

# "Consistent Workflows and Standards Across Multiple CADD Platforms"

IHEEP 2009

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# Agenda

- Introduction
- Case Study- Colorado DOT
- Return on Investment
- Case Study- Florida DOT Dual Platform Initiative
- Opportunities
- Considerations
- Conclusion

# Introduction



## ***Bohannan Huston, Inc.***

**Civil Engineering   ▲   Spatial Data   ▲   Advanced Technologies**

**Founded in 1959**



# Past Performance

Involvement with  
Departments of Transportation





## Utah DOT

Statewide conversion to MicroStation & InRoads

CADD drafting, design & workflow standards development

Custom CADD training documents

Customized, instructor-led training for >200 users

## New Mexico DOT

Conversion of General Office to MicroStation & InRoads

CADD Standards development

Engineering & Design workflow development

Long-term onsite support

Custom, instructor-led training for >300 users

Assessment to convert 6 District offices

## Colorado DOT

Statewide conversion to MicroStation & InRoads

Standards development & programming

Training customized to CDOT standards, workflows & utilizing CDOT datasets

Instructor-led & web-based training

Extension of CDOT Help Desk for CADD support calls

Phone, individual & group onsite support

## Oklahoma DOT

Statewide migration from MicroStation J to V8 versions of MicroStation & InRoads

Standards & workflow development

Customized, instructor-led training for >250 users

Development of WBS-structured, CADD support intranet website

# Case Study

## Colorado Department of Transportation



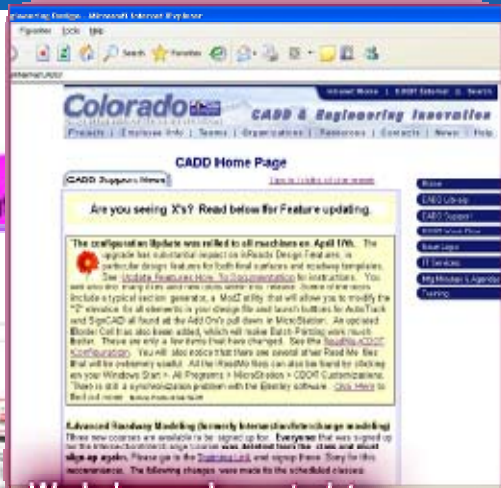
# CDOT Prior to MicroStation and InRoads

- Estimated level of development for various specialty groups using AutoCAD, MX, PICS, and Eagle Point prior to MicroStation and InRoads (% complete):

	AutoCAD	MX	PICS	Eagle Point
Survey	95%		90%	80%
ROW	60% - 90%		60%	60%
Design:	60% - 90%	60%	70%	60%
Hydraulics:	60% - 90%			
Traffic:	60% - 90%			
Environmental:	60% - 90%			
Bridge:	60% - 90%			
Construction:	60% - 90%			

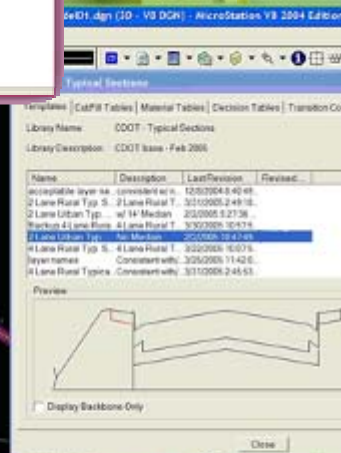


# Vision for Implementation



Web-based portal to Information

As Built Information



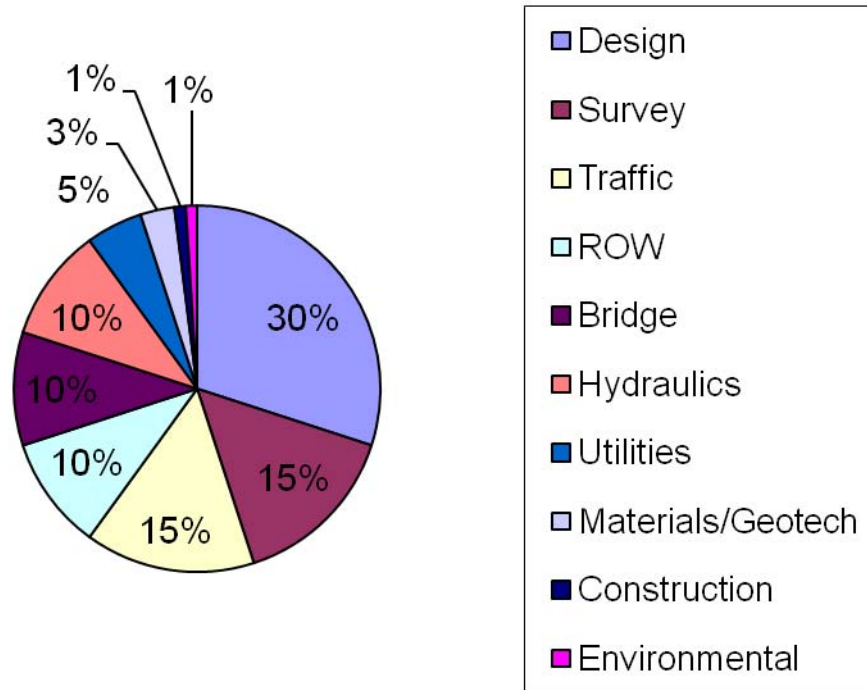
Design





# Discipline Configuration

Discipline Configuration



# Project Implementation Plan

1606	✓	Manipulate DTM Models	100%	\$5,500.00
1607	✓	Prepare 60% Design Plans	100%	\$8,500.00
1608	✓	☐ <b>90% Design Submittal</b>	<b>100%</b>	<b>\$104,000.00</b>
1609	✓	Develop Traffic Plans (We have created cells libraries and lev	100%	\$7,000.00
1610	✓	Develop Utility Plans	100%	\$5,000.00
1611	✓	Develop Landscape Plans	100%	\$2,000.00
1612	✓	Create Construction Sequencing	100%	\$5,000.00
1613	✓	Prepare 90% Design Plans	100%	\$85,000.00
1614	✓	☐ <b>PS&amp;E Submittal</b>	<b>100%</b>	<b>\$19,000.00</b>
1615	✓	Submittal Checklist	100%	\$3,000.00
1616	✓	Consultant Guidelines	100%	\$16,000.00
1617	✓	☐ <b>Construction and As-Built P</b>	<b>100%</b>	<b>\$96,000.00</b>
1618	✓	Verification of Design Data	100%	\$3,000.00
1619	✓	Field Changes	100%	\$5,000.00
1620	✓	Earthwork Volumes	100%	\$3,000.00
1621	✓	Reporting	100%	\$85,000.00
1622	✓	☐ <b>Archiving</b>	<b>100%</b>	<b>\$5,000.00</b>
1623	✓	Project Archiving (ProjectWise)	100%	\$5,000.00



# Configuration and Workflows

(1 of 3)

- **Configuration**
- MicroStation and InRoads is an “off the shelf” product that must be configured to meet CDOT needs.
- All specific CDOT information needs to be programmed into the software.
  - Survey Codes
  - M & S Standards (Type R Inlets, Guardrail Type 3, Curb & Gutter Type 2 Section IIB, etc.)
  - CDOT design Guide (Taper rates, typical section requirements, etc.)
  - AASHTO requirements CDOT is using (Super Elevation)
  - AASHTO Roadside Design Guide
  - CDOT cost data book
  - CDOT’s construction manual
- This also means each time one of these documents is updated MicroStation and InRoads needs to be updated.

# Configuration and Workflows

(2 of 3)

- In the past there were as many ways of designing a set of plans as there are people and consultants working for CDOT.
- CDOT has decided to standardize the process; taking 100's of ways of developing plans and developing one set workflow and configuration, for every specialty division within CDOT.
  - Survey
  - Roadway Design
  - ROW
  - Hydraulics
  - Bridge
  - Traffic
  - Environmental
  - Utilities
  - Materials / Geotechnical
  - Construction
- Configurations must be developed for consultants so they can prepare CDOT plans per our contracts.



# Configuration and Workflows

(3 of 3)

- **Workflows**

- Workflows need to be defined so that levels, features, cells, training, and documentation can be done. To develop workflows and the configuration so all users can effectively and efficiently develop plans requires a long term commitment.
- Specialty teams have been formed to develop workflows so configuration of the software can be implemented. This requires a large commitment of time and people representing each Region to develop these workflows.
- CDOT workflows must be provided to consultants so they can prepare CDOT plans per our contracts.
- Development needs to be carefully thought out and scrutinized to fully realize future growth in the Civil Engineering world. (GPS controlled construction equipment, implementation of future plans checking and quantity manager programs, etc.)

