Converting CAD Data

Creating a Stand-Alone Feature Class with the Correct Spatial Reference

By Michele Mattix, ESRI Instructor

Editor's note: *In this article, the author walks the reader through the process of converting CAD data to a correctly projected stand-alone feature class in a geodatabase. The accompanying article, "Pre-Work Checklist," provides a systematic method for becoming familiar with CAD before processing it.*

CAD data used to give me fits. I began my GIS career working part-time for a consulting company that performed both forestry and civil engineering services. Inevitably, the engineers would create the schematics for a new housing development using their computer-aided design (CAD) software, then hand it to me, "the GIS girl," to add it to my ArcMap project. I would proceed to spend the next hour or so wondering why the CAD data was so far out of alignment with my other data that it seemed in another universe.

Many GIS professionals use CAD data in their projects. It can be useful, particularly for adding new data to an existing geodatabase. For example, new development projects in a city are typically drawn up using CAD. The new data often fits into an existing dataset of streets or parcels and can be aggregated with this data to bring the geodatabase up to date.

Though it is not necessary to convert CAD data to the geodatabase format to use geoprocessing tools, there are several advantages to converting CAD data. When converted and added to the geodatabase, CAD data

- *Can be edited in ArcMap (unconverted CAD data cannot be edited)*
- *Can be used to build a topology*
- *Can have subtypes and domains applied to it*
- *Shares a common format with other, related data*

However, the most important reason to convert CAD data is to get it into proper alignment and set its spatial reference so that it is not just in the same universe but in the same coordinate system as the rest of your data.

The Task

I have a geodatabase named MyCity that contains a feature class called parcels that consists of land parcel polygons. I've been given the schematics of the new development in CAD format named Plat677 that should be added to the parcels data. After previewing the CAD data in ArcCatalog, it appears that

Pre-Work Checklist

Answer these questions to get familiar with the data.

__Do you have reference data?
Reference data should have the same coordinate system you want to apply to the CAD data when it is converted to a geodatabase feature class. This reference data may contain data that the CAD data should fit inside such as a parcels feature class. Use this data as a guide when transforming the CAD data's position. After the CAD data is converted, you may want to aggregate the two datasets into one. In this example, I check the coordinate system of the parcels feature class and learn it is NAD_1983_HARN_StatePlane_Kansas_North_FIPS_1501. *[See the accompanying article, "Check the Spatial Reference for a Stand-Alone Feature Class," if you are not familiar with checking the spatial reference for a feature class.]*

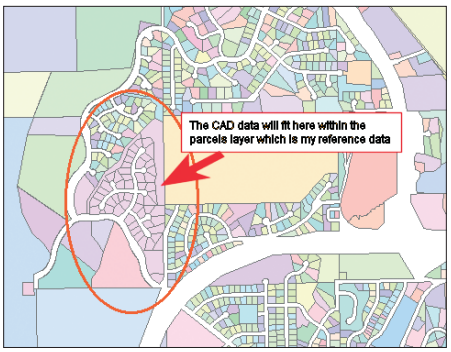
__Which CAD file do you want to work with?
The CAD data has two entries in ArcCatalog. The entry with the white icon is the CAD drawing dataset. This is essentially a picture—its symbolization cannot be controlled in ArcMap and it does not have an attribute table. The turquoise icon is the CAD feature dataset. It can be expanded to show a series of feature classes (e.g., annotation, multipatch, point, polygon, and polyline). Typically, GIS users are only interested in the Polyline feature class. In this case, I will use the Polyline feature class for the Plat677 feature dataset.

__Does the CAD data include projection information (i.e., a .prj file)?
A projection file is a text file that contains information about the geographic and projected coordinate system to which the CAD data refers. ArcMap needs the .prj file to automatically align the CAD data via on-the-fly projection. Without it, ArcMap has no way of knowing where to place the data. You can check the data's coordinate system information by right-clicking the CAD feature dataset in ArcCatalog and viewing the Spatial Reference tab. The coordinate system for the Plat677 CAD dataset is undefined, which means no projection file exists. If one did exist, it would be called Plat677.prj and it would be listed in ArcCatalog.

__Do you have a World file or transformation coordinates?
A World file is a text file that must have the same name as the CAD data and has .wld as its file extension. It contains one or two coordinate pairs of from and to values. These coordinates will define the transformation of the CAD data so it can be properly oriented and aligned with the other layers referencing a known coordinate system. World files are not automatically created by either CAD software or ArcGIS.

In this example, I do not have a world file and would need to come up with two coordinate pairs of from and to values. The from values represent the (x,y) coordinates of two points in the CAD data as it is currently positioned. The to values represent the same two points with coordinates in the correct position to display properly. Using the CAD Polyline feature class and the parcels reference data, I created a world file. To learn how to create a World file, see the article "HowTo: Transform CAD data in ArcMap to line up with other data," at the ESRI Support site (article #29039 at support.esri.com).

