Raster Imagery for Mapping and Land Development Professionals

David Zavislan, P.E. – NV5, Inc.

CI2710   Explore the functionality in AutoCAD® Raster Design, and AutoCAD® Map 3D software for working with aerial imagery, viewing Digital Elevation Model (DEM) data, editing scanned maps and photos, and converting raster data into vector. Learn how to accurately insert georeferenced images. Insert and correlate non-referenced images. Access and manage imagery using image manipulation tools. Improve image display with nonlinear tonal adjustment and palette controls. Create slope and elevation maps from DEM data. The class will also look at draping images on surface models and the raster capabilities of the AutoCAD Map 3D Feature Data Objects (FDO) functions.

Learning Objectives

At the end of this class, you will be able to:

- Insert and manage multiple geo-referenced images
- Use rubber sheeting tools to correlate raster images
- Improve image display with nonlinear tonal adjustment and palette controls
- Generate color elevation models from DEM data file
- Connecting to raster data with AutoCAD Map's Feature Data Objects (FDO).
- Drape an aerial photograph image on a terrain surface.

About the Speaker

David Zavislan is the CAD manager at NV5, Inc. NV5 is a full-service civil engineering firm with offices across the United States. At NV5, David supports the firm's infrastructure design division with design, BIM modeling, and document delivery processes. In addition to support, he also develops custom CAD software, training, and company standards. Prior to joining NV5, David was an independent CAD consultant, specializing in civil engineering, surveying, and mapping. Other past work experience includes: structural engineer, staff engineer for a municipal public works department, project engineer, project manager, and as a trainer and consultant for a software reseller. David has also obtained professional civil engineering licenses in California and Colorado. This is the twelfth Autodesk University that David has been a speaker.

david.zavislan@nv5.com

Overview

This class demonstrates some of the common functions used to display and manage aerial images and Digital Elevation Models (DEM) in the AutoCAD® Map 3D, AutoCAD® Civil 3D® and AutoCAD® Raster Design programs.

The following table shows the basic raster capabilities of each of these applications. Civil 3D is not listed because it contains all of the AutoCAD Map 3D functionality. Civil 3D also has tools to quickly apply an image to a surface model as a render material.

	AutoCAD	AutoCAD Map 3D	AutoCAD Raster Design in AutoCAD	AutoCAD Raster Design in AutoCAD Map 3D
Insert Image	✔	✔	✔	✔
Insert Geo-referenced Image		✔	✔	✔
Edit Raster Image			✔	✔
Re-project Image		✔ (FDO)		✔
Web/Server Image		✔ (FDO)		

Inserting Images with Map 3D and Civil 3D

The MAPIINSERT command will place geo-referenced images at the correct coordinate location, based on the values in the image's corresponding world file, or, in the case of geoTiff images, within the file itself. If an image file does not have any correlation data with it, you will have to locate it manually. After insertion, you can use AutoCAD's MOVE, ROTATE and SCALE commands to align it with your model. Once placed, images can be managed with AutoCAD's reference manager and image commands.

Inserting Images with Raster Design

Raster Design's IINSERT command will place geo-referenced images at the correct coordinate location, based on the values in the image's corresponding world file, or, in the case of geoTiff images, within the file itself. Unlike the image insert command in Map 3D, this command also provides the capability to convert images to different coordinate projections.

If an image file does not have any correlation data with it, you will have to locate it manually. After insertion, you can use Raster Design's IMATCH and IRSHEET (rubber sheet) commands to quickly align it with your model. After the image has been correlated to the model, Raster Design can generate a world file, so that the image can be automatically placed at the correct location in other drawing files.

Concepts and Terms

Caution about correlation during image insert– Since Raster Design can edit multi-resolution images you will need to watch the Transform settings in the Image Insert command. If you use the True or 4 point rubbersheet transformation methods, it may take Raster Design several hours to calculate the correlation values for a large MrSid, ECW, or JPEG 2000 files.
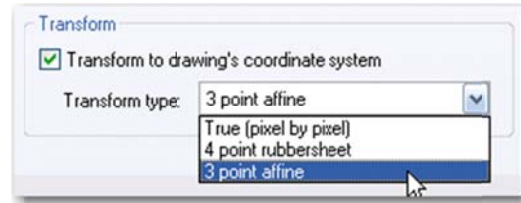
For these large files, it is best to use the 3 point affine method. This method will quickly place the image in the drawing using three points to insert, scale and rotate the image. The image itself will not be modified.

Save – allows you to save a modified image. If the image is in a format that Raster Design cannot write, you will be prompted to enter a new file name and type.
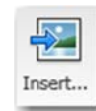
Save As – allows you to save an image to a new file with a new file name, and possibly a different file type.

Export – allows you to save an image and simultaneously create a correlation file.

World file – a correlation file that can be created for all exported raster file formats. It is saved in the same directory as the raster image. The world file will have the same name as the raster file but with a modified extension – such as *tfw* for a tiff image. The Image Insert commands in Raster Design and Map 3D will read an image's corresponding world file to place the image in a drawing at the correct coordinates, scale and rotation.
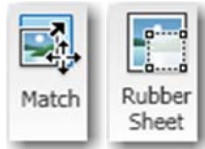
Insert Images with Raster Design

1. Select the **Raster Tools** tab on the ribbon bar. 2. Select the **Insert…** command button.	
3. Browse to and select the image file(s) that you want to import.	
4. At the bottom of the Insert Image window are insertion options to control the dialogs that appear after clicking the Open button. If you know that the image you are inserting has correlation data, select the Quick insert option. The images will be inserted at the scales and coordinates specified in their world file(s). If the image(s) you are inserting do not have correlation data, or if you need to transform the image to the drawing's coordinate system, you need to make sure to select the Insertion Wizard or Insertion Dialog options.	

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5. After the image has been inserted in the drawing, you can use the **IMATCH** or **IRSHEET** commands to manually correlate the image to your model.	
6. If you only used the IMATCH command to correlate the image, the raster file was not modified and, therefore, does not need to be saved. Use the **IWORLDOUT** command to generate a new world file for the image.	
7. If you used the IRSHEET command, or any other image editing commands, you will need to use the **IEXPORT** command to save the edits to a new image file, along with the correlation data.	

Basic Editing with Raster Design

This section covers some of the basic image editing commands that are available in Raster Design. These commands are typically used at the beginning of a project to clean up images and reduce their file sizes, so that they can be used more efficiently within the AutoCAD program. The time spent cleaning up and editing the image files will reduce future time spent during opening and plotting drawing files.

