How the Florida Department of Transportation Implemented AutoCAD® Civil 3D®

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CI4078 The Florida Department of Transportation (FDOT) is implementing Civil 3D as an alternative design software for consultants to use. FDOT has traditionally used Bentley® MicroStation® and GEOPAK software for transportation projects, and will continue to do so. However, the department has developed a very robust Civil 3D state kit to provide more opportunity for consultants who may not use Bentley software. This class will examine FDOT’s unique and customized CADD configuration and how they implemented it in Civil 3D, and it will confirm that Civil 3D is a true transportation-ready product.

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

- Describe how FDOT set up Civil 3D for a multidiscipline environment with over 500 users
- Explain how FDOT incorporated their custom applications from a different CAD system into Civil 3D
- Describe how FDOT transformed from one CAD system to another

About the Speaker
Seth Cohen is a CAD applications specialist, specializing in civil engineering and CAD applications including Civil 3D®, Map 3D, AutoCAD®, MicroStation®, and InRoads®. He has conducted many classes for CAD professionals and specializes in providing project start-up and CAD standards implementation for commercial and government organizations. He has over 10 years of civil engineering experience, working in the industry as a CAD technician and CAD manager designing and producing production plans for many state departments of transportation (DOTs) and municipalities.
Introduction
For more than 15 years, the Florida Department of Transportation (FDOT) has been using Bentley’s MicroStation and GEOPAK software to design transportation projects. The Engineering CADD Systems Office (ECSO) is in charge of the CADD systems at the FDOT. ECSO’s mission is to coordinate and manage computer-based technology to provide the Department’s engineering community with engineering / CADD oriented applications, support, and training; to be used in the planning, design, construction, and maintenance of transportation facilities. Their vision is to remain the national leader in CADD Services provided by a state transportation agency.

On top of the standard CAD packages, ECSO has developed many custom applications that help in the development of transportation projects, creating a very robust state kit that enables consultants to better follow FDOT’s CAD/Design standards, and project workflows. In addition to the custom CAD tools, FDOT also uses an application to sign and seal documents that are stored electronically called PEDDS (Professionals Electronic Data Delivery System). “PEDDS is a project centric system designed specifically to meet the rules of those Boards of Professional Regulation and suite the needs of FDOT for delivering electronically produced plans sets along with the native CAD files, input files used in the design of a project, reports, journals, specifications and data files to be used later in construction” (from the FDOT website).

At around 2009, The Florida Department of Transportation Executive Board made the decision to acquire Civil 3D, and support the effort to implement it based upon the best information available at the time. FDOT acquiring Civil 3D was a business decision based on many considerations. One of them was that consultants developing projects in CADD have always questioned why FDOT did not accept Autodesk based CADD files. The main reason was that FDOT did not own AutoCAD in quantity or have the infrastructure in place for AutoCAD CADD deliverables, as required exclusively in the format that was used at FDOT.

Even though FDOT has acquired Civil 3D, FDOT plans on maintaining state kits for both Bentley and Autodesk software.

This presentation will delve into the existing CAD system and custom applications that makeup the FDOT environment, and how they are implementing a similar environment in Civil 3D.

DISCLAIMER: As of this writing, FDOT has not fully released their Civil 3D State Kit, and is currently only piloting projects in the Civil 3D environment. Civil 3D is only to be used for those projects selected as such; not as a production platform for any other project(s). The published FDOT CADD Standards still apply for Electronic Deliveries to the Department. The Civil 3D 2012 State Kit does not authorize any user to begin performing production work for FDOT in AutoCAD or Civil 3D.
### Terminology

Before getting started it is important to define some terminologies used in both CAD packages that will be used throughout the presentation.

