AutoCAD®
Map 3D

The Benefits of AutoCAD Map 3D to AutoCAD Users

About the Author: Russell Martin is an independent consultant who has worked with AutoCAD® software and other spatial data and cartographic design tools since 1985, on several different computer platforms and in many different business and academic settings. He pioneered the position of staff geographer at a multidisciplinary civil engineering firm and later managed its CAD department. He has assisted with the development of many different computer systems involving spatial data for industries as diverse as entertainment, transportation, property management, engineering, and facilities management. He is a member of the Association of American Geographers, the Autodesk Developer Network, and several GIS user groups. He has also coauthored several books on AutoCAD® Map 3D, including Digging into AutoCAD Map 3D 2008 *for Cadapult Software Solutions, Inc.*

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Introduction

I have used AutoCAD since 1985, in a wide variety of fields. For several years I served as CAD manager at a multidisciplinary engineering firm, where we pushed AutoCAD releases 9 through 14 to their absolute limits. We employed a wide variety of third-party add-ons, located and modified shared AutoLISP® routines, and basically did everything we could to force AutoCAD to the extent of its capabilities. The sheer versatility of the core AutoCAD product facilitates this, but we longtime users of the flagship product often tend to overlook some of the amazing features of Autodesk's industry-specific product line, thinking that they are only for specialists or that the price is too high or learning time too long.

AutoCAD Map 3D is one of those products. Although it includes many powerful tools that are beneficial to nearly all AutoCAD users and are very easy to use, it is often overlooked. Many of my clients know that AutoCAD Map 3D is available as a stand-alone product, intended primarily as a fully functional geographic information system (GIS) application, but they are often surprised to learn that it is also a suite of versatile utilities that can save them countless hours by expediting common tasks. Implementing just some of the tools described in this paper can yield a substantial return on the modest initial investment of upgrading to this product.

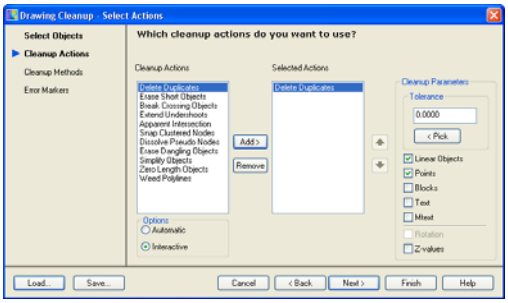
Although AutoCAD Map 3D has many additional features, this paper discusses these specific tasks:

- Drawing cleanup
- Object data
- Object classification
- User-friendly coordinate geometry (COGO)
- Automated annotation
- Inserting raster images
- Queries
- Thematic mapping
- Coordinate conversions and tracking

Drawing Cleanup

Do your CAD technicians spend hours correcting imported or legacy geometry?

Many AutoCAD users share drawing files and data with clients, colleagues, co-workers and organizations throughout a project cycle. The source data or base maps used often vary significantly in quality. Substandard digitizing and poor translations from other software can introduce geometric errors that are time consuming to locate and fix. AutoCAD drawings need to be extremely precise, as we increasingly rely on them not just for plotting plan sets but as repositories of project data. Geometric problems such as lines not connected precisely at endpoints can result in seemingly precise data that is highly inaccurate. Isolating these problems can involve hours of searching for them visually, and neglecting to fix them can result in major problems later, when others rely on the data.



The Drawing Cleanup Wizard steps you through a variety of actions, offering many options to fine-tune each action to suit your needs. In interactive mode, each instance of a perceived error is marked with a symbol, allowing you to verify or ignore each correction, while the automatic mode fixes them all with one click.