__What coordinate system do you want to apply to the CAD data when you convert it to a geodatabase feature class?
In the geodatabase, features classes can be stand alone or can be created within an existing feature dataset. A feature class created within a feature dataset will inherit the spatial reference of the feature dataset. Spatial references must be set for stand-alone feature classes. In this case, I want my soon-to-be converted CAD data to have the same spatial reference as the parcels feature class.



The parcels feature class in the MyCity geodatabase is my reference data. The CAD data will fit within the purple polygon (encircled) area and will use the same spatial reference as the parcels layer.

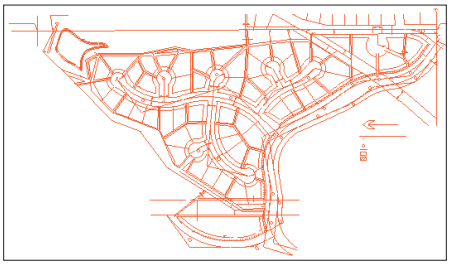
this data is not properly oriented relative to its designated position in the parcels feature class. I want to orient and align the CAD Polyline feature class and convert it to a new stand-alone feature class and ensure that the spatial reference is properly set for the MyCity geodatabase. First, I will go through a pre-work checklist to get familiar with the data. Please read the accompanying article, "Pre-Work Checklist," before reading further.

The Workflow

After going through the pre-work checklist, I am more familiar with my data and ready to begin aligning and converting the CAD Polyline feature class. Using ArcMap, I want to transform the CAD data so it aligns with the parcels feature class, then convert it to a stand-alone feature class in the MyCity geodatabase. The spatial reference for the parcels feature class will be assigned to the CAD data. The accompanying workflow model shows the steps I go through to accomplish this task. An alternate method for accomplishing this task, not covered in this article, would be to convert the CAD data to a feature class in a geodatabase first, then use spatial adjustment tools to align the CAD data.

1. Add Reference Data.

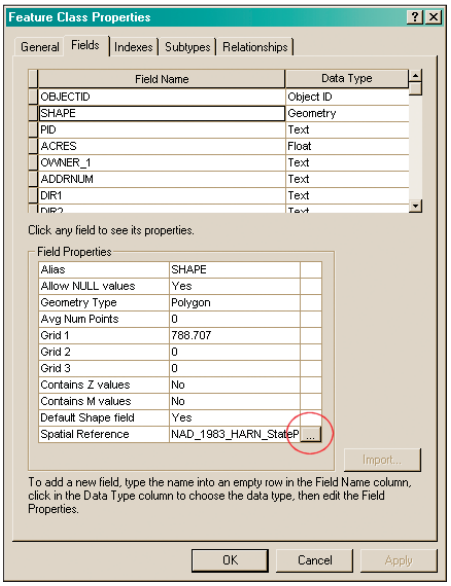
I will add the parcels feature class to a new map document in ArcMap. It will be the reference data for the CAD data. The Data Frame adopts the layer's coordinate system (NAD_1983_HARN_StatePlane_Kansas_North_FIPS_1501).



By adding the CAD Polyline feature class dataset, I can see it is not properly oriented. It needs to be transformed.

2. Add the CAD Polyline Feature Class.

After adding the CAD Polyline feature class to the map document, ArcMap displays a warning that this layer has an unknown spatial reference and may not align properly. I check



Right-clicking on the feature class name in ArcCatalog allows you to view its Fields properties. Clicking on the SHAPE field at the top of the dialog box populates the Field Properties below. The last row provides spatial reference information. Clicking on the ellipsis button, circled here in red, allows you to view and change the coordinate system.

the layer's alignment by viewing the Data Frame's coordinate system properties and verify that this is true. The Polyline layer is not visible at the current extent. When I zoom out the full extent, I see that the two layers are drastically out of alignment—each appears as a speck on my screen. Transforming the CAD layer will solve this problem.

3. Transform the CAD Layer.

After right-clicking on the CAD Polyline feature class, I choose Properties from the context menu and click on the Transformations tab in the Layer Properties dialog box. The Transformation tab provides three options. I click on the box next to Enable Transformations, browse to the location of the World file, and ensure that Transform By: World File is selected. Alternatively, if I had two pairs of from and to coordinates (perhaps obtained from the supplier/creator of the CAD dataset), I could use them to create a World file or enter them in the Transform By:

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Workflow

Transform CAD data, then convert to geodatabase.

1 **Add the reference data to ArcMap.** If none exists, then set the Data Frame's coordinate system to the correct coordinate system.

2 **Add the CAD Polyline feature class.** It probably will not align with the reference data because it is not georeferenced.

