may be different.

Integrating CAD Template Files

It is common practice in AutoCAD to start each new drawing with a template file, which is essentially a blank AutoCAD drawing where layers and symbology, and perhaps other graphic marginalia, that are useful for productivity have been predefined. This template file is used as a starting point for new projects. An organization may have different template files for different types of projects.

When implementing ArcGIS for AutoCAD, users should consider including GIS map references and schema in the template files. Template files can go a long way to assist AutoCAD users in setting up their drawings to include GIS data creation capabilities

based on their CAD standards and to provide specific map service content relevant to their work.

IntelliCAD, AutoCAD LT, MicroStation, and Other DWG File Editors

The schema information and coordinate system information of drawings created with ArcGIS for AutoCAD or exported from ArcGIS are stored as standard AutoCAD nongraphic entities completely within the AutoCAD file. Feature class definitions are just definitions of how the drawing should be interpreted. Entities created or modified in the drawing file qualify for certain feature classes based on that filtering criteria, so any valid editor of a DWG-formatted file can be used to build GIS content. This includes software where ArcGIS for AutoCAD is not running or supported. In such cases, users would have neither map service capability nor the ability to see or manipulate attributes.

IntelliCAD, MicroStation, and AutoCAD LT are all able to modify, delete, and add geometries to such files. Later, when these drawings are used in either ArcGIS for AutoCAD or ArcGIS Desktop, the geometries would be sorted according to their various feature class definitions stored in the AutoCAD file independent of the entities and safely stored and carried along with the file.

Customizing ArcGIS for AutoCAD

ArcGIS for AutoCAD is built as an extension to Autodesk® AutoCAD software, and the data structures and content used are standard AutoCAD graphic and nongraphic DWG entities. As such, the same methods for customizing standard AutoCAD are all useful for customizing ArcGIS for AutoCAD. AutoCAD customizable interfaces, AutoLISP, or scripting can all be used to customize ArcGIS for AutoCAD.

The tools provided in the ArcGIS for AutoCAD application programming interface (API) can also be built from scratch using the standard AutoCAD APIs since the former is really built from the latter and all objects in the drawing are DWG objects. The included API gives users direct access to the functionality of ArcGIS for AutoCAD, as well as objects of specific interest, to make it easier to customize and build useful ArcGIS for AutoCAD software-based applications.

The ArcGIS for AutoCAD Help system includes a section on the Mapping Specification for CAD (MSC), which is a description of how ArcGIS for AutoCAD uses AutoCAD nongraphic entities to store the necessary information to support coordinate system identification, feature class definitions, and attributes schema on graphic entities—*GIS layers* in ArcGIS for AutoCAD.

User Interfaces

The functionality of ArcGIS for AutoCAD is provided primarily from the ribbon interface. There are functional panels accessed from the ribbon that control various parameters of different objects managed by ArcGIS for AutoCAD. Several of the standard AutoCAD interfaces have been extended to access content managed by ArcGIS for AutoCAD. The entity property sheet is one example, whereas other interfaces, such as the layer management dialog box, are purely AutoCAD interfaces but are echoed on the ArcGIS for AutoCAD ribbon because they are equally useful to workflows in that program. There is no need to load a menu file or custom user interface (CUI) for ArcGIS for AutoCAD; the ribbon interface is generated dynamically when the application is loaded.

Ribbon

The primary interface provided in ArcGIS for AutoCAD is the ribbon. It contains buttons to access the major functionality panels and useful tools for working in ArcGIS for AutoCAD. The behavior of the ribbon conforms to the standard implementation of customized ribbons in AutoCAD. It can be hidden, docked, or floating and can be presented in different states of larger and smaller button presentations.

Functional Panels

Some of the more advanced functionality and less frequently used configuration parameters are accessed through the major functional panels that are invoked from buttons on the ribbon. Various properties settings and configuration options are included on these panels.

AutoCAD's Property Pane

The standard AutoCAD property pane can be invoked by right-clicking on any entity or series of selected entities and choosing the Properties option from the context menu. This AutoCAD interface is extended by ArcGIS for AutoCAD to present a means to edit any of the attributes defined in the schema of which the entity or entities are a member. The multiselect and variant behavior of the property pane is the same whether working with the standard AutoCAD graphic properties or the extended attributes of the ArcGIS for AutoCAD schema.

AutoCAD's Quick Properties

Similarly, AutoCAD's Quick Property and Rollover functions have been extended to allow users to define the behavior of this functionality to present the ArcGIS for AutoCAD schema in the same way they might use it to display the AutoCAD graphic properties they are most interested in viewing and modifying in a more automated fashion or for quick review.

Commands

Most of the major functionality to add and configure data is also provided in the form of ArcGIS for AutoCAD commands that can be typed at the AutoCAD command line, included within scripts, or invoked from the various AutoCAD APIs.

AutoLISP Functions

There are a number of AutoLISP functions included with ArcGIS for AutoCAD that are designed to help build AutoLISP applications to automate and control data creation and the display of map services in drawing sessions. These tools allow access to high-level control of the various objects introduced to AutoCAD by ArcGIS for AutoCAD. These functions give quick access to objects to add, remove, and modify feature classes, their schema and attribute values, and maps and their visibility.

AutoCAD APIs

Attributed GIS layers are implemented in ArcGIS for AutoCAD using bits of information relating standard graphic and nongraphic entities available completely within the AutoCAD DWG file. ArcGIS for AutoCAD uses only standard entities common to AutoCAD DWG files to accomplish this; therefore, knowing the data structure of this information can be used to anticipate and control the entities in the drawing using the existing AutoCAD API tools to manipulate the ArcGIS for AutoCAD objects in the drawing. For cases where the existing AutoLISP tools are not explicit or flexible enough to accomplish a desired task, users can create their own version of those tools or even more powerful tools to manipulate the same information using knowledge of the mapping specification for drawings and AutoCAD APIs.