Concepts and Terms

Image Selection – If you have only one image in the drawing file, Raster Design commands will automatically select that image without prompting. With multiple images in the drawing, you will be prompted to select the image frame. If you have frames turned off, or you are zoomed in on an area where the frame is not selectable, you can pre-select the image by depressing the shift key and picking within the image. You can disable this functionality by toggling the Shift+Left Click Select button on the Raster Tools > Snap ribbon panel, or clearing the toggle on the User Preferences tab of the Raster Design Options window (IOPTIONSPAGE).
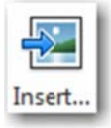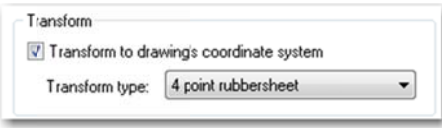
Merge Images
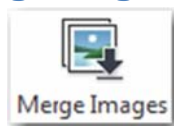
Merge – The Merge command is used to combine multiple images into a single image file. In order for this command to work, all of the images must have uniform X and Y scale factors. When dealing with images downloaded from web servers, you may need to work in the data's default coordinate projection so that the image scales will remain uniform. For web based imagery this is usually a projection called Web Mercator. In Map 3D, use the similar WGS84.PseudoMercator projection for the drawing's coordinate system. After the images are merged together, you can use Raster Design's Image Insert command to change the final image to the desired coordinate system.

If possible, have some overlap of the tiled images to create a seamless final image. If the source images do not overlap, the Merge command may add black pixels where the edges were.

1. After inserting all of the tiled images, select the **Merge Images** command. It is located in the expanded Edit panel of the Raster Tools ribbon tab.	
2. Select all but one of the images as sources. 3. Press **Enter** once to finish selecting source images.	
4. Select the remaining image as the destination.	
5. Answer **Yes** to erase the source images when they are done being merged.	
6. For each image that is erased you will need to answer **Yes** to the remove from drawing prompt.	
7. Select the **IEXPORT** command to save the cropped image to a new file, along with the correlation data.	

Change Image Coordinate Projection

1. Open a new drawing with the desired coordinate system assigned. 2. Use the Map 3D ADESETCRDSYS command, or Civil 3D drawing settings to set or verify the drawing's coordinate system.	
3. Select the **Raster Tools** ribbon tab. 4. In the Insert & Write ribbon panel, select the **Insert…** command. 5. Browse to and select the image file to insert.	
6. In the Insert Image window, change the insert option to **Insertion Dialog**. 7. Click the **Open** button.	
8. Select the **Transform** tab. 9. Toggle **on** the Transform to drawing's coordinate system option. 10. Set the transform type to **4 point rubbersheet**. If the image file is large, you may want to use the 3 point affine method instead. 	
11. Use the **Select** button to assign the coordinate system that the image file was saved in.	

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|---|
| 12. Click the **OK** button.
It will take the software a minute or two to calculate the 4 point rubber sheet transformation. |
| 13. Select the **IEXPORT** command to save the cropped image to a new file, along with the correlation data. |

Manually Correlate an Image

Match - Correlates an image by moving, scaling and rotating the image. Matching is performed by selecting two "source" points on the image and two "destination" points in the drawing.

Polynomial Rubber Sheet – Correlates an image by stretching and warping the image to remove distortions. At least three pairs of "source" and "destination" points are used to adjust the image. Better correlation is achieved by selecting six or more pairs of points that are distributed evenly across the image.
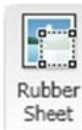
Triangular Rubber Sheet – Imposes a series of triangles between the control points then applies the transformation to those areas. Because each triangular area is transformed separately, the triangular method is much more accurate than the polynomial method. However, the triangular method may result in the loss of some image data. The area to be transformed is defined by the outermost destination points. Image data outside of the transformation area is discarded. To preserve more of the image data, place control points near the extents of the image.

"**Source**" **point** – A correlation point on the image.

"**Destination**" **point** – A point in the drawing file that is selected by specifying coordinates, snapping to entities, picking on another image, or by using Civil 3D point data.

Civil 3D transparent point toggles – When specifying start or destination points for the Match and Rubbersheet commands you may use the Civil 3D transparent command toggles. The toggles allow you to specify coordinates with point numbers, point objects or by entering northing and easting coordinate values.

'**PN** - Specify point number

'**NE** - Specify Northing and Easting coordinates**.**

'**PO -** Select Civil 3D point object in the drawing

Crop an Image

Crop – Removes image data outside a specified boundary. Cropping greatly improves AutoCAD software's performance. Working with cropped images, AutoCAD will only need to open and load the image data needed for a view. Any editable image that is within the crop boundary will be cropped.

Mask – Applying a mask to an image only hides the data. AutoCAD must still open and read the entire raster file to display it.

1. Select the **Crop > Rectangular Region** (**ICROPRECT)** command in the Edit panel of the Raster Tools ribbon tab.	
2. Pick the location of one of the rectangle corners. 3. Enter a rotation angle of **0**.	
4. Pick the opposite corner.	
5. Select the **IEXPORT** command to save the cropped image to a new file, along with the correlation data.	

Change Image Density

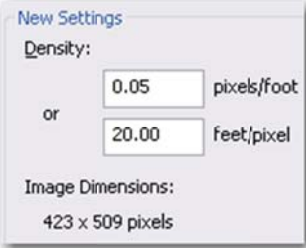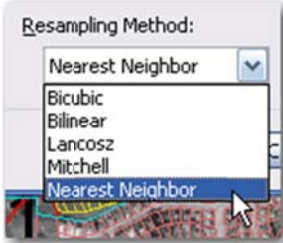**Density** – The number of pixels/dots per unit of measure.

Reducing Density – Reduces the size of the file. This increases AutoCAD performance when opening files and plotting, and may reduce the amount of hard drive space needed for storing image files. Use an image density value that is appropriate for the scale and resolution of the final output.

Resolution Management – Use lower resolution versions of images for daily work and then activate the original, high resolution images for detailed viewing and plotting.

You can use the AutoCAD IMAGEQUALITY command, setting it to Draft, to improve image display performance, while working in AutoCAD. This setting does not affect plotting.
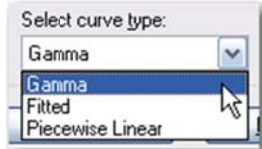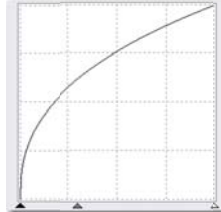
Images with varying densities can also be managed by attaching them with Map 3D Feature Data Objects. After connecting to image data, stylize the layers to specify the view scales that the images will be displayed at. At larger view heights, display only the lower resolution images. As you zoom in closer to the site, have it switch to display the layer containing the higher resolution images.

1. Select the **Process Image > Change Density**… (**IDENSITY)** command, located in the Edit panel of the Raster Tools ribbon tab.
2. If multiple images are inserted in your drawing, select the image that you want to modify.

3. On the left side of the Change Density dialog, verify the current density values for the image.

   To decrease the files size, use a pixel/foot value that is lower than the current or a feet/pixel value that is greater than the current.

4. On the right side of the dialog, change one of the density values.

   Raster Design will calculate and display the new image dimensions.