# Definition of CADD Environment

- **Level 1 - Individuals working independently; requires manual drafting to complete plans**
  - Simplistic standards developed that set the groundwork for continued development of the comprehensive CADD environment.
  - No Design or plotting features have been created and producing plan sets is a manual effort with little automation.
  - There is no intelligence to the features.
  - Training is software dependent with no customization.
    - File Names and Directories defined
    - Primary Drafting Levels determined
    - Some necessary Drafting Cells developed
    - Some Drafting symbologies

# Definition of CADD Environment

- **Level 2 - Squads working together**
  - Building on Level 1, drafting file names and directory structures are created for survey, roadway design, and supporting groups.
  - 70% of all drafting features are created and defined with level names and symbologies.
  - Preliminary preferences are created in the design software (InRoads).
  - Plan sets can be created with some automation and digital data can be shared between design groups by using reference files.
  - Manual drafting is significantly required to complete the plan sets and there is little intelligence in the digital data.
  - Basic software training is customized to include department workflows.
    - All File Names and Directories defined
    - Most Drafting features are developed
    - Preferences are created for basic work flows
    - Basic Plotting configurations are established

# Definition of CADD Environment

- **Level 3 - Efficiently and confidently able to develop a set of plans**
  - Completion of all file, directory, and feature naming created for drafting of primary and supporting groups.
  - Standards for the “Look and Feel” of the plan sets is initiated to create a comprehensive style for all the department roadway design plan sets.
  - Design software contains most preferences and features for automated placement within the drafting system.
  - Intelligence is added to some features and integration between design software is started.
  - Plotting is enhanced to add shading and hatching, improving the depth of the plan sets.
  - Training is developed that addresses specific workflow issues, elevating the abilities of the users within the department.
    - All File Names and Directories defined
    - All Drafting features are developed
    - Preferences are created for intermediate work flows
    - Additional Plotting configurations are established
    - Drafting data contains some intelligence
    - Groups can share data with confidence that elements are placed in the correct location



# Definition of CADD Environment

- **Level 4 - Specialty teams working together; confidence in and accessibility to all digital data produced by other groups.**
  - Drafting and Design elements for primary groups are completed and typical plan sets are developed with significant automation in place to greatly reduce the manual drafting required, allowing the design engineer to work in InRoads and produce elements suitable for plotting in plan sets.
  - Consistency is created across regions for workflows and processes for drafting, design, and plotting, creating equivalent plan sets across the state.
  - An intranet site is developed and used as a comprehensive location for enhancements to the environment where users can share workflows and the support staff can answer questions and provide assistance for all users.
  - Plotting is completed and annotation is standardized so all users use the same tools to documents drawings.
  - Intelligence is in place for most features allowing the digital data to move forward into a comprehensive GIS system, and tools are created to move quantities and design elements into a automated bid letting system.
  - Training is enhanced for specific, advanced workflows.
  - Some training and workflows are provided on the intranet site for on-demand, self paced training.

# Definition of CADD Environment

- **Level 5 - Complete interconnection of all groups and complete automation including electronic bid letting process.**
  - All digital data is created, has features and intelligence across all design squads.
  - All design software is customized to eliminate the user from adjusting any settings.
  - All data is shared across the organization real-time, so that design changes are apparent to all working on the project.
  - Digital data from previous projects is available to import into current projects, reducing rework.
  - All standard drawings are digital and are added to the plan sets automatically.
  - Batch plotting is completed, bid letting is automated and the digital data is imported directly into GIS with maximum intelligence.
  - Consultants are delivered all standards so that all plan sets, internal and consultant, look the same, greatly enhancing the contractors ability to estimate and construct a project, reducing change orders for the department.
  - All users are trained with specific, workflow specific training courses.
  - All training courses and established workflows are available on the Intranet, on-demand and self- paced.
  - Adoption of new software versions and processes are easily implemented in the standardized environment.

# Examples of Workspace

- Multi Tiered Standards
  - CDOT
  - Group
  - Project
  - User
- CDOT Menu
- Access to Documentation

# Multi Tiered Standards - CDOT Levels & Filters

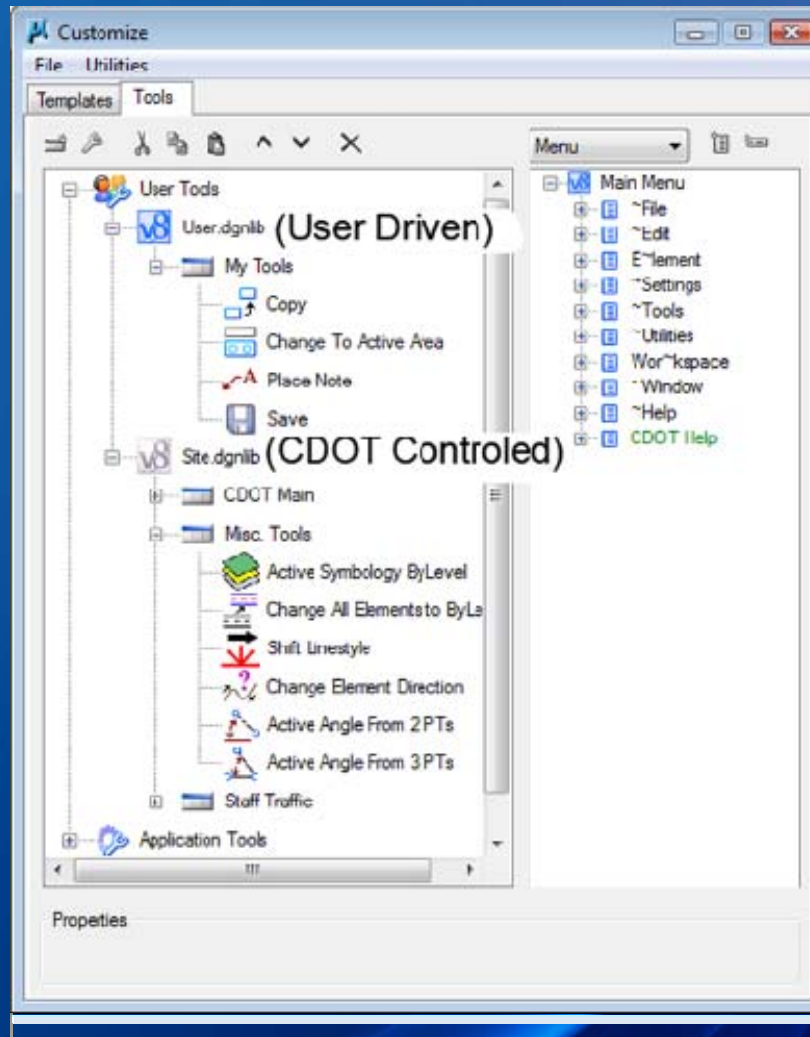
The screenshot shows the 'Level Manager' window for a project named '3D-Seed\_CDOT.dgn'. The interface includes a menu bar (Levels, Filter, Edit), a toolbar with icons for level management, and a 'Symbologr:' dropdown set to 'ByLevel'. The left pane shows a tree view of filters, with 'Filters' expanded to show various categories like 'Alignments', 'Bridges', 'GIS', 'Hydraulics', etc. The right pane displays a table of level definitions.

Name	Color	Code	Symbol	Used
BFDG_Rebar-Prestress	71	BRDG_Febar	—————	3
BFDG_Rebar-Ties	81	BRDG_Febar	—————	3
BFDG_Rebar-Transverse-Bottom	91	BRDG_Febar	—————	3
BFDG_Rebar-Transverse-Top	101	BRDG_Febar	—————	3
BFDG_Scour	6	————— 1	—————	1
BFDG_TEXT	4	————— 0	—————	1
BFDG_Text-FieldNotes	4	————— 0	—————	1
BFDG_TITLE	1	————— 0	—————	3
CCNST_As-Construct-Linework	112	————— 0	—————	2
CCNST_As-Construct-Text	112	————— 0	—————	2
Default	0	————— 0	—————	0
DES_Annotation	3	————— 0	—————	1
DES_BIKEPATH	3	————— 0	—————	3
DES_Existing-Ground	2	----- 2	—————	1
DFS_FFENCE	4	————— 0	—————	1
DES_FFENCE_Barbed-Wire	4	FENCE_BarbedWire_proposed	—————	1
DFS_FFENCE_Barrier	4	FFENCE_Barrier_proposed	—————	1
DES_FFENCE_Chain-Link	4	FENCE_Chain-Link_proposed	—————	1
DFS_FFENCE_Debris-Barrier	4	FENCE_Debris-Barrier_proposed	—————	1
DES_FFENCE_Deer	4	FENCE_Deer_proposed	—————	1
DES_FFENCE_Gate	4	FENCE_Gate-Proposed	—————	1
DES_FFENCE_Plastic	4	FENCE_Plastic	—————	1
DES_FFENCE_Snow	4	FENCE_Snow_proposed	—————	1
DES_FFENCE_Wood	4	FENCE_Wood_proposed	—————	1
DES_FFENCE_Woven-Wire-Combination	4	FENCE_Woven-Wire-Combination_proposed	—————	1
DES_Finished-Grade	3	————— 0	—————	3
DES_GUARDRAIL	5	————— 0	—————	2
DES_GUARDRAIL_Cable	5	GUARDRAIL_Barrier-Cable-Proposed	—————	2
DES_GUARDRAIL_End-Anchorage	5	GUARDRAIL_Right_proposed	—————	2