<table>
<thead>
<tr>
<th>AutoCAD</th>
<th>MicroStation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARX / AutoLISP</td>
<td>MDL / Visual Basic,</td>
<td>Programmable command language.</td>
</tr>
<tr>
<td></td>
<td>MicroStation BASIC</td>
<td></td>
</tr>
<tr>
<td>Attributes</td>
<td>Tags</td>
<td>Non-graphical text data associated with elements/blocks.</td>
</tr>
<tr>
<td>Autodesk</td>
<td>Bentley</td>
<td>Software Developers for AEC.</td>
</tr>
<tr>
<td>Block</td>
<td>Cell</td>
<td>Single or multiple objects grouped together to create a single element/object.</td>
</tr>
<tr>
<td>ByLayer</td>
<td>ByLevel</td>
<td>Element/object properties are determined by level/layer settings for color, style, and weight.</td>
</tr>
<tr>
<td>Command window /</td>
<td>Key-in window/</td>
<td>Allows for keyboard input.</td>
</tr>
<tr>
<td>Dynamic Input</td>
<td>AccuDraw</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>Active</td>
<td>File or object in use.</td>
</tr>
<tr>
<td>Explode</td>
<td>Drop</td>
<td>Converts an element/object into multiple elements/objects.</td>
</tr>
<tr>
<td>DWG</td>
<td>DGN</td>
<td>Standard CAD file extensions.</td>
</tr>
<tr>
<td>External Reference (Xref)</td>
<td>Reference</td>
<td>A design/drawing file attached to the active/current drawing.</td>
</tr>
<tr>
<td>Hatching</td>
<td>Patterning</td>
<td>To fill an area within a drawing with lines or symbols.</td>
</tr>
<tr>
<td>Insertion Point</td>
<td>Handle Point</td>
<td>Benchmark point used to place objects in a drawing.</td>
</tr>
<tr>
<td>Layers</td>
<td>Levels</td>
<td>Used as transparent overlays for display graphics.</td>
</tr>
<tr>
<td>Linetype</td>
<td>Line Style</td>
<td>Defines the appearance of lines.</td>
</tr>
<tr>
<td>Object snap</td>
<td>Key Point snap</td>
<td>Controls the selection location for elements/objects.</td>
</tr>
<tr>
<td>Pickbox</td>
<td>Locate Tolerance</td>
<td>Identification/selection limits for the pointer.</td>
</tr>
<tr>
<td>Polygon</td>
<td>Shape</td>
<td>Enclosed shape.</td>
</tr>
<tr>
<td>Polyl ine</td>
<td>Linestring / Complex</td>
<td>Connected line segments.</td>
</tr>
<tr>
<td></td>
<td>Chain</td>
<td></td>
</tr>
<tr>
<td>Redraw / Regenerate</td>
<td>Update</td>
<td>Refreshes screen display.</td>
</tr>
<tr>
<td>Select/Pick</td>
<td>Identify/Accept</td>
<td>Choose elements/objects for manipulation or modification.</td>
</tr>
<tr>
<td>Template</td>
<td>Seed File</td>
<td>A drawing design template file.</td>
</tr>
<tr>
<td>User Coordinate System</td>
<td>Auxiliary Coordinate</td>
<td>An XYZ coordinate system with user-selected origin.</td>
</tr>
<tr>
<td>(UCS)</td>
<td>System (ACS)</td>
<td></td>
</tr>
<tr>
<td>World Coordinate System</td>
<td>Design Cube</td>
<td>Defines the location(s) of all objects in a design/drawing using the Cartesian coordinate system.</td>
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</tbody>
</table>
The Existing CAD System
The following section summarizes what FDOT is using for CAD and design software, as well as the custom applications that FDOT develops and maintains.