5. At the bottom of the dialog, select the resampling method that will be used to determine the color of the new pixels.

   Read the help file for explicit descriptions of each method. The **Nearest Neighbor** method is the quickest because it derives the color of a pixel from only the single, existing pixel that is nearest to it.

6. Click the **OK** button to process the image.

7. Select the **IEXPORT** command to save the reduced density image to a new file, along with the correlation data.

Tonal Adjustment

Histogram – The IHISTOGRAM command is used to modify image quality and convert images to grayscale or binary.

1. Select the **Process Image > Histogram… (IHISTOGRAM)** command, in the Edit panel of the Raster Tools ribbon bar.	
2. If there are multiple images in the drawing, select the one that you want to modify. 3. Press **Enter** to finish the selection process. 4. Press **Enter** once to modify the entire image.	
5. Select the **Tonal Adjustment** tab. 6. Select the curve type that you want to use to modify the image: **Gamma**, Fitted, or Piecewise Linear.	
7. Adjust the graph by clicking on it to add and move curve points or by moving the triangular markers at the bottom. 8. Click the **Apply** button. 9. Click the **Close** button.	
10. If the results are not satisfactory, use the UNDO command to return to the original image tone. Then try the command again. It is best not to apply edits upon edits.
11. Use the ISAVE, ISAVEAS or IEXPORT command save the changes.

DEM Data with Raster Design

Raster Design can display Digital Elevation Models (DEM) by applying a color map to the elevation values.

Concepts and Terms

DEM – Digital Elevation Model. Grid of points with elevation at each point recorded as a floating point number. Raster Design can map elevation, slope or aspect data to user defined color maps.

The DEM files used in this exercise were downloaded (free) from The National Map Viewer http://viewer.nationalmap.gov/viewer/

USGS National Elevation Dataset (NED) - The NED is a seamless raster model of elevation data covering the United States. Data can be downloaded in ArcGIS Binary Grid format, or GeoTiff format, from the National Map Viewer website (http://viewer.nationalmap.gov/viewer/). Image coordinates are NAD83 datum, Latitude – Longitude, Degrees (Map coordinate system code LL83).

ESRI Grid Format – Raster Design will read ArcGIS Binary (.adf file extension) and ASCII format grid files.

GeoTiff – Similar to GeoTiff image files except that the instead of color information being saved for each pixel, the file contains elevation values.

DTED – Raster Design will also read Digital Terrain Elevation Data (DTED) formatted files.

Color Map – Color maps are used to assign color values from a palette to ranges of data values in the DEM file. Colors can be assigned to the DEM file based on elevation, slope or aspect (direction of slope).

Data ranges can be specified manually or automatically. The automatic methods include Equal, Standard Deviation or Quantile. The standard deviation method will create six ranges with the upper value of the third range set to the arithmetic mean of the entire data set.

Color palettes are saved as in ASCII files containing lists of comma delimited sets of RGB values.

Hillshade – Applies lighting from the northwest direction. Darkens pixels whose aspect is towards the southeast, creating the appearance of shadows in valleys.
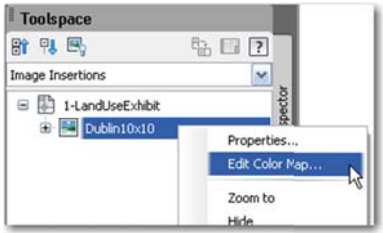
Image Capture – Can be used to save displays of images that cannot be saved, such as DEM and multispectral images with color maps applied. The captured images can be saved in standard raster file formats, which can be opened and viewed in other applications.

Inserting a DEM

1. If you plan on transforming the DEM file, make sure that the drawing file has been assigned a coordinate projection.	
2. Select the **Raster Tools** tab on the ribbon bar. 3. Select the **Insert…** command button.	
4. Select the **dem, adf** or **tif** digital elevation model that you would like to insert.	
5. At the bottom of the Insert Image dialog, select the **Insertion wizard** option. This will allow us to select the transformation options to convert the DEM data to the drawing's coordinate system.	
6. Select the **Standard** color map.	
7. Click the **Next>** button until you get to the **Transform** dialog.	

8. Toggle **on** the Transform to drawing's coordinate system option.
9. Select the Transform type. For very large DEM files, the True (pixel by pixel) method may take a very long time to complete.
10. Enter or select the coordinate system code that is used by the DEM file.
11. Click the **Next>** button.
    If you applied the drawing's and DEM file's coordinate systems correctly, the DEM image should now appear with your model.

12. Click the **Finish** button to complete the insertion.

Modifying DEM Color Map

1. Open the **Image Manager** (IMANAGE). This will open a Toolspace window with an Image tab.

2. At the top of the Image Toolspace, change the view mode to **Image Insertions**.
3. Expand the tree for the current drawing by clicking on the plus sign to the left of the drawing name.

4. Right-click on the DEM file name, and select the **Edit Color Map…** command from the shortcut menu.

5. Select the **Create new color map** button.

6. Enter a name for the new color map.
7. Set the data interpretation to **Value**. This will use the default elevation values from the DEM file. This is where you can specify elevation values, slope or aspect to be used to assign color mapping.

8. Set the value distribution to **Parametric** and the type to **Equal**. This will distribute the elevations to equal sized ranges. The number of ranges will be determined by the assigned color palette.

9. In the Palette area, select the **Import…** button.
10. Select the Palette File (.pf) that you want to import. The palette files are located in your Raster Design Support folder.
11. Click the **Open** button.

The Range Table will update, displaying the range values and colors from the imported palette. 12. To add the appearance of depth to the image, toggle **on** the Hillshade option. 13. To enhance the hillshade effect on models with little elevation relief, increase the Vertical Exaggeration value.	<table><tr><td>11</td><td>378.2727</td><td>24.7727</td></tr><tr><td>10</td><td>353.5000</td><td>24.7727</td></tr><tr><td>9</td><td>328.7273</td><td>24.7727</td></tr><tr><td>8</td><td>303.9545</td><td>24.7727</td></tr><tr><td>7</td><td>279.1818</td><td>24.7727</td></tr><tr><td>6</td><td>254.4091</td><td>24.7727</td></tr><tr><td>5</td><td>229.6364</td><td>24.7727</td></tr><tr><td>4</td><td>204.8636</td><td>24.7727</td></tr><tr><td>3</td><td>180.0909</td><td>24.7727</td></tr><tr><td>2</td><td>155.3182</td><td>24.7727</td></tr><tr><td>1</td><td>130.5455</td><td>24.7727</td></tr><tr><td>0</td><td>105.7727</td><td>24.7727</td></tr></table>

14. Click the **OK** button to save the changes to the color map.

15. Back in the Palette Assignment Color Map dialog; make sure the new color map is selected.   16. Click the **Apply** button.