Active Level: Default  
1231 of 1231 displayed; 1 selected



# Multi Tiered Standards - User and CDOT



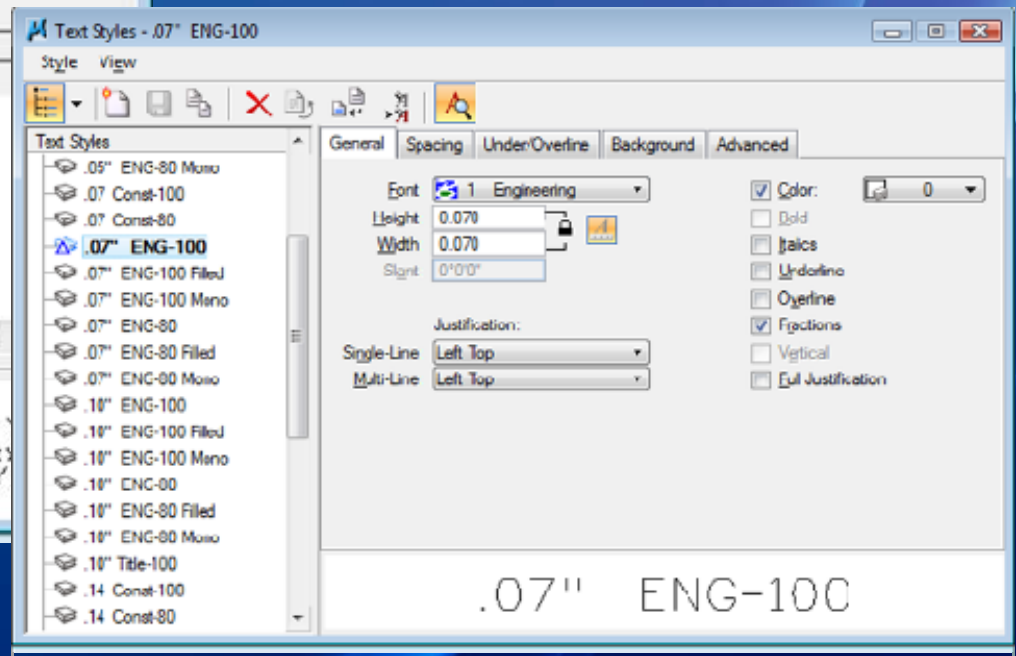
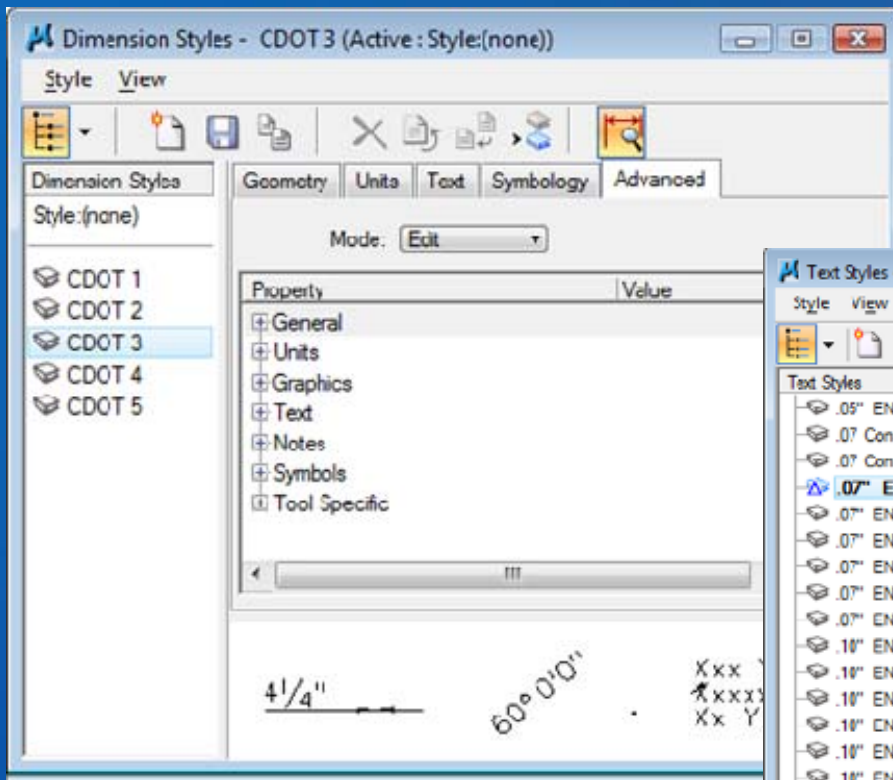
# Multi Tiered Standards – Project

The image shows a screenshot of the MicroStation Manager interface. The main window displays a file explorer for the 'Seed' directory, listing three DGN files: '2D-Seed\_CDOT.dgn', '3D-Seed\_CDOT.dgn', and 'Bridge-3D-Seed\_CDOT...'. Below the file explorer, there are buttons for 'Open', 'Cancel', and 'Options', along with dropdown menus for 'User' (CDOT User), 'Project' (12345), and 'Interface' (12345).

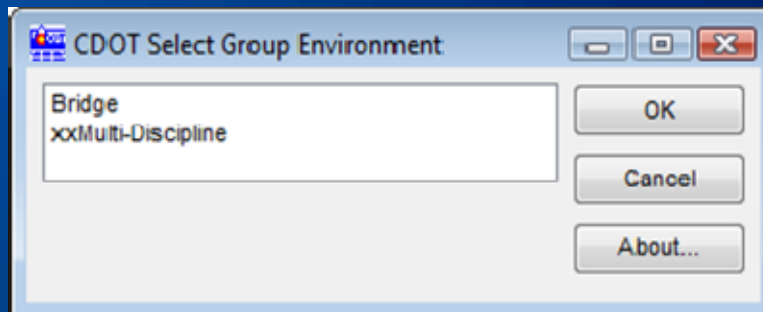
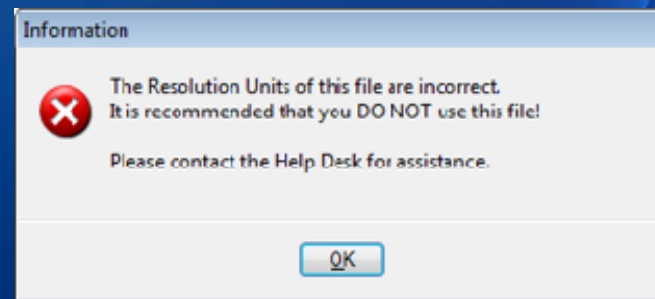
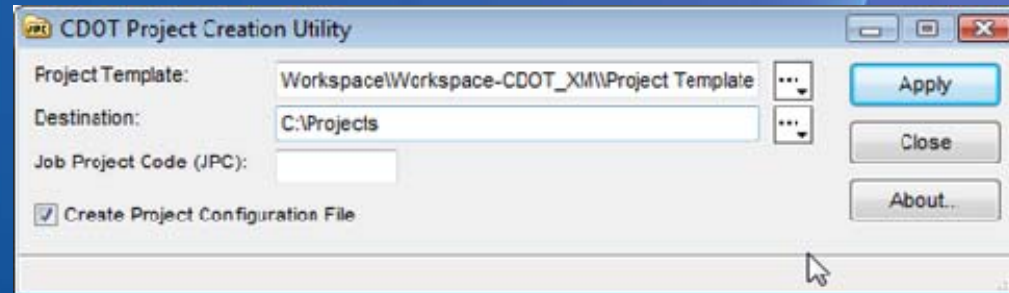
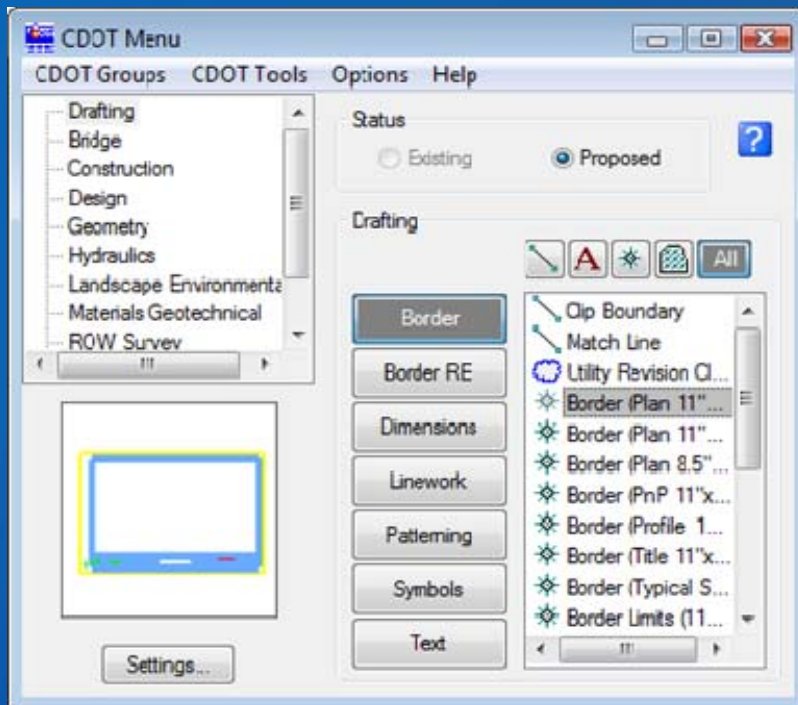
An inset window titled '12345.pcf - Notepad' shows the project directory settings. A black arrow points from the 'Project' dropdown menu in the MicroStation Manager window to the Notepad window. The Notepad window contains the following text:

```
#----- Project Directory -----  
MS_DEF=C:/Projects/12345/  
#----- Reference Files -----  
MS_RFDIR=$(MS_DEF)  
MS_RFDIR>$(MS_DEF)Bridge/Drawings/  
MS_RFDIR>$(MS_DEF)Bridge/Drawings/Reference_Files/  
MS_RFDIR>$(MS_DEF)Construction/Drawings/  
MS_RFDIR>$(MS_DEF)Construction/Drawings/Reference_Files/  
MS_RFDIR>$(MS_DEF)Landscape_Environmental/Drawings/  
MS_RFDIR>$(MS_DEF)Landscape_Environmental/Drawings/Reference_Files/  
MS_RFDIR>$(MS_DEF)Hydraulics/Drawings/  
MS_RFDIR>$(MS_DEF)Hydraulics/Drawings/Reference_Files/  
MS_RFDIR>$(MS_DEF)Materials_Geotechnical/Drawings/  
MS_RFDIR>$(MS_DEF)Materials_Geotechnical/Drawings/Reference_Files/  
MS_RFDIR>$(MS_DEF)Design/Drawings/  
MS_RFDIR>$(MS_DEF)Design/Drawings/Reference_Files/  
MS_RFDIR>$(MS_DEF)ROW_SURVEY/Drawings/  
MS_RFDIR>$(MS_DEF)ROW_SURVEY/Drawings/Reference_Files/  
MS_RFDIR>$(MS_DEF)Traffic_ITS/Drawings/  
MS_RFDIR>$(MS_DEF)Traffic_ITS/Drawings/Reference_Files/  
MS_RFDIR>$(MS_DEF)Utilities/Drawings/  
MS_RFDIR>$(MS_DEF)Utilities/Drawings/Reference_Files/  
MS_PLTFILES=$(MS_DEF)Plot_Sets/  
MS_DGNOUT=$(MS_DEF)  
MS_IMAGEOUT=$(MS_DEF)  
#  
CDOT_WKSP=C:/workspace/workspace-CDOT_XM/  
CDOT_PREF=$(CDOT_WKSP)Standards-Global/InRoads/Preferences/
```