3 **Transform the CAD layer.** (Layer properties > Transformations tab) Use either the World file or two coordinate pairs of from and to values.

4 **Turn off unwanted CAD attribute fields.** (Layer properties > Fields).

5 **Convert the now transformed CAD layer into a geodatabase feature class.** Export the data (right-click the CAD layer, Data > Export Data).

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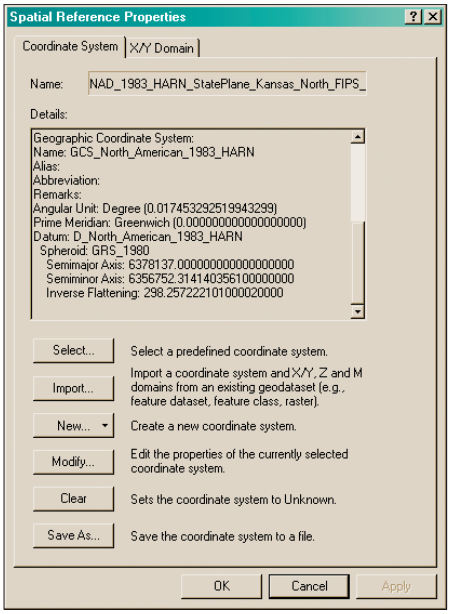
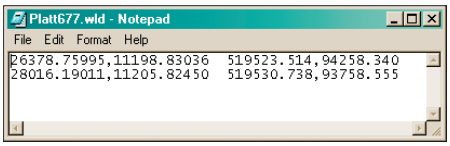


On the Coordinate System tab of the Spatial Reference Properties, you can select a coordinate system from a list of predefined ESRI supported systems, or you can import (i.e., borrow) the coordinate system of another feature class. If you want to create a projection file (.prj), click the Save As button.

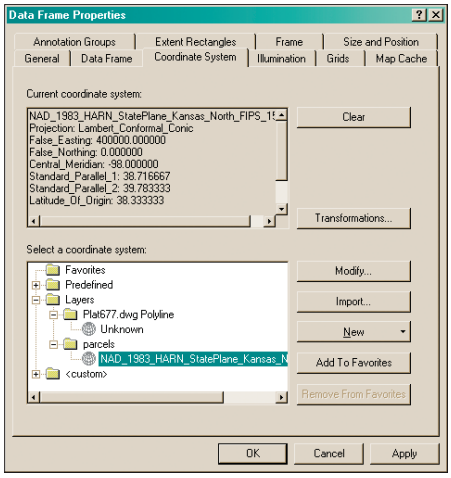
Coordinates option. No matter which method I choose, when I apply the transformation, the CAD data moves to the proper location.

4. Turn Off Unwanted CAD Attribute Fields. CAD data contains attribute fields that are not useful in GIS. Before converting the CAD Polyline feature class to the geodatabase format, I right-click on the CAD Polyline feature class and choose Properties. In the Layer Properties dialog box, I click on the Fields tab and uncheck everything except the FID and Shape fields.

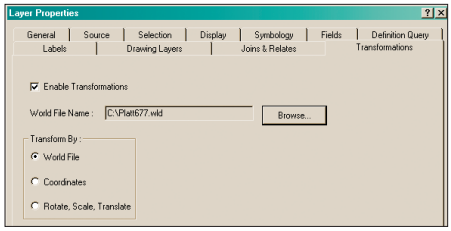


A World file is a text file that contains coordinate values of two points, both their current CAD values (from) and their transformed values (to).

5. Convert to a Geodatabase Feature Class and Set the Spatial Reference. Right-clicking on the Polyline layer in the Table of Contents, I open the context menu and choose Data > Export Data to export all features. I use the same coordinate system as the Data Frame, choose Personal geodatabase feature class,



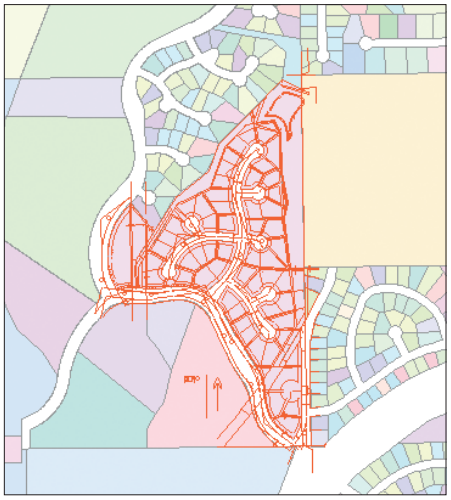
Viewing the Data Frame Properties Coordinate System tab allows you to see the coordinate system of all layers as well as that of the Data Frame.