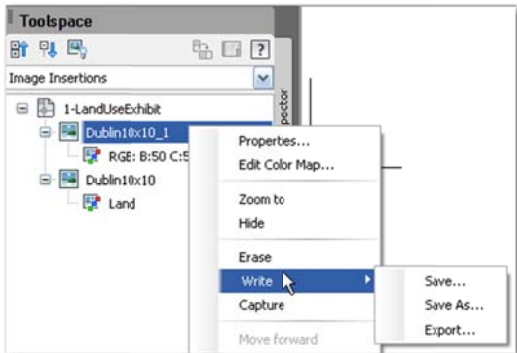|	
17. To modify an existing color map, select the **Edit Color Map** button in the Palette Assignment Color Map dialog.	

Capture an Image of a DEM with an Applied Color Map

1. Select the **ICAPTURE** button in the Insert & Write panel of the Raster Tools ribbon tab.	

2. Select the frame of the DEM image. If the DEM is the only image in the drawing, it will be selected automatically.

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3. A new RGB image is created. Use the ISAVE, ISAVEAS or **IEXPORT** command save. These commands can be found by right-clicking on the image name in the Image Manager. The new image should have the same name as the original DEM file, with a counter number appended to the end.	

Feature Data Objects (FDO) Raster

Feature Data Objects (FDO) are an open source programming interface that allow the AutoCAD Map 3D program to connect to GIS data files in their native format. A comprehensive collection of FDO providers are installed with AutoCAD Map 3D. This section explores the use of the Raster FDO provider to display and stylize aerial images and DEM files.

Concepts and Terms
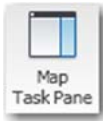
Map Task Pane – All of the data connection, stylization and layer management functions are readily available from the Display Manager tab of Map 3D's Task Pane window.

Data Connect – Toolspace to select and configure FDO data connection providers.

Resample Raster – Raster layers can be re-queried by right-clicking on the layer name in the Map 3D Display Manager. The Resample Raster command will query the source data files and display only the portion of the image that appears in the current view window.

Map 3D queries the image files and creates a temporary raster file. This temporary image file is then referenced into the drawing. It will be inserted on the current drawing layer, so make sure that the current layer will display and plot. The images are automatically re-queried every time the drawing file is opened.

Images are also resampled when the drawing is plotted. Since there is only a single insertion of the FDO image, it will not be able to generate separate plot preview images for multiple viewports. However, it is able to plot correctly because the image for each viewport is queried when the viewport is plotted.

Layer Opacity – You can add an opacity value to an exported raster layer file. To set the opacity to 60%, edit the layer file and add the following line below the <FeatureName> line:

> **<Opacity>0.6</Opacity>**

When the layer is imported back into Map 3D, the raster layer will display as transparent.
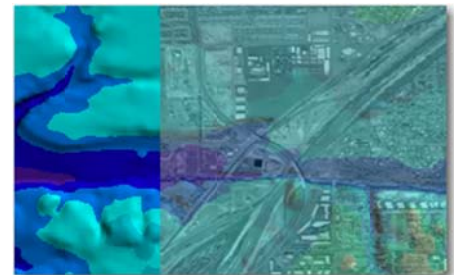
The image above shows a screen capture of a transparent aerial photo on top of a stylized DEM.
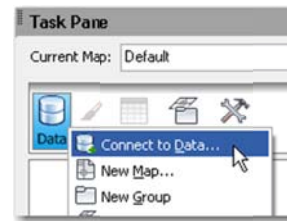
Opacity is not applied when plotting or viewing in 3D.

Image Capture – The Raster Design image capture command has been enhanced to allow the capturing or stylized data from Map 3D FDO raster providers. The command generates a new raster image from the selected FDO raster layer. The command only works when AutoCAD is in a 2D plan view.

Save Current Map to AutoCAD – This command converts all of the currently displayed map layers as AutoCAD drawing objects. Sampled raster data will be saved as a png file in the drawing's folder, and it will be inserted as an image reference.

Display Raster Images with FDO

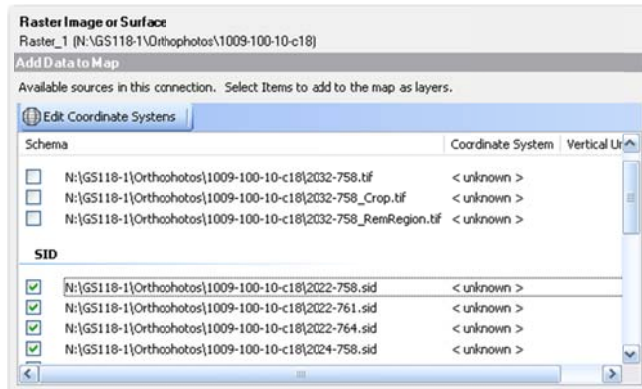|	
1. In the Map 3D Task Pane, Select the **Data > Connect to Data…** command. 2. Select the **Add Raster Image or Surface Connection** provider.	
3. For multiple images, select the **Browse Folder** button. If you only want to add a single image file, select the **Open File** button.	
4. Browse to and select the folder containing the image files you want to connect to. 5. Click the **OK** button to close the Browse to Folder dialog.	
6. Select the **Connect** button.	
7. Toggle **on** the image(s) that you would like to connect to and add to your drawing. 8. Select the **Edit Coordinate Systems** button located at the top of the file list.	
9. In the Edit Spatial Contexts dialog, select the **Default** item. 10. Click the **Edit**… button and then select the coordinate system used for the images. All of the images selected for this connection must have the same coordinate projection. 11. Click the **Ok** button to select the coordinate system override. 12. Click **Ok** button to close the Edit Spatial Context window.	
13. If multiple image files were selected, toggle **on** the Combine into one layer option. 14. Enter a name for the layer. This will be displayed on the Display Manager tab of the Task Pane.	
15. Click the **Add to Map** button.	
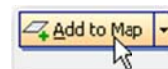
FDO DEM

FDO can connect to raster elevation models in Digital Elevation (DEM), ESRI Grid, GeoTiff or Digital Terrain Elevation Data (DTED) file formats. Raster display can be stylized similar to the color map tools in Raster Design. Pixels can be colored based on elevation, slope or aspect.

Concepts and Terms

3D Viewing – Raster Elevation data in Map 3D will display with the Z dimension when AutoCAD is set to a 3D view. Any Map 3D layer that is displayed above the elevation data layer will be projected and displayed at the same Z location. This provides a quick method to drape aerial photography onto a surface.

Map 3D Status Bar – Toggles AutoCAD between preset 2D and 3D views. The Vertical Exaggeration is applied to 3D display of raster elevation data.