# Multi Tiered Standards - CDOT



# Multi Tiered Standards - Group and CDOT





# Multi Tiered Standards - InRoads Symbology and Preferences

**Named Symbology Manager**

Show Symbologies with Properties

Include Default       Include Profile

Include Plan             Include Cross Section

Preference File: C:\Workspace\Workspace-CDOT\_XM\Standards-Global\InRoads\Preferences\CDOT\_Civil.xin

Name	Description	Default	Plan	Profile	Cross Section
D_FEN_Barbed-Wire	D_FEN_Barbed-Wire	X			X
D_FEN_Barrier	D_FEN_Barrier	X			X
D_FEN_Chain-Link	D_FEN_Chain-Link	X			X
D_FEN_...					X
D_FEN_...					X
D_FEN_...					X
D_FEN_...					X

**Preference Manager**

Modeler      Drafting      Tools

File      Surface      Geometry      Drainage      Evaluation

Preference: Proposed 100' Mjr - 20' Minor

Commands

- Inlet Type 16 Title
- Inlet Type C
- Inlet Type D
- Inlet Type R (L,5)
- Inlet Type R (L,10)
- Inlet Type R (L,15)
- Inlet Type, Size
- Inlet Vane Grate Double
- Inlet Vane Grate Single
- Manhole
- Other
- Other Circular
- Other Spiral
- OTHER-100 Ft Interval
- OTHER-500 Ft Interval
- Pipe-RCP-18"
- Pipe-RCP-Elliptical
- Proposed
- Proposed 1' Mjr - 0.2' Minor
- Proposed 10' Mjr - 2' Minor
- Proposed 100' Mjr - 20' Minor
- Proposed 5' Mjr - 1' Minor
- Proposed Circular
- Proposed Grades Only
- Proposed Spira
- Proposed-100 ft Interval
- Proposed-100 ft Interval Left
- Proposed-100 ft Interval Right
- Proposed-500 ft Interval
- Proposed-500 ft Interval Left
- Proposed-500 ft Interval Right
- Secondary
- Secondary Circular
- Secondary Spiral
- Secondary-100 Ft Interval
- Secondary-500 Ft Interval
- SS\_Drain
- Stacked 20 per column
- Urban

**Style Manager**

Show Styles with Properties

Include Surface

Include Geometry Point

Include Geometry Line

Include Geometry Arc

Include Geometry Spiral

Include Survey

Surface Properties

Display Plan

Display Cross Section

Display Profile

Pay Item

Survey Properties

Custom Operations

Attributes

Geometry Tabling

Point Tabling

Line Tabling

Arc Tabling

Spiral Tabling

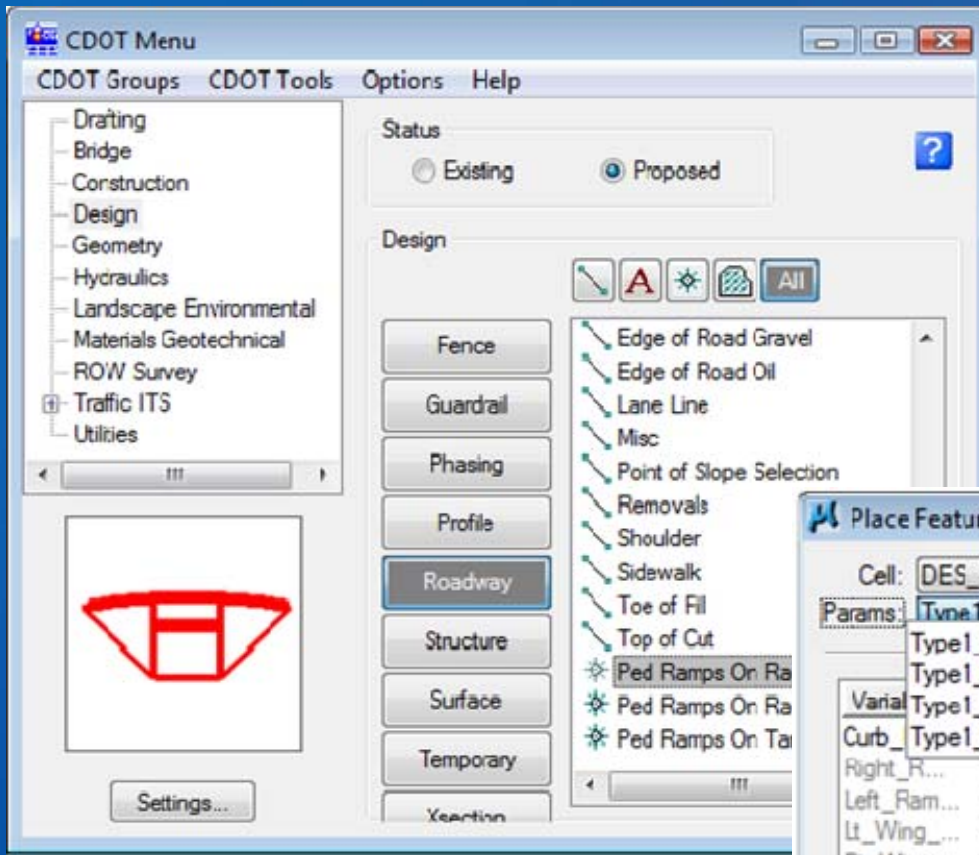
Preference File: C:\Workspace\Workspace-CDOT\_XM\Standards-Global\InRoads\Preferences\CDOT\_Civil.xin

Name	Description	Numeric Code	Pay Item	Surface Named Symbology
T_Bridge Abutment	Bridge Abutment	2312		T_Bridge Abutment
T_Bridge Column	Bridge Column	2376		T_Bridge Column
T_Bridge Curb (CCW)	Bridge Curb CCW	2343		T_Bridge Curb (CCW)
T_Bridge Curb (CW)	Bridge Curb CW	2313		T_Bridge Curb (CW)
T_Bridge Drain Hole	Bridge Drain Hole	2375		T_Bridge Drain Hole
T_Bridge Parapet Wall	Bridge Parapet Wall	2315		T_Bridge Parapet Wall