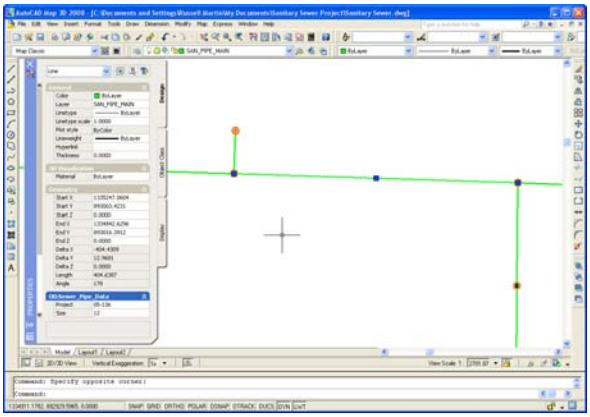
Another common problem with drawings is duplicate objects in the exact same location; finding them can be nearly impossible without the right tools. If the number of items such as valves, windows, or electrical components is derived by exporting the number of symbols used in a drawing, hidden duplicates can cause costly errors.

AutoCAD Map 3D includes a series of powerful and easy-to-use tools for finding and repairing many types of geometric problems. These tools can be used individually; finding and repairing problems by type, layer, or both. They can also be used automatically, to search through very large drawings with the aid of an intuitive dialog box wizard. Once found, the problems can be repaired instantly and simultaneously. When this is not practical, the process can be performed interactively: The software identifies different problems with user-defined marker symbols. Then further user control is achieved by allowing objects that are known to be accurate to serve as anchor points to which the inaccurate objects are adjusted. This avoids issues such as moving good data to join it to bad data.

Object Data

Did you know you can add user-defined properties to objects and use them to automate many other processes?

Geometric objects drawn or imported into AutoCAD contain a number of *properties,* which are stored in the drawing file as part of the object. These properties include the specifics of the object's geometry, such as starting and ending point coordinates, as well as information that controls and manages the appearance of the object, such as the layer it resides on and the color it appears in. These properties can be listed, tallied, and exported and can also be used to control other automated processes.



Think of Object Data as user-definable properties; once attached to an AutoCAD entity, it can be viewed, edited or used like any other AutoCAD property.

AutoCAD Map 3D provides the ability to include additional, user-defined properties called *object data* or to attach external data to objects. This capability can be extremely useful even to those who do not consider themselves GIS users.

Once added, this object data can be used like any other property, for performing analytical processes such as those required for quantity takeoffs, materials lists, and inventories. Object data can also be used in many of the processes described later in this paper, such as automated annotation, thematic mapping, and queries.

To see how object data can enhance a drawing file, consider a basic map of utilities, such as water pipes. If you add information on materials, size, pressure, date of installation, details about service, and so forth, this new information can then be used to create a map that is color coded to show pipe material, water pressure, or even predicted service dates based on the material's life expectancy and installation date. This additional information can also be used to create reports, isolate objects by like properties, and automatically label the objects.

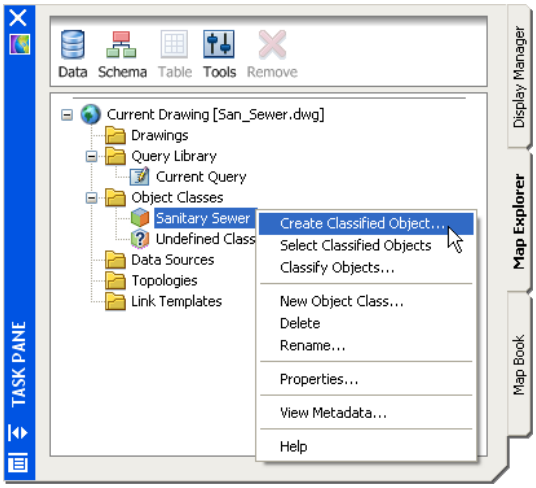
Object data can be created only with AutoCAD Map 3D, but it can be displayed using free Autodesk® Design Review software, so enabling anyone to take advantage of this powerful feature. For instance, a field worker displaying a DWF™ version of a water pipe map can simply position the cursor over a water valve and see any information added to

it. This means that a map can contain much more useful information, as needed, without adding so much text that it becomes difficult to read.

Object Classification

Would you like to save drawing production time while increasing adherence to CAD standards?