To see the Map status bar, the drawing status bar must be toggled on and the MAPSTATUSBAR command must be set to 'show'.
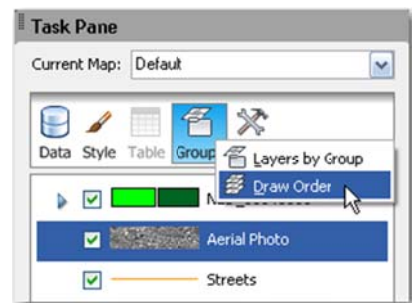

Display DEM with FDO

| |
|---|
| 1. In the Map 3D Task Pane, Select the **Data > Connect to Data…** command.
2. Select the **Add Raster Image or Surface Connection** provider. |
| 3. Select the **Open File** button.
4. Browse to and select the DEM file that you want access. |
| 5. Click the **Connect** button. |
| 6. Toggle **on** the image that you would like to connect to and add to your drawing. |
| 7. If a coordinate system is not displayed for the image, select the **Edit Coordinate Systems** button located at the top of the file list.
8. In the Edit Spatial Contexts dialog, select the **Default** item.
9. Click the **Edit**… button and then select the coordinate system used for the raster DEM.
10. Click the **Ok** button to select the coordinate system override.
11. Click **Ok** button to close the Edit Spatial Context window. |
| 12. Since we are only adding a single item, leave the Combine into one layer option toggled off. You could turn this on if you want to enter in the layer name that will appear in the Display Manager. If you don't specify a name, the layer will have the same name as the file. You can edit the layer name in the Display Manager by clicking on it twice. |
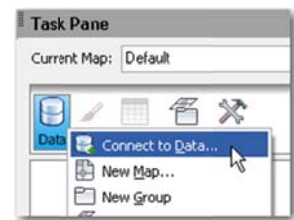
13. Click the **Add to Map** button.

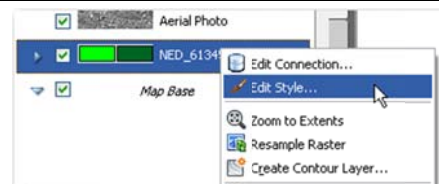|	
14. The DEM image will insert on top of all existing Map layers. 15. To change the layer display order, click on the **Groups** icon at the top of the Display Manager, and select the **Draw Order** option.	
16. Pick and drag the DEM layer to the bottom of the order list.	
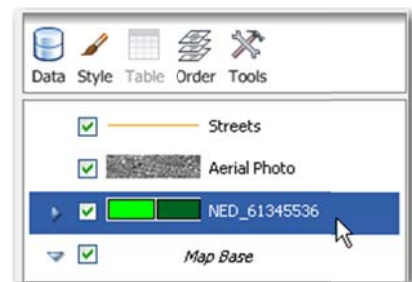
Stylize DEM

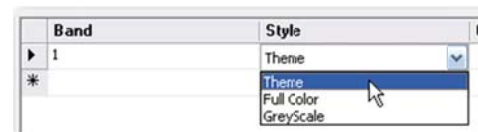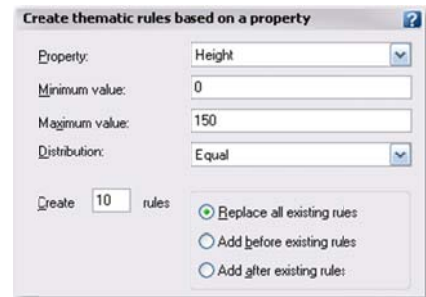|	
1. In the Map 3D Task Pane, right-click on the DEM data layer and select the **Edit Style…** command.	
2. In the middle of the style editor, select band **1** to be used for both the Hillshade and Elevation bands.	
For this example all of the elevation data will be presented in a single scale range. 3. In the lower half of the Style Editor, for band number 1, expand the Style list and select **Theme**.	
There are two options for defining a theme. The first is to specify the number of rules and a color style ramp to apply to the rules. The second option is to select a predefined palette that contains the number of rules and their corresponding colors. This exercise will apply an elevation color theme using the first method.	

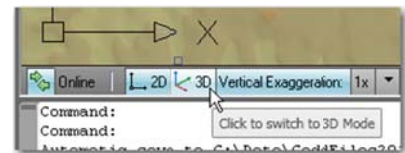|	
4. Set the property to **Height**. The other options are slope and aspect. 5. Enter appropriate minimum and maximum values for your data. 6. This example uses an **Equal** distribution method. 7. Enter the number of rules (ranges) that you would like to create.	
8. Make sure that Specify a theme is toggled **on**. 9. Select the **Style ramp** option. Then click the style ramp button to specify the start and end colors for the ramp.	
10. Toggle **on** Create legend labels. Enter the text you would like to appear in the legend and select the label format. The legend labels appear in the expanded layer listing in the Map 3D Task Pane.	
11. Click the **OK** button to close the Theme editor.	
12. Click the **Apply** button to update the layer in the drawing.	

View DEM in 3D

1. At the bottom of the drawing window, select the **3D** view button on the Map 3D status bar.	
2. Change the Vertical Exaggeration with the scale list on the Map 3D status bar.	
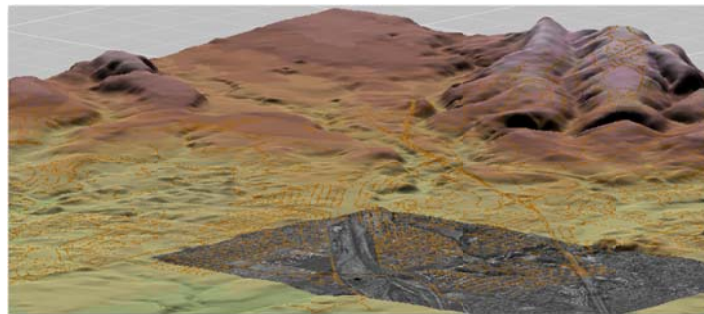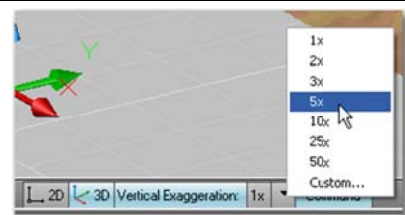
FDO Web Mapping Service (WMS)

This lesson introduces the concept of using image servers to manage and provide raster data into the AutoCAD environment.

Concepts and Terms

WMS – Web Mapping Service. WMS is a data standard developed by the Open Geospatial Consortium, Inc. (OGC). It specifies the HTTP interface used to request and display geographic map data in a browser application. Data is queried based on geographic location and returned for display as map images (JPEG, PNG, and other formats).

WFS – Web Feature Service. WFS is a data standard developed by the Open Geospatial Consortium, Inc. (OGC). It specifies the platform independent requests for geographic information. It allows for queries on spatial and non-spatial data. In simplified terms, WFS is used to query and display vector and tabular data.

Sample Data - Map 3D's help files lists several WMS and WFS links that you can use to try out the FDO connections. Search on 'Adding an Image from a WMS'.   Not all of the connections will work because of changes to URLs.