# CDOT Menu System – Group Specific

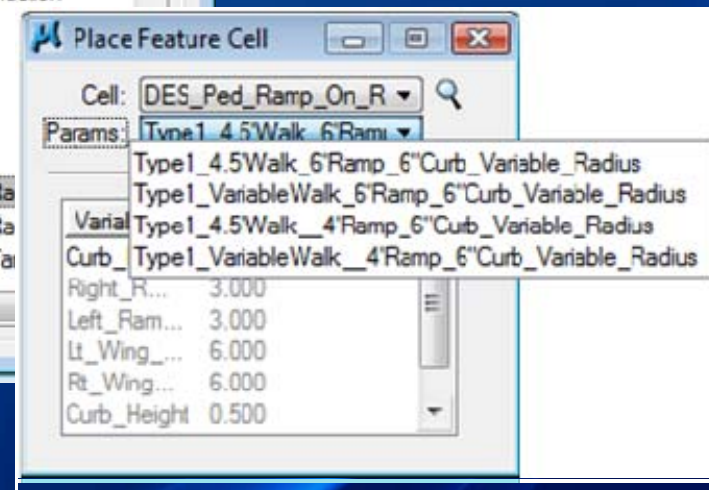


# CDOT Menu System – Built in Design Standards



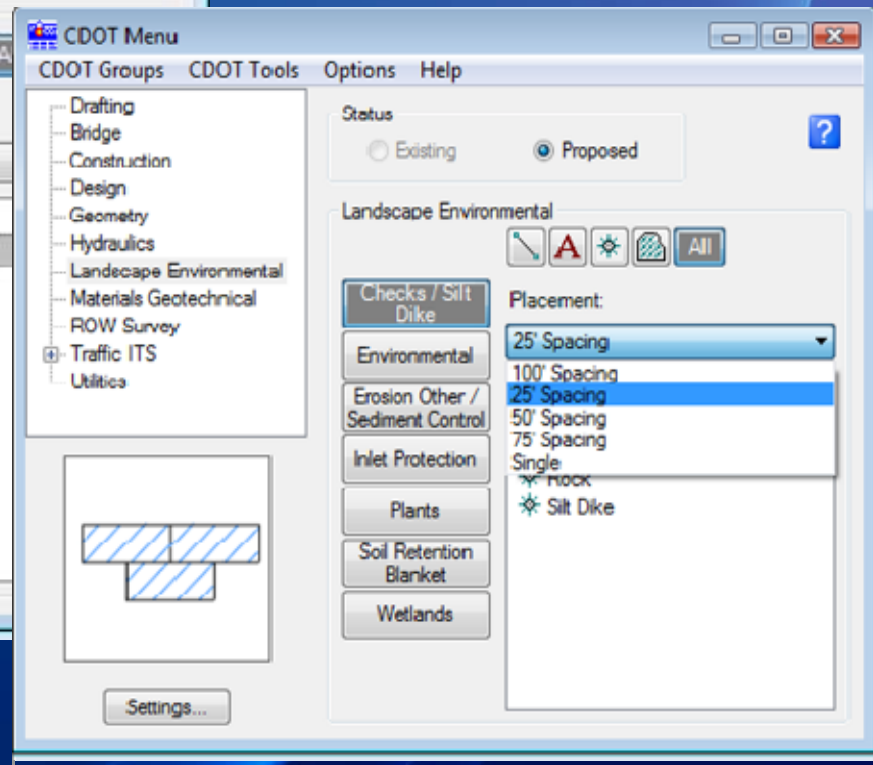
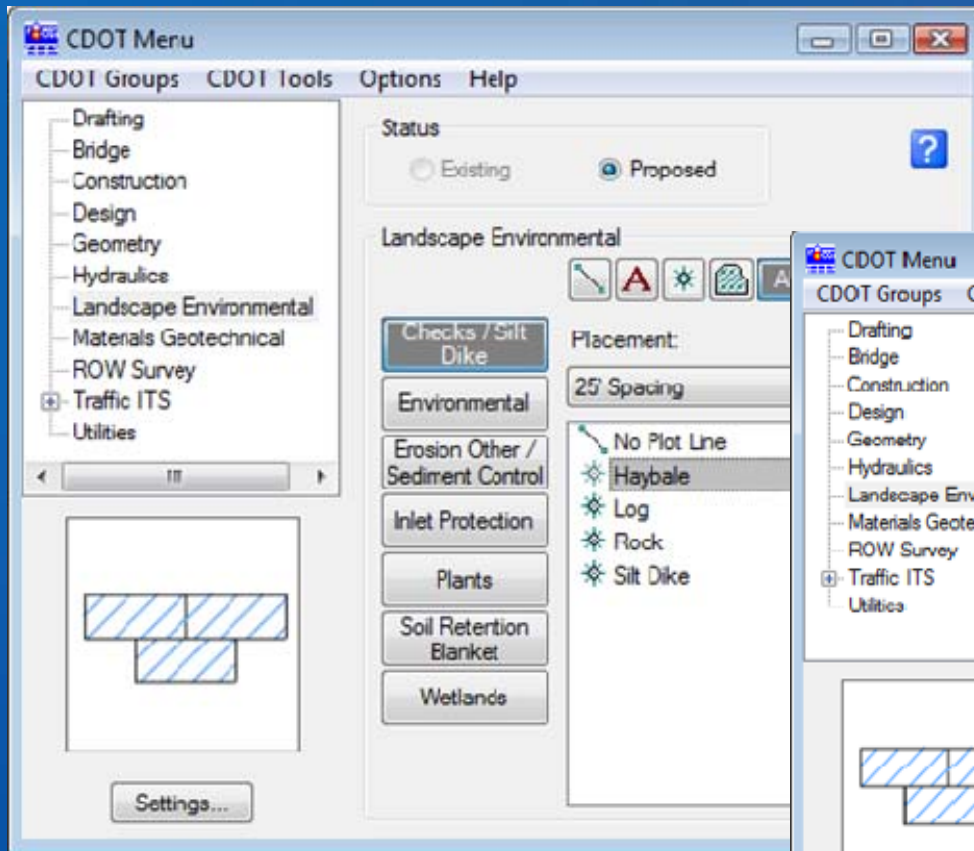
*“The CDOT menu system that is included is well thought out and provides the additional tools necessary to streamline the production process.”*

**Richard Hamilton, URS  
CAD Manager Denver, CO**



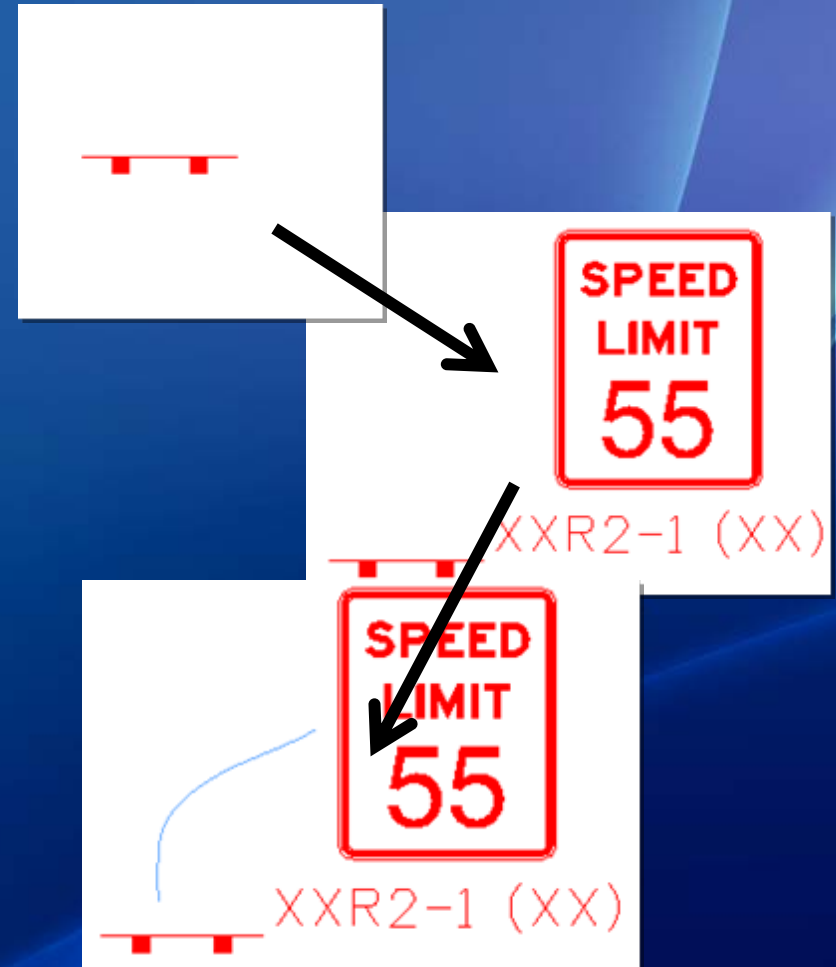
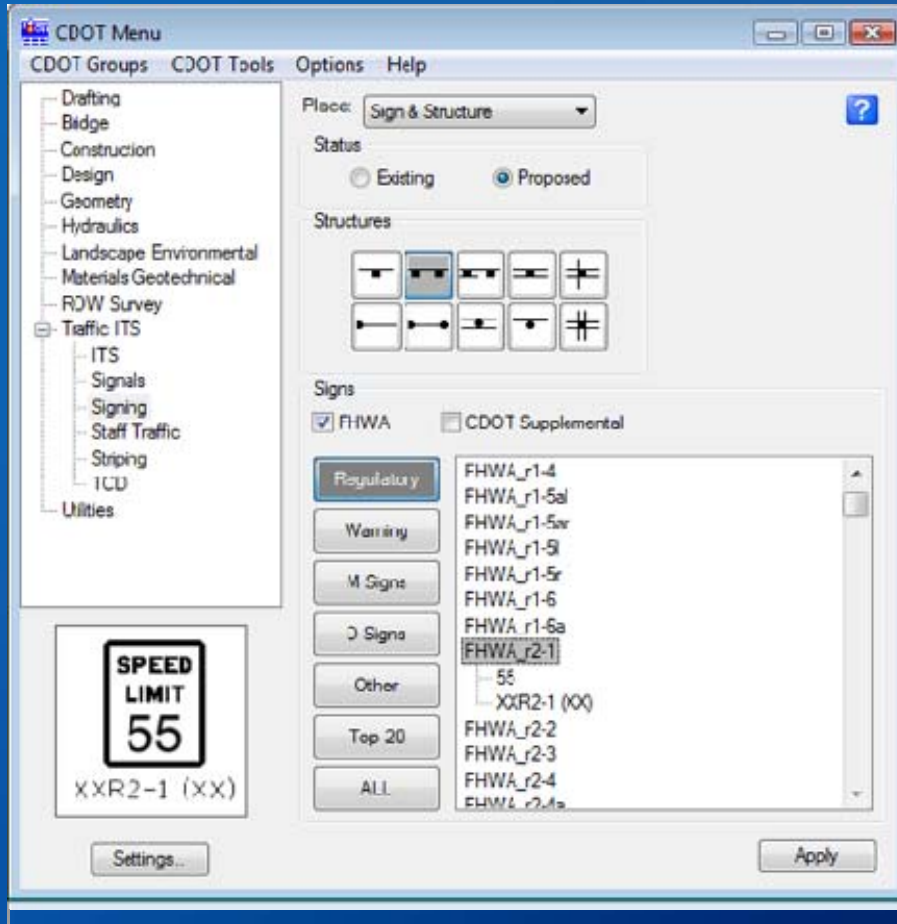