When new objects are created in a drawing, many of the properties of that object, such as the layer it resides on or additional object data, must be entered manually, one entity at a time. This step can substantially hinder the data-capture process, as the operator must pause to check the source data, key in the data, and double-check the accuracy for each item. This discontinuity not only slows the process (since it is always easier to focus on one type of activity and repeat it) but is also conducive to errors in both the geometry and the information entered at the keyboard.



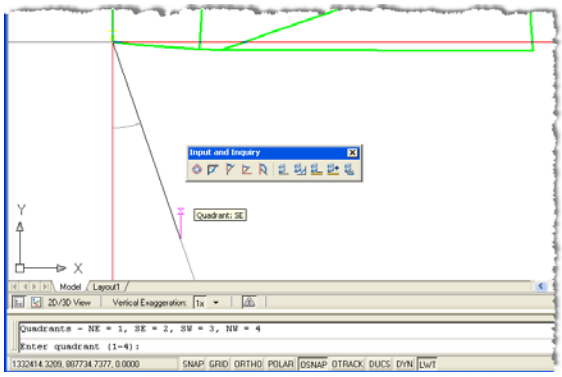
Once defined, Object Classes can be employed several different ways: to apply properties while creating new objects, to apply them to existing objects, or to select objects based on them. This is all achieved by simply selecting an option in the Map Explorer.

Object classification is an AutoCAD Map 3D feature that facilitates this process. Once classification is set up, the operator can simply select an object type from a menu and then digitize the object's geometric properties, focusing on the editor screen and the location, while the software takes care of the similar data that the digitized object shares with like objects. This data can include properties such as layer, color, and lineweight, as well as object data, as we have seen. When set up properly, object data can also be used to automatically annotate the drawings, as discussed later. Object classification significantly increases not only operator speed and efficiency but also accuracy and adherence to standards.

User-Friendly COGO

Did you know there are intuitive COGO tools available?

Coordinate geometry is simply the method by which CAD software stores the geometric information about the objects drawn, in the form of X and Y coordinates (and in the case of 3D objects, Z coordinates, as well). Although COGO stands for coordinate geometry, it actually refers to the more specific language of bearings and distances used by land surveyors, construction contractors, land development professionals, mapmakers, and civil engineers.



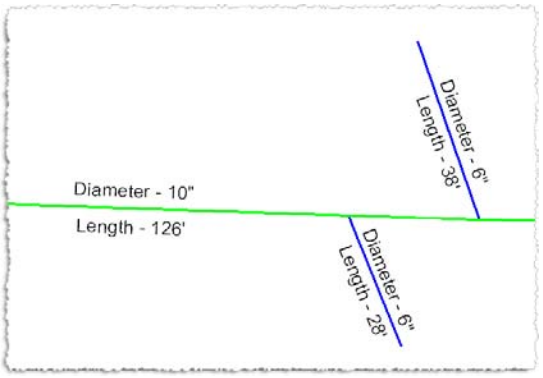
Map 3D offers intuitive COGO Input tools. Here the Dynamic Input prompt can be answered by simply picking in the correct quadrant, rather than responding to the command line text, which dramatically expedites an otherwise tedious process.

Although AutoCAD software has long included the ability to create, modify, and analyze objects using COGO, the terminology and techniques it uses can be intimidating and tedious to the uninitiated. In contrast, AutoCAD Map 3D includes intuitive COGO commands that help expedite the processes of creating new geometry and deriving information from existing geometry. Many of these tools work with Dynamic Input prompts, and respond to logical mouse movements as well as keyboard entries. This can save a great deal of time when you are entering even a moderate amount of survey data.

Automating Annotation

How many hours do your CAD technicians spend adding text labels to drawings?

AutoCAD users have, for years, spent a large portion of their time adding text to drawings that identifies objects. Ironically, the information entered at the keyboard is often already in the drawing file, stored as object properties when the entities were created or imported or previously added in the form of object data. When this same information has to be reentered manually, many hours of redundant labor are required, but more important, typographical or transcriptional errors can be introduced. In addition, inconsistencies in formatting and placement can occur, so standards compliance can suffer.



Annotation can be created from object properties, making it dynamic; change the length of a line, and annotation based on that property can be automatically updated.