I have had good luck in connecting to the JPL server: http://wms.jpl.nasa.gov/wms.cgi?

Save Current Map to AutoCAD – Use this command, from Map 3D's Output ribbon tab, to save queried images to files that can be opened by non-FDO versions of AutoCAD.

Current Image Insert CAD model –

Costs:

- Locating Image Data – Time is spent looking for files in folders or in file editing software.
- Crop and Edit Image Data – Besides the time required performing these tasks; extra cost is incurred storing the additional files created with each cropping.
- File Storage – Figure 2 contains the results from a file storage analysis of a file server in one of our offices. Three of the top four data types are raster images.
  Image files must be created and stored for every project. Many of these images are duplicates from adjacent projects.
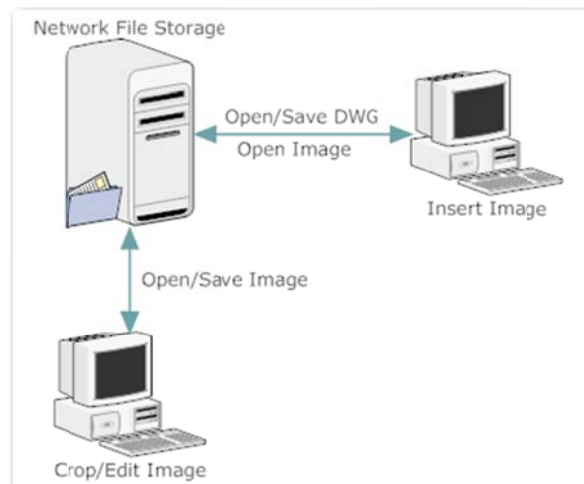
Extension	Description	> Bytes	% By...
.tif	TIF Image	668.3 GB	37.5%
.sid	SID File	124.1 GB	7.0%
.dwg	DWG File	121.9 GB	6.8%
.jpg	JPEG Image	101.2 GB	5.7%
.pdf	Adobe Acrobat Document	85.0 GB	4.8%

Figure 2: Sample Network File Storage

- Performance – Most raster files are at too high of a resolution for the drawing's plotted scale, or the image covers a much larger area than what is required. Both scenarios will require additional time to open, regenerate and plot drawing files.
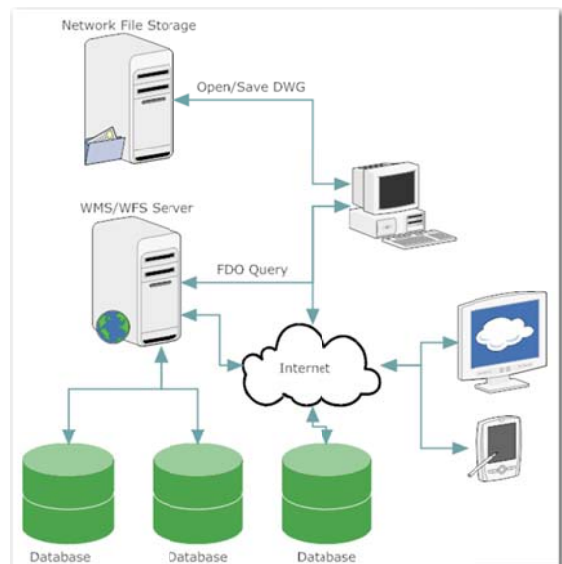
FDO Image Query Model –

Cost:

- WMS Server – Upfront capital expenditure to purchase hardware and software for Web Mapping Service.
- Image Database – Upfront capital expenditure for database software and hardware. Time is required to clean up and add imagery to database. Some vendors provide 'turn-key' severs with the image data preloaded. There are also several vendors that let you subscribe to WMS data.


Benefits:

- Locating Data - Once connected to a WMS server, imagery is displayed based on the coordinates of the view.
- Performance – image is queried and displayed based on the current view and zoom factor.
- Data is automatically converted to coordinate system used in drawing.
- Data is available to internal and external web applications.
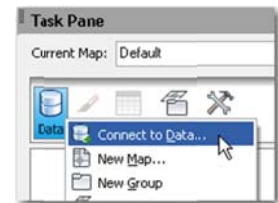
Updated FDO Image Query Model

Since this class was last presented at Autodesk University 2009, there have been changes in the software and data delivery models. The trends are shifting towards greater reliance on cloud based applicatinos and data. We are finding that instead of maintaining our own WMS servers and data, we are able to connect to servers on the internet. A prime example of this trend is the recent Base Jump application from Autodesk Labs that allows you to connect to Microsoft's Bing maps with the FDO query capablities of AutoCAD Map 3D and Civil 3D. The final evolution of this trend will be the ability to create 'mash-up' images inside the AutoCAD drawing window similar to what consumers are accustomed to seeing with internet applications like Google Map.
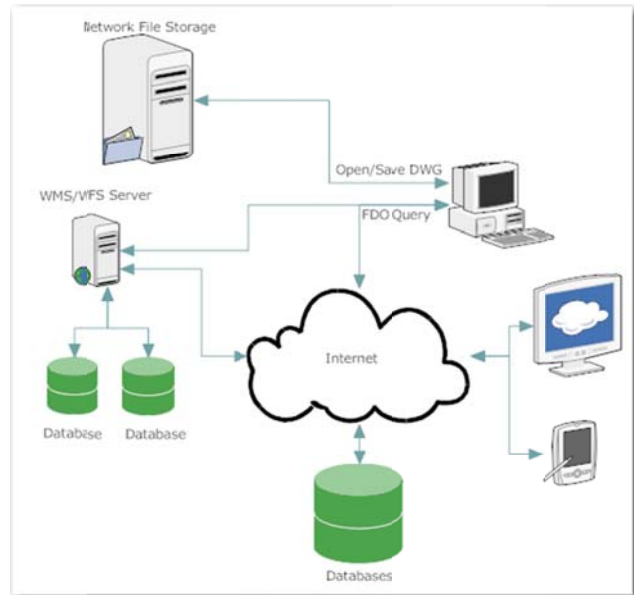
Steps to Display WMS Image with FDO

| |
|---|
| 1. In the Map 3D Task Pane, select the **Data > Connect to Data…** command.
2. Select the **Add WMS Connection** provider. |
| 3. Enter the full server name or URL.
4. Select the WMS version that is utilized by the server. |
| 5. Click the **Connect** button. |
| 6. If needed, enter a valid user name and password.
7. Click the **Login** button. |
| 8. Select the layer that you would like to add to the drawing. |
| 9. Verify server and drawing coordinate systems. |
| 10. Click the **Add to Map** button. |
| 11. In the Display Manager, change the order of the layers so the image is below the Map Base and line layers and above any DEM or surface layers. |
| 12. Right-click on the WMS layer name and select the **Resample Raster** command. |

Civil 3D Image Drape

Civil 3D simplifies the process of applying aerial photographs to surface models with its Drape Image command. The command requires that a surface object and a geo-referenced raster image exist in the drawing. The command will create a material from the raster image, using its geo-referenced coordinates to map the material to the surface.
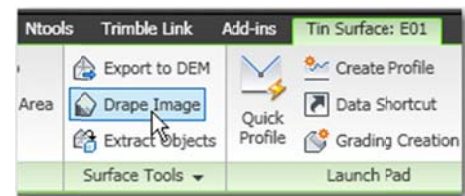
Concepts and Terms
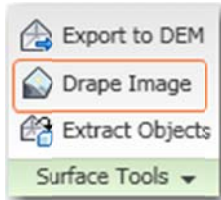
Drape Image – Selecting a surface model in Civil 3D will activate the Tin Surface ribbon tab. The Drape Image command is located in the Surface Tools palette.