# CDOT Menu System – Placement Flexibility





# CDOT Menu System – Workflow Based

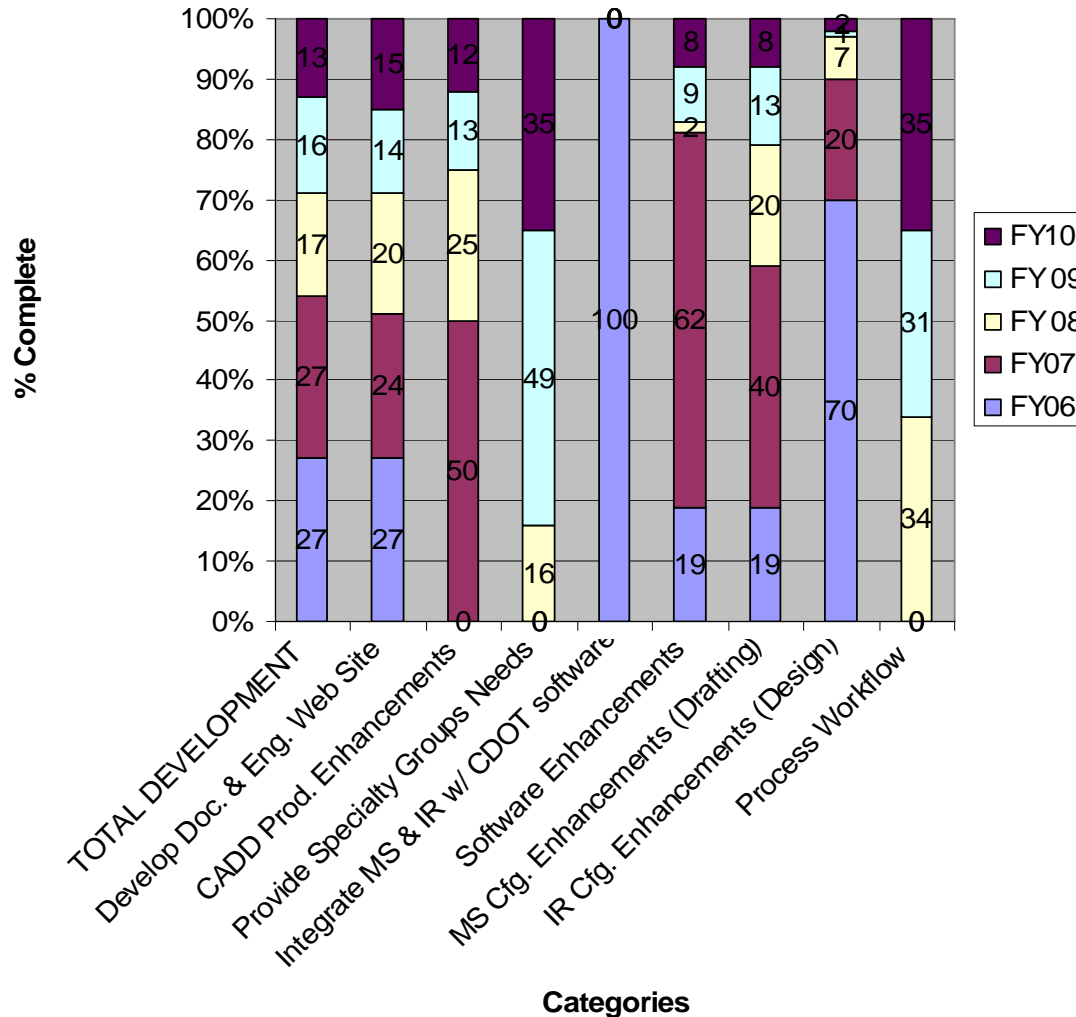


# Documentation Built In

The image displays several overlapping screenshots of the CDOT software interface. The top-left screenshot shows the 'CDOT Menu' with a 'Help' dropdown menu highlighted, listing options: CADD Home Page, CADD Manual, Requests Support, Workflows, and About CDOT Menu... The top-right screenshot shows the 'CDOT Menu' with a question mark icon in the top right corner highlighted by a black box and an arrow pointing to the PDF document. The middle-left screenshot shows a file explorer window with the path 'C:\Workspace\Workspace-CDOT\_XM\Standards-Global\MicroStation\Seed\3D-Seed' and a file named 'CDOT.dgn (3D - V8 DGN)'. The middle-right screenshot shows the 'CDOT Design Menu.pdf' document in Adobe Acrobat Pro Extended, with a question mark icon in the top right corner highlighted by a black box and an arrow pointing to the PDF document. The bottom-left screenshot shows the 'AccuDraw' panel with coordinates X: -7539.299, Y: , and Z: 0.000. The bottom-right screenshot shows the 'CDOT Help' dropdown menu with options: CADD Home Page, CADD Manual, Request & Support, and Workflows.

# CDOT 5 Year Plan

## Five Year Development Plan



# Return on Investment

## Return on Investment Five Year Plan

Number of Users Realizing Time Savings	Expected at CDOT	Total Hours Saved per month			Expected for Consultants	Total Hours Saved per month		
		Year 3	Year 4	Year 5		Year 3	Year 4	Year 5
		161	213	250		0	160	250
<b>Time Savings per Employee per Month</b>								
MicroStation/ AutoCAD Translations	6	1066	1276	1500	1	0	160	250
Comprehensive Standards	2	362	426	500	2	0	360	500
Custom Workspaces and Menus	4	724	852	1000	4	0	720	1000
Annotation	4	724	852	1000	4	0	720	1000
<b>Production Hours Saved Per Month</b>		<b>2696</b>	<b>3406</b>	<b>4000</b>		<b>0</b>	<b>1680</b>	<b>2700</b>
<b>Average Cost per Hour to CDOT</b>		<b>\$45</b>	<b>\$45</b>	<b>\$45</b>		<b>\$85</b>	<b>\$85</b>	<b>\$85</b>
<b>Expected Dollar Savings to CDOT per Month</b>		<b>\$130,320</b>	<b>\$153,300</b>	<b>\$180,000</b>		<b>\$0</b>	<b>\$144,000</b>	<b>\$231,750</b>
<b>Expected Dollar Savings to CDOT per Year</b>		<b>\$1,563,840</b>	<b>\$1,840,320</b>	<b>\$2,160,000</b>		<b>\$0</b>	<b>\$2,016,000</b>	<b>\$2,905,000</b>