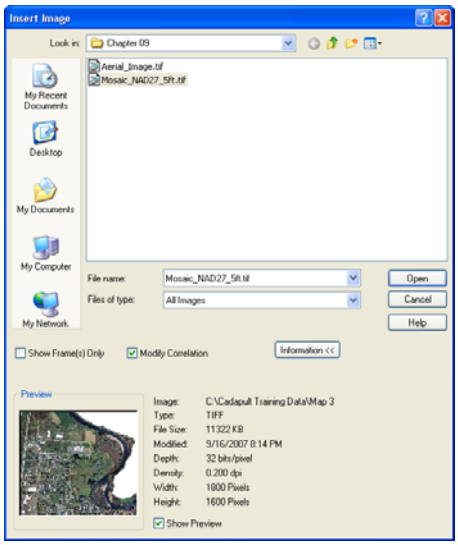
AutoCAD Map 3D includes a powerful system for automatically adding text to objects. Templates can be defined to control the appearance, location, and content of these labels, and once they are set up properly, hundreds or thousands of objects can be labeled in seconds. When objects are created using object classification, as discussed earlier, they can contain object data fields, which can in turn be used to automatically annotate the objects, saving countless of hours of labor.

Inserting Raster Images

Would you like to use high resolution aerial and satellite imagery in your drawings?

Images such as aerial photographs and satellite imagery can be inserted into any AutoCAD drawing and serve as useful background information. These images typically contain specific information about their precise location and scale, available either within the image file or in a separate data file. This information is known as *correlation data,* and an image file that includes it is said to be *correlated* or geo-referenced.

AutoCAD, by itself, is not equipped to use this correlation information, which is now included with most aerial and satellite imagery. This means time-consuming and error-prone manual correlation is necessary to properly position the imagery. AutoCAD Map 3D, however, can read this information from a wide variety of source types including Mr.SID® and ECW files and use it to precisely position the image.

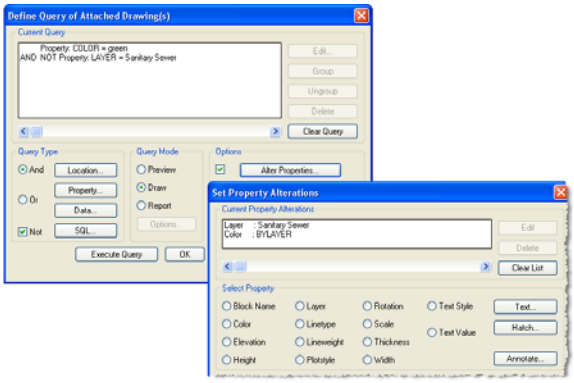


Map 3D offers a better way to insert aerial photographs and satellite imagery; it can read correlation data in all of the commonly available formats and use it to automatically insert the image at the precise location in your drawing.

Queries

Do you want to know more about what's in your drawing files? Just ask!

One of the most powerful features in AutoCAD Map 3D can also seem the most intimidating, but it needn't be. The word *query* sounds like database administration jargon, but all it really means is to ask a question. Queries enable you to ask a wide variety of questions about a drawing and obtain answers in the form of tabular information, selected objects, or even automatically modified objects.



Queries can be used to easily solve all sorts of problems, such as entities colored by object and not on correct layers. In this example, all green objects that are not on the sanitary sewer layer can be located, their color changed to ByLayer and moved to the correct layer, all in one quick action.

Once a user masters a few basic skills, a whole new world of productivity and data sharing opens up. You can accomplish tasks such as pulling only the specific information you need out of many different large drawing files, finding objects that are on incorrect layers (and automatically moving them), finding objects that satisfy certain criteria (such as "all lines on these layers that are longer than X and shorter than Y" or "all objects within a radius of Z from this point"). Once located and selected, the objects can be saved into a new drawing, modified, copied, and so on. Once found and isolated, the queried data can easily be exported to a GIS data format such as an ESRI SHP file, and as reports, such as bills of materials and quantity takeoffs.