Vertical Scale Exaggeration – The triangle display mode of the surface style can be set to exaggerate the surface's elevation. This will create a more dramatic three-dimensional view of a surface.

Hardware Acceleration – Depending on the video card and drivers installed on your computer, image draping my not display the image correctly. Turning off hardware acceleration may correct this problem.

## Steps to Drape an Image on a Civil 3D Surface

1. The drawing must contain a Civil 3D surface, a surface style that displays triangles, and a georeferenced image file.
2. Select the surface in the drawing window. This will display the Tin Surface tab in the Ribbon Bar.
3. Select the **Drape Image** command, located in the Surface Tools ribbon palette.
4. Select the inserted image. 5. Select the surface. 6. Enter a name for the new material. The default name will be a concatenation of the surface name and the image name. 7. Click the **OK** button.

8. Turn **off** the image display
9. Set AutoCAD to a 3D view.
10. Change the visual style to **Realistic**.
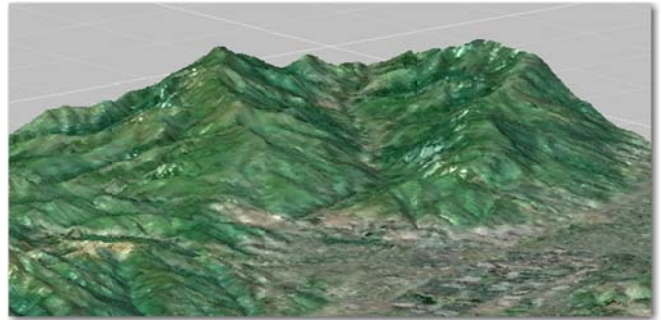
Digitize Contours

This section covers the Raster Design commands and the process used to clean up and convert color images so that contour polylines can be rapidly digitized.

While not a part of the presentation, I have included this section in the handout because the need for this process seems to occur about once a year in my office.

Concepts and Terms

Color Palette – The Palette Manager dialog box displays color tables representing the values in the image palette. You can select individual colors in the color table to get information on their color values, frequency, and index values. By selecting one or more colors from the color table, you can also change their color values, combine colors, assign transparency, and delete colors from the palette.

Color palette editing can be used to combine colors and simplify an image for digitizing purposes. In this example, all of the unwanted pixel colors will be converted to white, leaving behind only the desired linework.

This command does not work on Truecolor images. Truecolor images will need to be converted to indexed color. This conversion can be done with the Change Color Depth (IDEPTH) command.

Thresholding – Found in the IHISTAGRAM command, it is a process of converting a color or grayscale image to a bitonal (black and white) image. A pixel color number is selected as the threshold value. All pixels with a color number less than the threshold number are changed to black. All pixels with color numbers greater than the threshold value become white.

Inverting – reverses the color order of a raster image. For bitonal images, black pixels become white and white pixels become black. For color and grayscale images, negatives can be converted to positive, or visa-versa.

Often the thresholding process will create a bitonal image where the linework is generated in the background color. These images will need to be inverted before any of the vectorization commands can be applied.

 Contour Follower – Raster Design can generate 2D Polylines or Land Desktop's (LDT) contour entities with the Contour Follower command. The command will follow a raster 'line' in binary images. It will prompt the user for elevation values to be applied to the contour line.

LDT applies styles to contour objects to control their appearance and how they are labeled. In Civil 3D, the contour polylines can be used as data for building surface models.
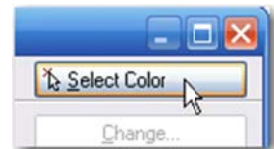
 Raster Snap - Snaps AutoCAD crosshairs to raster linework in bitonal images. Raster Snap options can be toggled with the buttons in the Snap palette of the Raster Tools ribbon tab.

Steps to Convert Color Image to Bitonal

|	
1. Select the **Process Image > Palette Manager…** (IPAL) command located in the Edit panel of the Raster Tools ribbon tab.	
2. Use the **Select Color** button to pick on the image the color that you would like to isolate. 3. Repeat this step, selecting each of the colors that you would like to isolate.	
4. In the bottom portion of the Palette Manager, sort the table by **Frequency**. This is done by clicking on the column's header. The image to the right is from a scanned USGS Quad sheet. The two selected colors are used to display contours.	
5. To select all of the other colors, right-click on the selected rows and pick the **Invert Selection** option from the shortcut menu.	
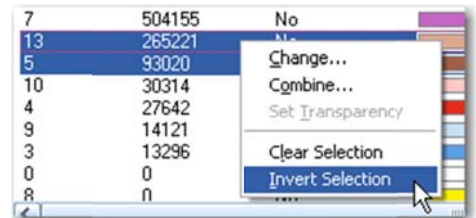
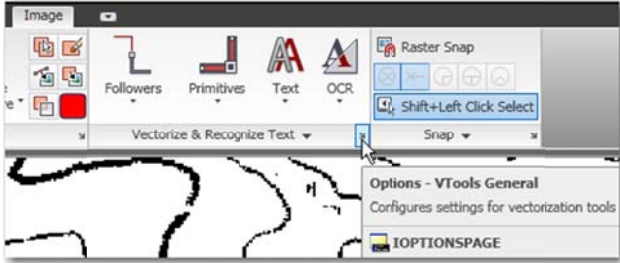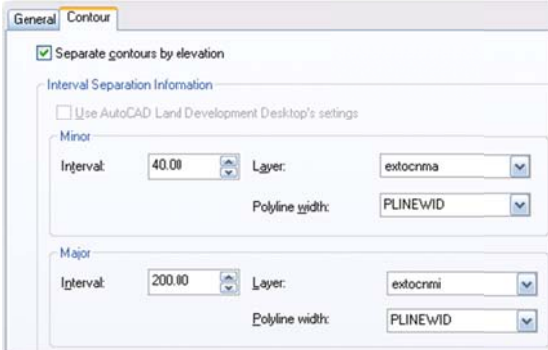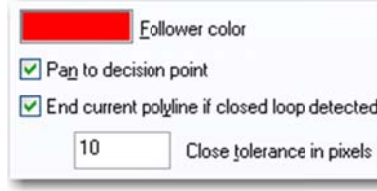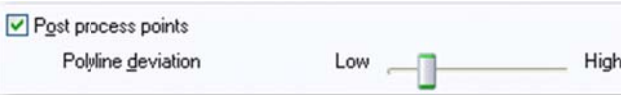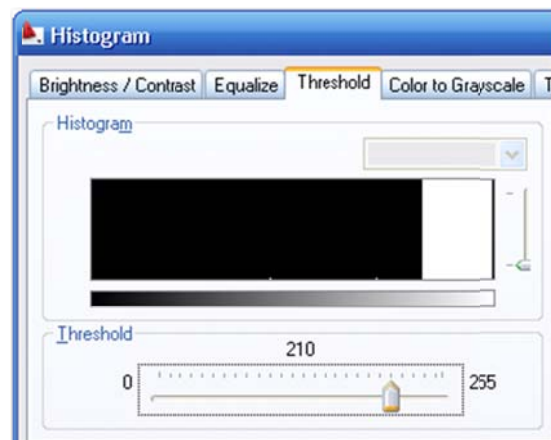|	
6. Right-click on one of the highlighted colors. Select the **Combine…** command from the shortcut menu.	
7. In the Target Color dialog, select the color tile that represents the image's background color. 8. Click the **OK** button.	
9. Click the **OK** button to close the Palette Manager and update the image.	
10. Select the **IHISTOGRAM** command, from the Edit palette of the Image ribbon.	
11. Press **Enter** to select the entire image.	
12. Select the **Threshold** tab. 13. Adjust the threshold value by moving the slider. Any pixel with a lower color value will become black and any with a higher value will become white. For some image files this may take several attempts to determine the best threshold value. Undo after each attempt to try the command with a different value.	
14. Click the **Apply and Close** button to finish the Histogram command.	
15. If the image foreground and background colors are backwards, use the **Cleanup > Invert** (IINVERT) command to invert them. The command is located in the Edit panel of the Raster Tools ribbon bar.	