### Current Development Proposal Total

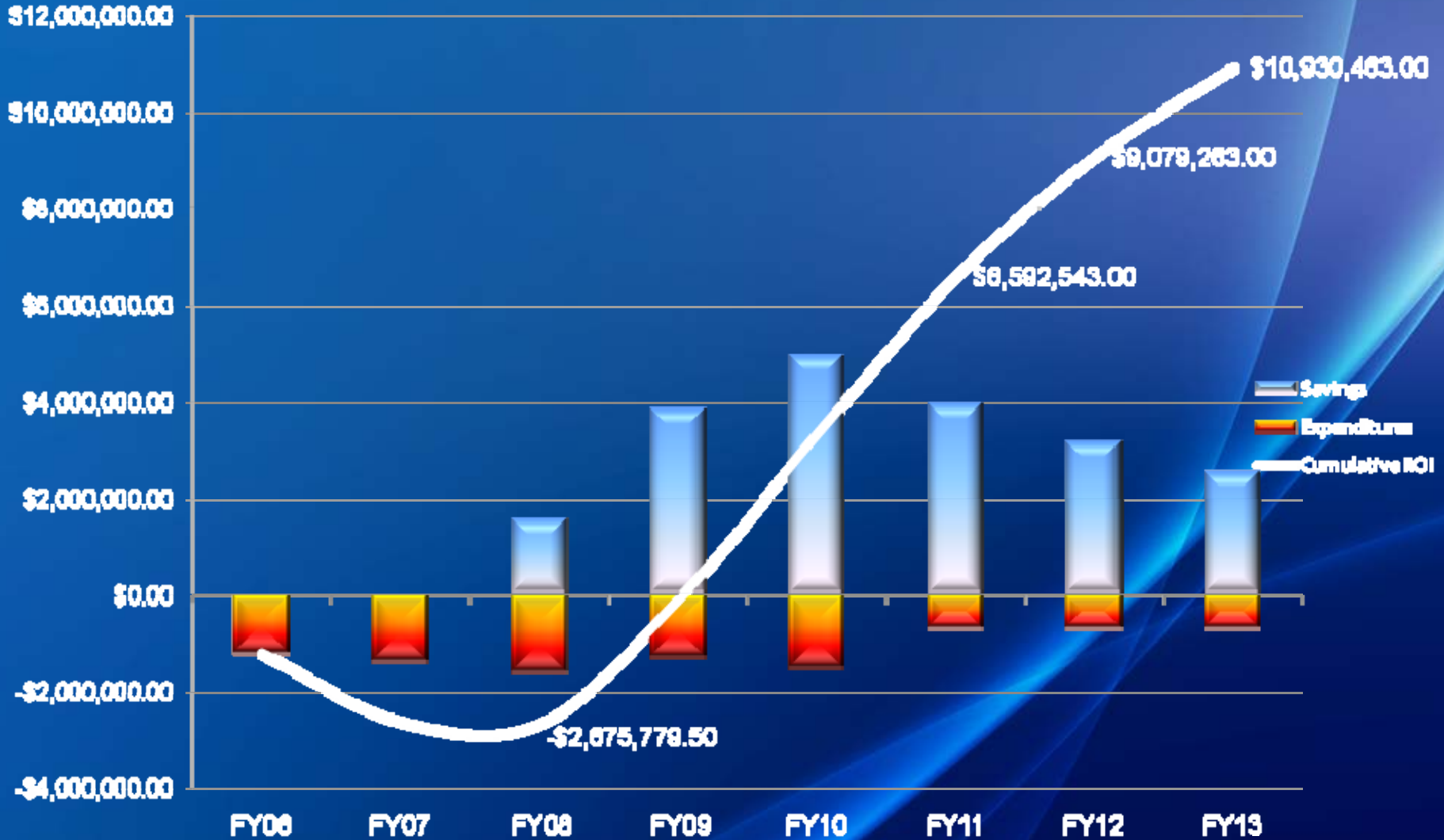
\$ 7,877,337.00

Return On Investment for Development		CDOT Alone	CDOT and Consultants	Consultants Alone
After Year 5	Months	39.22	17.11	34.29
	Years	3.29	1.43	2.82

\* The expected hourly time savings are estimated based on configuration experience at Oklahoma DOT and New Mexico DOT.



# Return on Investment



# Case Study

## Florida DOT Vision

### Dual Consistent Platforms

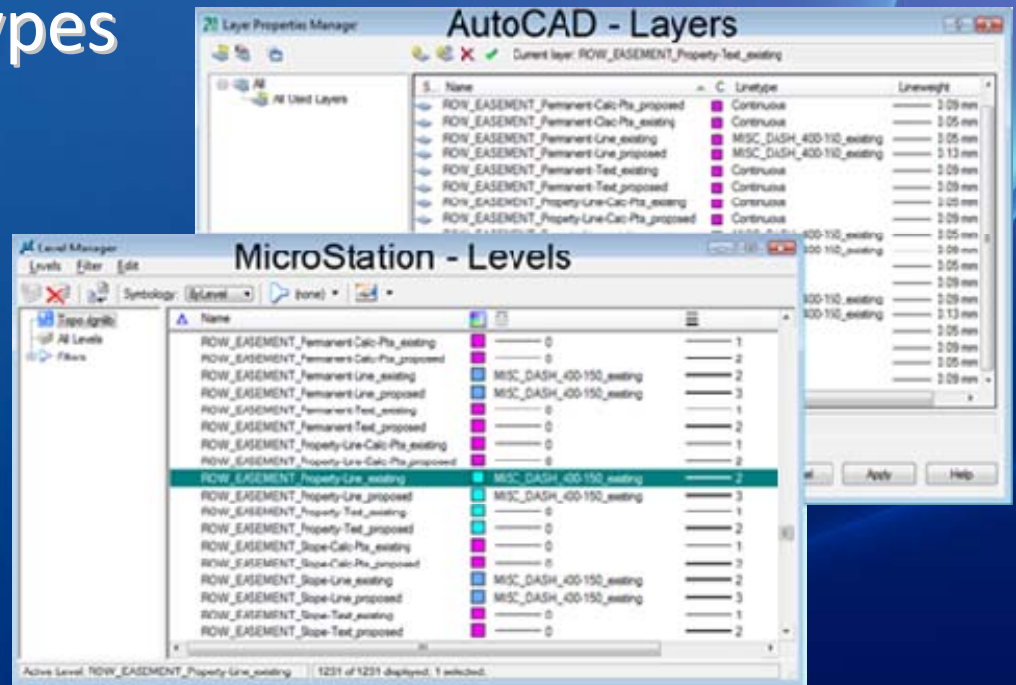


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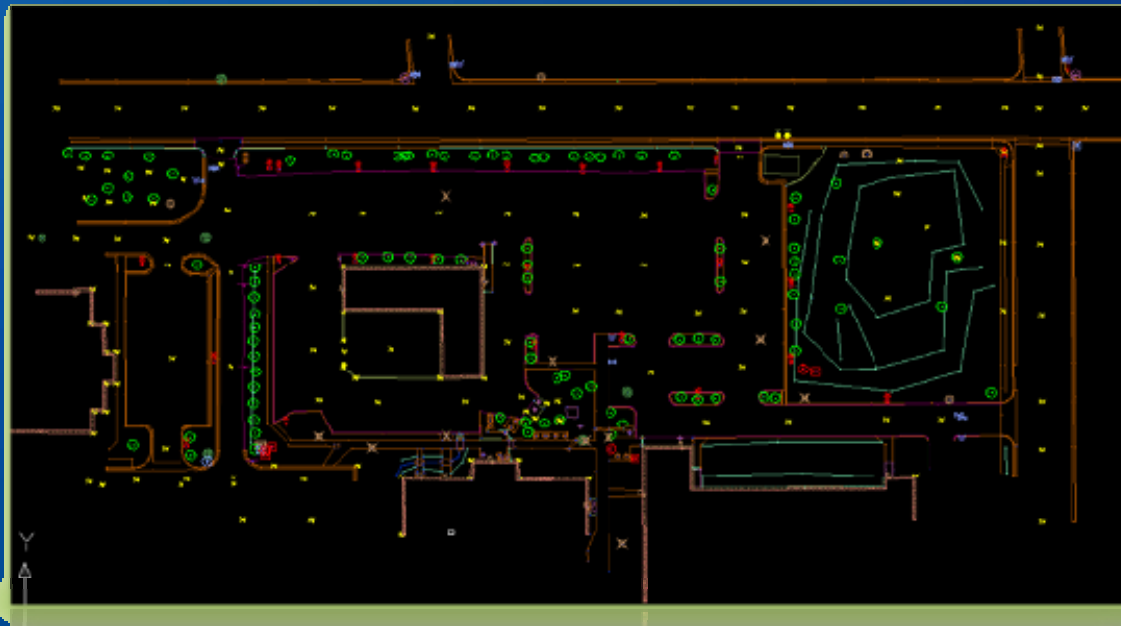
# Drafting Standards

- Levels & Layers
- Linetypes & Linetypes
- Cells & Blocks
- Seed Files
  - Template Files