If you have ever opened up a drawing that contains some objects on a correct layer, colored by layer, and then discovered similar objects that belong on that layer, but are instead on other layers, and colored by entity, you will appreciate the ability to locate these objects, move them to the correct layer, and set the color to the right one for that layer, all from one wizard, with a few clicks.

Thematic Mapping

Would you like to display your drawing data a different way, without actually altering the properties of objects?

Another term that sounds like something only a GIS analyst would care about is *thematic mapping.* Again, this needn't be an intimidating concept, as nearly all AutoCAD drawings are in a sense, thematic maps. All the term means is that the objects' appearances are based on certain similar characteristics, or relationships between characteristics. With the thematic mapping feature in AutoCAD Map 3D, you can quickly and easily display your drawings in informative ways, without altering the properties of the objects themselves, just their appearance.

Thematic Mapping allows you to look at your data in new ways, without altering object properties. These streets were imported from an ESRI Shapefile to a single layer, colored by layer. Each street's speed limit was an attribute, converted to Object Data and mapped here by value using the Display Manager.

For instance, if you have a utility map that depicts all sanitary sewer lines on a green layer and all storm lines on

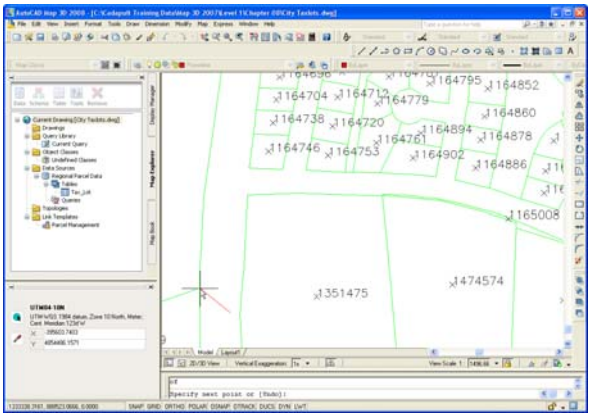
a yellow layer, you can quickly create a thematic map that redisplays the colors of these line segments by material, length, installation date, and so forth. This enables you to experiment with different ways of looking at your data, make better decisions, and present information in creative ways. Yet when you are ready to plot, the map retains all its original characteristics. There's no longer any need to make many copies of your drawings for a lot of different purposes, and then tediously pick objects to reveal and change their properties. It's all automatic; the only limits are the data itself. Whether you need the basic AutoCAD properties, the geometric information, or additional object data, if it is in there, you can map it quickly and easily.

These maps can also be plotted out or shared digitally through DWF files that are easily viewed and analyzed by anyone with the free* Autodesk Design Review software, even if they do not have or know how to use AutoCAD.

Coordinate Conversions and Coordinate Tracking

Do you often work with drawings in different coordinate systems?

As we continue to share more and more drawings with others and acquire base maps and project data from different sources, we often encounter maps, drawings and data created using different coordinate systems. AutoCAD Map 3D includes two powerful, easy-to-use features for dealing with this otherwise sticky problem. You can either convert the known coordinates of a drawing to those of another, so that they overlay with mathematical precision, or you can easily digitize objects based on the known coordinates from a different system. For instance, if you are working in a drawing in State Plane coordinates, and you know the longitude and latitude of some points to add, the Track Coordinates control allows you to enter the new points without converting the base drawing.



The Coordinate Tracking feature allows you to work within two different coordinate systems simultaneously. The AutoCAD X and Y coordinates in this example reflect the State Plane coordinates of the Current Drawing, and the UTM Zone 10 coordinates are displayed in the Coordinate Tracking box above. You can also enter coordinates into these fields, and click the digitize button, to precisely pick points in the alternate coordinate system.

Conclusion

This paper describes just a few of the many tools available in AutoCAD Map 3D that can benefit every AutoCAD user, not just GIS specialists or cartographers. Learning just a few of these tools and using them to implement productivity-enhancing processes in your organization could quickly pay for the software's additional cost, and your AutoCAD users will wonder how they got along without them.

*Free products are subject to the terms and conditions of the end-user license agreement that accompanies download of the software.