Steps to Digitize Contours

Before digitizing, set the VTools options appropriately to allow as much of the process to be automated as possble.

1. Open the **IOPTIONSPAGE** command by clicking on the arrow button located in the lower right corner of the Vectorize & Recognize Text ribbon palette.

2. Select the **Vtools General** tab.
3. Select the Removal Method that you would like to use. The contour follower command will remove (erase) pixels under contour lines that have been digitized. This will help keep track of which areas have been converted.

4. Select the **Vector Separation...** button.

5. Select the **Contour** tab.
6. Toggle **on** the Separate contours by elevation option.
7. Specify the contour intervals and associated layers.
8. Click the **OK** button.

9. Select the **Vtools Follower** tab.

10. Select the color you would like for the follower. This color is used to show the contour before an entity is created.
11. Toggle **on** the Pan to decision point.
12. Toggle **on** the End current polyline if closed loop is detected.
13. The close tolerance is the maximum gap, in pixels, that the follower will jump to create a close polyline.

14. Toggle **on** Post process points. This will add or remove vertices from the contour (polyline). A lower deviation will create a contour with more vertices.

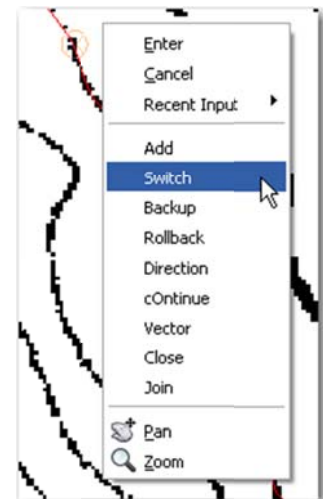| |
|---|
| 15. Specify the type of contour entity to be created. In Land Desktop you can select contour objects.
16. Set the elevation option to **Prompt**.
17. Enter the contour interval that is displayed in the image. Raster Design will automatically increment the elevation values as you digitize adjacent contours. |
| 18. Click the **OK** button to close the Raster Design Options dialog. |
| 19. Select the **Follower > Contour Follower** (VFCONTOUR) command. It is located in the Vectorize & Recognize Text panel of the Raster Tools ribbon tab. |
| 20. To help you select the raster contour lines, toggle **on** Raster Snap.
21. Toggle on the **Center** and **End** of raster lines snap options. |
| 22. The follower will trace the raster line in both directions until it gets to locations in the image where it cannot determine the direction.
23. Right-click and select the appropriate action from the shortcut menu. These options are also available via keyboard commands.

The key commands are listed on the command prompt.

To jump a gap - pick on the raster contour, on the other side of the gap. Then select the **Continue** option.

If it followed incorrectly, you can use the **Backup** and **Rollback** options to return to the point where it deviated from the raster line. Then pick on the line where the follower should go and select the **Continue** option.

To investigate how the other end of the line was followed, use the **Switch** option. |
| 24. When the contour is followed correctly, press **Enter**.
25. Enter the elevation value for the contour. |
| 26. Repeat the process until all the contours have been digitized. |

Trouble Shooting Plotting

This section off the handout provides information on a couple of variables and some plotter configuration settings that can be adjusted to improve performance, or even allow, plotting of drawings with large raster data references.

The information in this section was obtained from the Being Civil Blog web site in a post by Justin Ziemba, dated April 10, 2009 (http://beingcivil.typepad.com/my_weblog/2009/04/ troubleshooting-guide-for-plotting-raster-images.html).

Concepts and Terms

RASTERPERCENT – This variable controls the amount of system memory that is allocated to the output of raster data. The default is set to 20 percent, which should keep AutoCAD from hijacking memory resources from other applications on your system when you are plotting drawings with raster images. The default value will be sufficient for most plotting. However, for some large raster files, this may not be enough. If AutoCAD runs out of memory when plotting you will get incomplete plots, or the program may crash or lock up. Increase the RASTERPERCENT value to allow AutoCAD to use more system memory when plotting larger raster images. Just be aware that this will impact other applications running on your system.

RASTERTHRESHOLD – This variable controls the maximum plot file size that can be created. The default is set to 20 MB, which for most plot files is sufficient. AutoCAD will abort the plot if the calculated file size is greater than the RASTERTHESHOLD value. Increase the value to allow for larger plot files when you are working with large raster data sets.

Raster Slider – In addition to increasing system resources and allowing for larger plot files, you may also be able to control how much raster data is generated when plotting. Depending on the plotter and device driver you are using, there may be a raster slider in the plotter properties that will let you control the output of raster data. The adjacent image shows the raster graphics options for an HP DesignJet plotter driver. Moving the slider to the left will lower the image quality of the raster data that is sent to the plot file. This will reduce the size of the plot file that is sent to the plotter.