**Bentley® MicroStation**
MicroStation is the CAD Software that FDOT has used since design was migrated from 2D drafting boards to the computer. It is used by many DOT’s and the majority of its user base is DOT’s and the consultants that do work for them. FDOT has created a very customized MicroStation environment that incorporates its CAD standards (i.e. levels, cells, linestyles, etc.), and provided an interface for internal and external use. MicroStation is very configurable in a network/multidiscipline environment, making it well-suited for deploying internally to the DOT and for its sub-consultants.
Bentley GEOPAK®
Bentley GEOPAK is a family of integrated civil engineering road design software suited to civil engineering, road design, and transportation projects of all types. Developed and supported by practicing civil engineers and professional surveyors, GEOPAK Civil Engineering Suite offers a robust CAD plan-production focus that enables civil engineers to concentrate on delivering high-quality projects in one continuous cycle, survey through construction. FDOT has incorporated all of its design standards (i.e. criteria files, databases, superelevation tables, input files, etc.) into GEOPAK to ensure that design standards are followed.

Although GEOPAK does have 3D modeling capabilities, it is mainly used to produce accurate 2D plan, profile, and cross section sheets. This was something to consider when going to Civil 3D, as Civil 3D is model based design, and any graphics for plan sets are a byproduct of the model.
CADpilot UI®

CADpilot® UI is a set of user interface components for the development and deployment of custom user interfaces for MicroStation and AutoCAD. It is developed by CADmanagement Resources Inc. CADpilot® UI contains Toolbars, Toolbar Menus, Toolbar Buttons, TreeViews, Tab List, and Browser.

FDOT uses CADpilot UI to aid in all aspects of drafting and design when working on FDOT projects. A user has access to applications, commands, levels, cells, etc. through the various interface components in CADpilot UI. One of the other benefits to using CADpilot UI is that it also works in AutoCAD, and the interface is the same in both CAD products. In addition to CADpilot UI presenting the same interface in AutoCAD as in MicroStation, it also provides many startup enhancement tools for easier CAD management in AutoCAD.
Custom Applications
FDOT has a comprehensive suite of custom applications that range from electronic delivery of projects, placing key-maps on title sheets, to tools that help automate sheeting the project. FDOT maintains these applications internally, and subs out some of the development as well, for all new versions of CAD and Microsoft Windows that are released. These applications had to be considered in the implementation of Civil 3D, and decisions had to be made as to which ones would be implemented, and which ones would not.
Implementing Civil 3D at FDOT
This section will examine the resources and applications FDOT developed for their implementation of the Civil 3D state kit.

FDOT Provided Resources (AutoCAD and Civil 3D Files)
As with any implementation of Civil 3D and AutoCAD, resources must be developed to ensure that the FDOT CAD and design standards will be adhered to. Because FDOT already has a really good set of standards, nothing changed between the Autodesk Implementation and FDOT’s longstanding MicroStation Implementation. All directory structure and naming conventions stayed the same between Platforms. This also includes layers, block libraries, block names, color, linetypes, and lineweight. Below is a list of additional resources that are provided.

- FDOT2012.C3D AutoCAD Profile
- FDOT2012.C3D shortcut
- Drawing Templates (Civil 3D styles and settings included)
- Blocks
- Plot Configuration Files
- Custom Line Types
- Subassemblies based off FDOT Design Standards
- Project Template
- Sheet Set Manager Template
- True Type Fonts
- Drainage Parts (Pipes Catalog)
- Ribbon (.CUIx file)
- Tool Palettes
- Pay Item
- Design Criteria
- Quantity Takeoff Reports
- SSA Mapping Definition Civil
FDOT Custom Tools

Along with the standard AutoCAD and Civil 3D resources, FDOT converted some of the custom applications to aid in the electronic delivery process (i.e. CreateProject, CreateEdit, PEDDS, etc.), while others are tools that work only in Civil 3D.

Below is a list of the applications that were converted for use in Civil 3D.