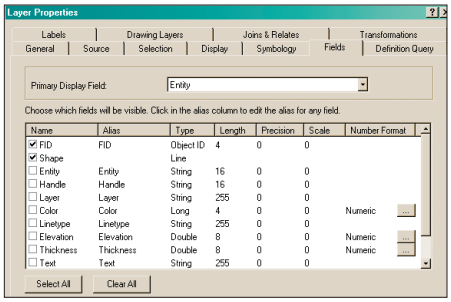
CAD data layer properties include a Transformations tab. Here you can properly position, or transform, the CAD layer using a World file or two sets of from and to coordinates.

name the output feature class Subdivision, and save it in the MyCity geodatabase. I also opt to add the new Subdivision feature class to the Data Frame. I confirm the spatial reference of the new Subdivision layer by viewing its properties on the Source tab of the Layer Properties in ArcMap or viewing its properties in ArcCatalog. Alternatively, I could also have used the Feature Class to Feature Class tool in ArcToolbox and set the spatial reference in ArcCatalog.

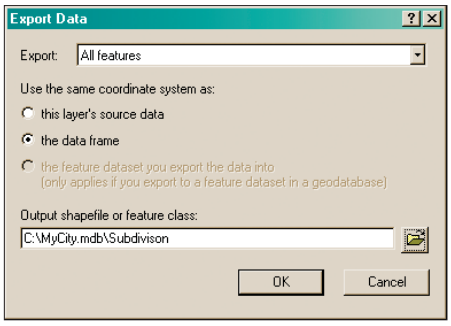
After creating the new Subdivision feature class, I could convert it to polygons. Now that I am working in the geodatabase format, I have several options for creating better data. There may be gaps and overlaps between the parcels and Subdivision features where the transformation was less than perfect. I can edit the Subdivision features now or build a topology to clean up the new feature class so that there are no slivers or overlapping polygons. I might also want to aggregate the Subdivision features with those of the parcels feature class.



The transformed CAD layer (shown in red) is now aligned with the reference data.



Before converting the CAD data to the geodatabase format, you can turn off unwanted CAD attribute fields by unchecking fields. Unchecked fields will not be converted.



The Export Data option allows you to convert the CAD data directly into a brand new geodatabase feature class. Since the CAD layer has an undefined coordinate system, I chose to use the coordinate system of the data frame. For output, I navigated to the MyCity geodatabase and named the new feature class Subdivision.

For now, however, my task is complete. I have successfully converted the CAD data into the geodatabase format and set its spatial reference so that it is properly oriented and aligned. This GIS girl finally can quit fretting over CAD data floating in undefined space and tell it, definitively, where to go.

For More Information

Learn more about working with CAD data at the ESRI Virtual Campus (campus.esri.com). A free, hour-long seminar, *Geoprocessing CAD Data with ArcGIS*, is available as well as a workshop, *Working with CAD Drawings in ArcGIS*.

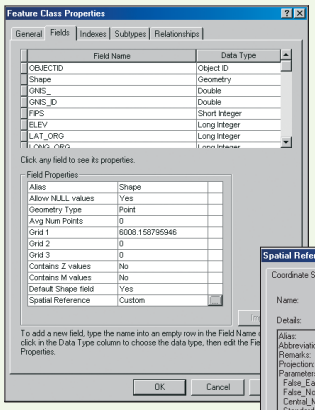
About the Author

Michele Mattix is an ESRI software instructor in Redlands, California. She holds a bachelor's degree in mathematics, a master's degree in geography, and a master's degree in environmental science. After struggling to learn GIS on her own, she vowed to make that task easier for others by applying her teaching talents to GIS software instruction.

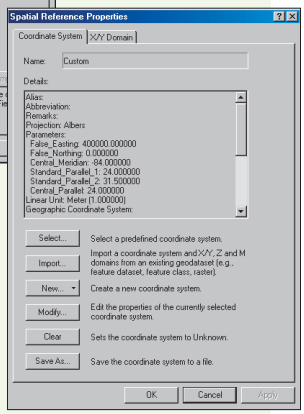
Check the Spatial Reference
for a Stand-Alone Feature Class

The spatial reference information of a stand-alone feature class can be viewed in ArcCatalog.

1. Right-click on the feature class, choose Properties, then click on the Fields tab in the Feature Class Properties dialog box.
2. The top of the dialog box lists the fields in the attribute table. Clicking on a field name populates the lower half of the dialog box with its field properties.
3. Click on the Shape field. The last item listed under Field Properties is Spatial Reference.
4. Click on the ellipsis button beside the coordinate system name to open the Spatial Reference Properties dialog box.
5. Select, import, modify, or create a coordinate system. Using the Save As button creates a projection file (.prj) that can be associated with the dataset.



In the Fields tab of the Feature Class Properties dialog box, click on Shape, then on the ellipse next to Spatial Reference.



In the Spatial Reference Properties dialog box, select, import, modify, or create a coordinate system. A projection file can also be created using the Save As button.