

## 3D Deliverables for Automated Machine Guidance (AMG)

Mariano Amicarelli, Todd Holt, and Taylor Carlquist

## TOPICS COVERED

- What are 3D Deliverables
- The needed 3D Deliverables
- Where the files are located
- Once you have created the 3D Deliverable now what
- Introduction to Trimble software





## 3D MODELS FOR CONSTRUCTION





#### **10** CREATING 3D DELIVERABLE FILES

#### INTRODUCTION

This chapter will provide detailed instructions for producing the specific output files used by contractors for Automated Machine Guidance (AMG). Specifically:

- Controlling Geometry Files
- 2D CADD files
- Proposed 3D Breakline CADD files
- Existing, Proposed and Subgrade/Earthwork surface XML files

3D DELIVERABLES SUPPORTING AMG for 3D PROJECTS (Store in project folder: 3DDeliverables)							
File Name	Description						
Design Alignments and Profiles							
AMG-ALGN##.xml	All Alignments and Profiles exported from the \Roadway\ALGNRD, PROF or model files and \Roadway\DSGNRD or CORRRD files in LandXML format.						
2D Proposed Planimetrics Design							
AMG-2DSGN##.dwg/dgn	2D proposed Roadway design exported from the \Roadway\DSGNRD file. (Production of this file for construction is at the designer's discretion.)						
AMG-2DRPR##.dwg/dgn	2D proposed Drainage design exported from the \Roadway\DRPRRD file. (Production of this file for construction is at the designer's discretion.)						
AMG-2PDPL##.dwg/dgn	2D proposed Pond design exported from the 'Roadway'PDPLRD file. (Production of this file for construction is at the designer's discretion.)						
2D Existing Survey (Note: These a	re being considered to merge into a single survey Planimetrics file)						
AMG-2TOPO##.dwg/dgn	2D proposed existing Topography exported from the \Survey\TOPORD file. (Production of this file for construction is at the designer's discretion.)						
AMG-2DREX##.dwg/dgn	2D proposed existing Drainage exported from the \Survey\DREXRD file. (Production of this file for construction is at the designer's discretion.)						
AMG-2UTEX##.dwg/dgn	2D proposed existing Utilities exported from the \Survey\UTEXRD file. (Production of this file for construction is at the designer's discretion.)						
3D Existing Survey Surfaces							
AMG-3SURFACEEX##.xml	3D existing terrain surface to be exported from the \Survey\GDTMRD file as LandXML format. (Production of this file for construction is at the designer's discretion. This file will be produced if the 3D Existing Surface dwg/dgn file(s) are not produced.)						
3D Proposed Surfaces							
AMG-3SURFACEPR##.xml	3D proposed finished (top) surface to be exported as LandXML format from the \Roadway\MODLRD file.						
AMG-3SURFACEEW##.xml	3D proposed finished (bottom) surface to be exported as LandXML format from the \Roadway\MODLRD file. This file will be used to generate surface to surface earthwork volumes.						
3D Proposed Break Lines							
AMG-3DSGN##.dwg/dgn	3D proposed Roadway design exported from the \Roadway\DSGNRD file. (Production of this file for construction is at the designed science). This file will be produced if the 3D Proposed Surface(s) LandXML file(s) is not produced. Geometric elements should be in vector.)						

#### 3D MODELS FOR CONSTRUCTION

FDOT Roadway Design and 3D Modeling



## What are the 3D Deliverables

- Alignments-Horizontal and vertical Geometry
  - Individual alignments(including profiles)are extracted from the DSGNRD file
  - These are saved as a landxml EX. (AMG-ALGNRDXX.xml)
- 2D Proposed Breaklines this is the 2D Planimetrics or the plan view line work usually placed off of the centerline using the horizontal civil tools
  - 2D proposed linework extracted from the DSGNRD file
  - These are saved as a dgn/dwg file EX. (AMG-2DSGNRDXX.dgn)



## What are the 3D Deliverables cont.....

- 3D Proposed Breaklines this line work is drawn by a template placed in a corridor along an alignment
  - 3D line work extracted from the Desgin file(DSGNRDXX.dgn) or Model file (MODLRDXX.dgn) file
  - These are saved as a dgn/dwg file EX. (AMG-3DSGNRDXX.dgn)
- 3D Exisitng Surface this is the terrain of the existing ground
  - These are saved as a landxml EX. (AMG-3SURFACEEX.xml)
- 3D Proposed Surface this is a surface made from the 3D breaklines
  - 3D proposed surface made from the AMG-3DSGNRDXX.dgn
  - These are saved as a landxml EX. (AMG-3SURFACEPR.xml)