# Survey Standards

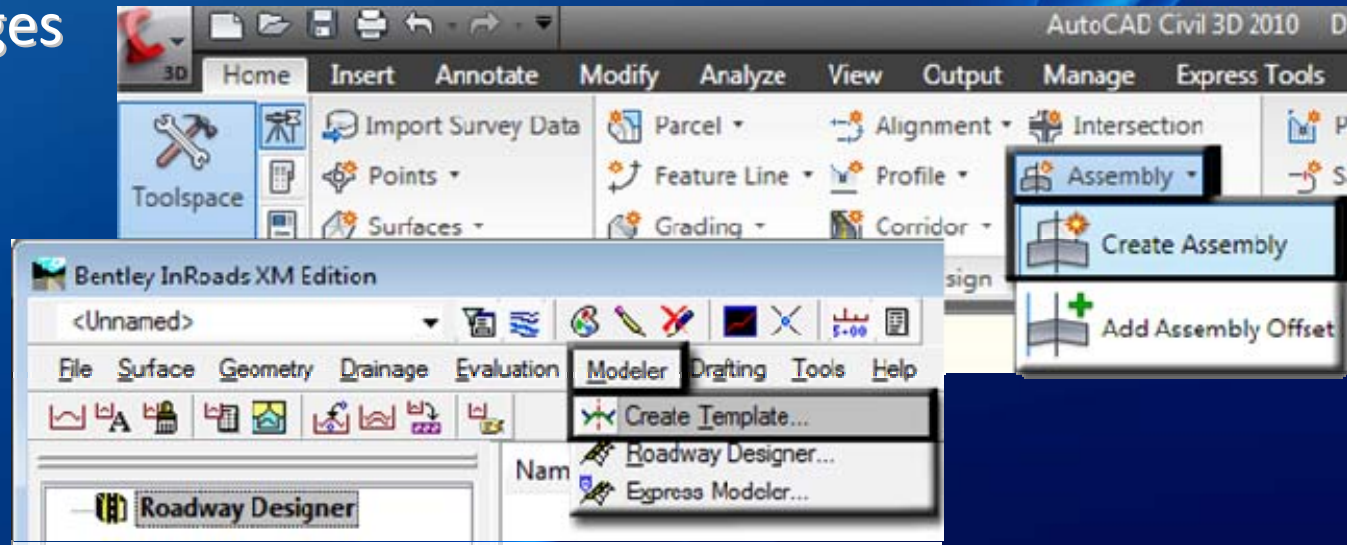
- Survey
  - Consistent downloading of field information into files using standards
  - Translations for different Field coding
  - Generate output to both platforms



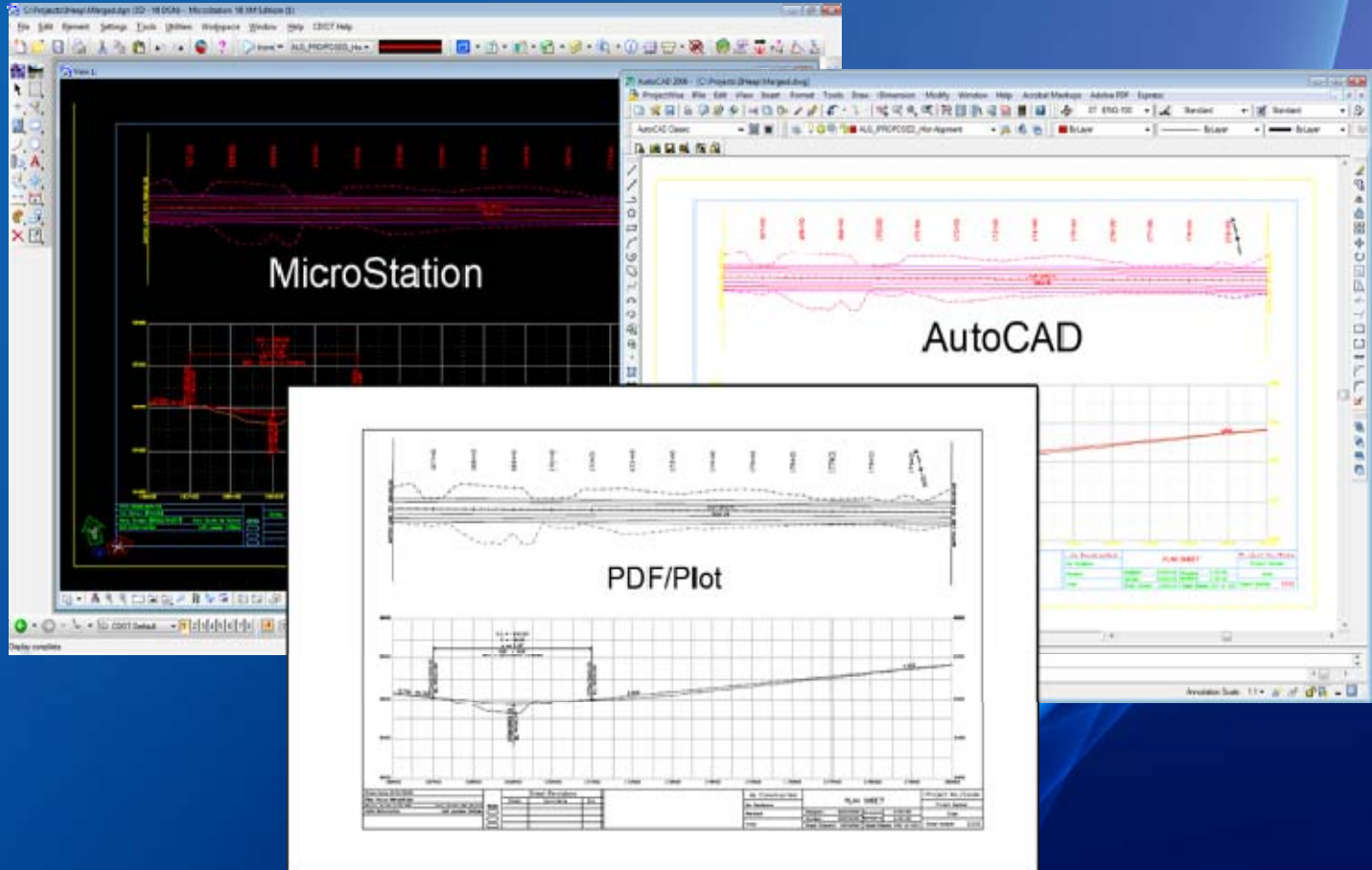


# Design Standards

- Preliminary & Final Design
  - Understand each program's terminology
  - Understand what information can and can not be transferred from one program to the other
  - Using set standards will ensure no issues when referencing data between platforms
  - Establish guidelines and rules for teams using multiple CAD packages



# Plans Production

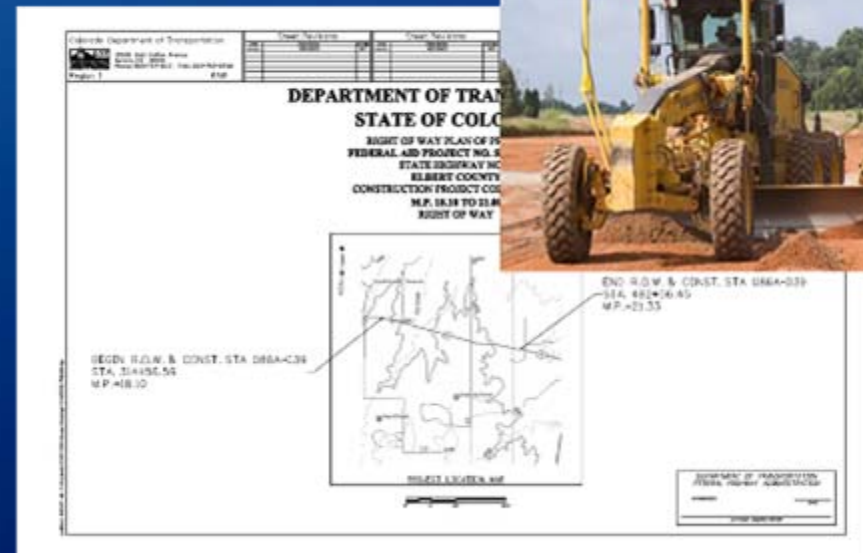


# Conclusions for FDOT

- State statutes about not dictating software platform
- Driven by current economy
  - More bids
  - More competitive bids
- Immediate successes
  - Firms want to be involved and help with beta testing
  - Firms want FDOT to succeed
  - Even without a lot of automation, they can produce a set of plans using Civil 3D

# Requirements for Consistency

- What is the final product?
  - Know what information is needed and what can be output
    - DTM for Contractor/Equipment
    - Data for GIS usage
    - Preliminary Design





# Opportunities

- Overall reduced costs in design and letting process
- More firms bidding jobs (ones that would not have bid before due to the expense of the dual platform)
- Reduced errors and omissions in construction
- Seamless collaboration with cities and counties
- Importing to GIS requires comprehensive CAD standards
- Workflow-based Training

# Considerations

- 100% compliance
  - Design data
  - Pitfalls/things to look into 80/20 rule
    - Custom Linestyles with 3D graphics
    - True Type Text Fonts
  - Documentation
- Team Workflows
  - Engineer/Designer/Technician
- Continual Maintenance
  - Management of Workspace
- Support

# Conclusion

- **Dual Platform**
  - Successful implementations underway
- **Training**
  - On standard processes and workflows
  - Not software platforms
- **Consistent Data**
  - Digital form
  - Not just paper
- **Return on Investment**
  - Immediate
  - Substantial

Thoughts and Questions?



Thank You  
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