- Create File/Project
- Create New FDOT Project
- Electronic Delivery
- FDOTTrnsport
- FileChecker
- LandXML to CAiCE / GEOPAK Conversion
- LandXML Group Maker
- PEDDS
- ProjDelta
- QCInspector
- qSheet
- SetMaker
- SheetSetOrganizer
- StrungProject
- SwapParts
FDOT Enhancements to Civil3D
Some of the tools that were developed for MicroStation and GEOPAK were also migrated to work in Civil 3D, but these tools also enhance everyday Civil 3D use. One of the great things about these enhancements to Civil 3D is that they all tie into the Entity Manager tool (described below), making quantity calculations automated when QTO needs to be done.

Entity Manager
Entity Manager is an application developed by FDOT to assign QTO aware pay item data to objects as the user draws them to the design file. It also helps with CADD QC efforts, as those entities (BYLAYER) are aware of what design file they should be placed into through Entity Manager. Entity Manager also serves as a launch pad for other drawing tools which need pay item connection, like the Place Block Group By Feature tool and the forthcoming Pavement Striping Tool.
Place Block Group
The Place Block Group tool can be used for placing Pavement Messages and Arrows, RPM’s or any other block you want to group together. Based on the items that are checked, the tool allows the designer to place up to three different blocks. Whatever you place using the Place Block Group tool automatically inherits the correct FDOT pay items.
**FDOT Signs**
The FDOT Signs tool is designed to assist in the placement of standard sign panels and post locations in signing and marking plans. Whatever you place using the FDOT Signs tool automatically inherits the correct FDOT pay items. All the signs that are in the *Standard Highway Sign Book* and the *Florida Roadway and Traffic Design Standards* are included with this tool.
Pavement Markings
The FDOT Pavement Marking Tool which is used to draw all solid or skip pavement markings in a drawing. The striping tool can reference a Civil 3D alignment or an existing AutoCAD linear element for length and offsets. Again, as with the previously mentioned applications whatever you place using the FDOT Signs tool automatically inherits the correct FDOT pay items.
The FDOT Civil 3D State Kit

The FDOT Civil 3D state kit was developed to help in the deployment of Civil 3D internally and for consultants. The state kit is an FDOT Windows installer application with a 32-bit and 64-bit MSI based install package.

The state kit will do the following:

- Set Environment variables used by the FDOT custom applications, FDOT project creation, AutoCAD, and Civil 3D.
- Install FDOT resource files for AutoCAD and Civil 3D (defined above).
- Install an AutoCAD profile FDOT2012.C3D.
- Update the ribbon with the FDOT ribbon tab
- Creates a .\FDOT2012.C3D folder structure where the FDOT resources are stored.
- Will install some files that must reside in standard Autodesk locations. This is due to AutoCAD system variable constraints.
- Should not harm your existing AutoCAD install.
Training and Support

Support
The ECSO (Engineering CADD Systems Office) has always provided support to its users in the form of one on one support, training materials, and resources to help users understand FDOT CAD and design workflows. The ECSO website is listed below:

http://www.dot.state.fl.us/ecso/
Civil 3D Workflows
With the implementation of Civil 3D, FDOT has provided many FDOT Civil 3D specific workflows that help users understand the design intent of FDOT tools and design processes as it relates to Civil 3D. The website for the FDOT Civil 3D workflows is listed below.

http://www.dot.state.fl.us/ecso/downloads/publications/civil3dworkflows/index.html
Florida Local Users Group
In addition to the FDOT Civil 3D workflows, there is a Florida Local Users Group (FLUG). FLUG typically provided workshops, presentations, and workflows specific to Bentley MicroStation, GEOPAK, and FDOT design processes. Now, there are many additional presentations for AutoCAD, Civil 3D, Map 3D, and Revit. Also, FDOT has presentations, and workshops on using the custom applications developed for use in Civil 3D. The website for the FLUG is listed below.

http://www.flugsite.com/

Conclusion
Thank you for taking the time to attend this presentation. Please feel free to contact me if you have any comments, questions, or suggestions. I am more than happy to share my experience and knowledge with Civil 3D Implementation, and DOT projects, my e-mail is below.

E-mail: scohen@cadmanage.com