Integrating with ArcGIS Geoprocessing

Because both ArcGIS Desktop and AutoCAD are extensible and support the same CAD feature classes, users can in a straightforward manner work with the APIs of both to access functionality from ArcGIS Desktop in the form of geoprocessing and the API in AutoCAD. The two can be used together to perform GIS analysis, then display the results of that analysis within AutoCAD. This works because ArcGIS Desktop accepts feature classes in an AutoCAD file from ArcGIS for AutoCAD as valid input to geoprocessing tools, and geoprocessing includes the tool Export To CAD, which creates feature class data in an AutoCAD format that ArcGIS for AutoCAD readily understands. The combination of the two applications can be integrated in some interesting and useful ways.

Within an enterprise, users can pragmatically access the geoprocessing functionality made available through an ArcGIS Server license to create integrated applications in a similar fashion.

Selection Tools

ArcGIS for AutoCAD includes a number of methods for selecting AutoCAD entities that participate as members of GIS layers. Because these objects are standard AutoCAD entities, all the standard AutoCAD selection methods also work with members of ArcGIS for AutoCAD GIS layers. In many ways, the definition of a GIS feature layer is itself a form of stored selection set or, perhaps more accurately, a selection filter. ArcGIS for AutoCAD includes a series of tools that allow users to perform attribute- and graphic-based selection with the precondition that the objects must also belong to a given ArcGIS for AutoCAD feature class.

The Current Feature Class

ArcGIS for AutoCAD maintains the concept of a current feature class. This feature class could be either nothing—if there are no feature classes, for example, in the drawing—or any of the feature classes defined in the drawing. The current feature class is used as the prefiltered target of the various selection tools. There are two different ways on the standard user interface to set the current feature class. It can be set from the pull-down list on the Select panel of the ribbon or from the similar pull-down menu on the feature class management panel.

Select and Zoom

The selecting and zooming functions are located on both the Select panel of the ribbon and the toolbar of the feature class management panel. Simply pushing the select and zoom button selects the members of the current feature class and changes the drawing view to the extents of the members of the selection.

AutoCAD SELECT with Feature Class Filtering

The Select by Feature Class button on the Select panel of the ribbon invokes the general AutoCAD SELECT command but will prefilter the results based on the currently selected feature class.

Feature Classes as Super and Sub Types

Another form of selection is the feature class query definition itself. Because membership in a feature class is based on a filtering criterion, it is possible for one entity to satisfy the filtering criteria of any number of different feature class definitions. This can be used when geometry, such as a river, truly does perform the function of two separate types of features, such as a county boundary and a river feature. An entity's qualification as a member of multiple feature classes can also be used solely as an organizing mechanism for the drawing. Users can, for example, develop a super feature class to include all the underground features of water, sewer, electrical, and gas in a single Utilities feature class. The Utilities feature class can then be queried and used in selections even though all its members also belong to other feature classes, where their attributes and schemas are recorded independently.

Users can also deploy the capabilities of feature classes and selection to create groups of entities for the sole purpose of data production editing and management within the AutoCAD drawing. Even when the data is never intended for use as GIS data, the tools can be used to advantage when working with pure CAD data to select, manage, and add attributes to any AutoCAD entities.

Conclusion

ArcGIS for AutoCAD allows easy access to imagery and other valuable maps from ArcGIS Online to give context to projects in AutoCAD. When it is used as part of the integrated ArcGIS system, users of ArcGIS Server can provide the same map service content to their AutoCAD users that they do to the GIS software clients within their organization. This common operating picture allows everyone in the organization to be working from a common basemap without putting a burden on CAD users to convert,

configure, and translate raw GIS data simply to access the information they need managed by the GIS and have already skillfully presented in the form of cartographic map products.

Using Esri coordinate system definitions in AutoCAD drawings ensures that stores of global datasets will be positioned correctly within drawings, which will then be more valuable as GIS content because their global position has been made known.

ArcGIS for AutoCAD makes CAD drawings into valuable input to ArcGIS by creating attributed feature classes; CAD data organization standards and existing workflows can assist and facilitate this capability rather than introducing foreign data constructs or custom entities.

ArcGIS for AutoCAD can also be helpful to AutoCAD users who need to read the GIS information created for them in ArcGIS Desktop. These AutoCAD users can, with ArcGIS for AutoCAD, also create data for ArcGIS Desktop users employing only their existing AutoCAD software and the free ArcGIS for AutoCAD download.

Download ArcGIS for AutoCAD from Esri now at esri.com/AutoCADapp.

About Esri

Since 1969, Esri has been helping organizations map and model our world. Esri's GIS software tools and methodologies enable these organizations to effectively analyze and manage their geographic information and make better decisions. They are supported by our experienced and knowledgeable staff and extensive network of business partners and international distributors.

A full-service GIS company, Esri supports the implementation of GIS technology on desktops, servers, online services, and mobile devices. These GIS solutions are flexible, customizable, and easy to use.

Our Focus

Esri software is used by hundreds of thousands of organizations that apply GIS to solve problems and make our world a better place to live. We pay close attention to our users to ensure they have the best tools possible to accomplish their missions. A comprehensive suite of training options offered worldwide helps our users fully leverage their GIS applications.

Esri is a socially conscious business, actively supporting organizations involved in education, conservation, sustainable development, and humanitarian affairs.

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