#### SubGrade Surface

- SubGrade\_pm can be used as 3D breaklines to create a surface
- SubGrade\_pm can be set to create an alternative Surface thru the corridor named SubGrade
- Vertical Faces all lines must have different xy value. They cannot be stacked in the z plane. Therefore, set the horizontal offset value no less than 0.01 Feet on vertical component points in the project template.
- Caves/Cliffs all lines must continue in the same direction. The TIN triangles will not reverse direction across a surface. Therefore, consider which points to usefor subgrade surface. I.E. base, base extensions, wall footers, etc.. Additional template points may be needed to intercept the top surface (Proposed) in these areas. As a rule, it is better to include the base, base extension, wall footers, etc... For excavation and not to include base base extensions wall footers, etc... for embankment.

#### SubGrade Surface

Chapter 10\_\_\_\_\_CREATING 3D DELIVERABLE FILES - Creating 3D Breaklines and Proposed Subgrade/Earthwork Files for AMG

63

#### Create Template







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#### File Edit Add Tools

a to make many more

#### AMG-ALGNXX.xml



File Tools Help C:\ProgramData\Bentley\Civil\ReportBrowser\8.11.9\en\ CivilGeometry A: AignmentsToLandXML xsl A: FDOT\_CoordinateDataTable xsl A FDOT\_CurveDataTable.xsl All Horizontal Alignment Area xsl A Horizontal Alignment Check Integrity xsl A Horizontal Alignment Control Line Data Table xsl Horizontal Alignment Curve Data Table xsl Horizontal Alignment Interval Only xsl Horizontal Alignment Interval XYZ xsl Horizontal/AlignmentLength xsl Horizontal Alignment Review xsl HorizontalAlignmentReviewASCII.xsl A: HorizontalAlignmentReviewWthPLxsl HorizontalAlignmentStationEquations xsl A Horizontal And Vertical Alignment Review xsl A Horizontal Bements Table xsl A Horizontal Bements Table Simplified xsl HorizontalBementsXYZ.xsl SettingOut Table xsl A SettingOut Table Deflection xsl Traverse xsl A TraverseCurveASCII.xsl A TraverseCurveASCII2.xsl A TraverseCurveASCII3.xsl TraverseEditASCII.xsl A TraversePoints.xsl Vertical Alignment Check Integrity xsl A Vertical Alignment Interval Station Elevation Grade xsl Vertical Alignment Interval Station Elevation Grade ASCII xsl A) Vertical Alignment Points XY xsl A) Vertical Alignment Points XY xsl A) Vertical Alignment Review xsl A) Vertical Alignment Review ASCII xsl A VerticalAlignmentReviewXY.xsl CivilSurvey Clearance CorridorModeling Custom DataCollection Evaluation
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Ľ	AMG-ALGNFRDSHP_2.xml
	AMG-ALGNSR61.xml

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6/4/2018 3:20 PM	XML Document	2 KB
6/4/2018 3:21 PM	XML Document	2 KB
6/4/2018 3:17 PM	XML Document	3 KB

• Verify that the file is created in the 3D Deliverables folder





#### 2D files

- Create Saved View for 2D planimetrics\*
- Use fence copy to new file
- Save as DGN and DWG

\*Top view, references, levels, construction elements, etc.



#### Example of 2D linework



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AMG-2DSGNRD01.bak	6/5/2018 12:00 PM	BAK File	159 KB
🚔 AMG-2DSGNRD01.dgn	6/5/2018 12:00 PM	DGN File	86 KB
🚵 AMG-2DSGNRD01.dwg	6/5/2018 12:34 PM	DWG File	166 KB



# Creating 3D Deliverables

#### 3D files

- Set Corridor Stage to final
- Create Saved View for 3D breaklines\*
- Use fence copy to new file
- Save as DGN and DWG

\*Top view, references, levels, construction elements, etc.



#### What are 3D Break Lines? \*





# Steps to create the AMG-2DSGNRDxx.dwg

- Open the AMG-2DDSGNRD01.dgn file form the 3Deliverables folder
- Set and/or verify GeoCooridante system is attached
- Select File>Save as from Menu
- Change the Save as Type to Autodesk<sup>®</sup> DWG
- Verify the name and folder and click save
- Select Survey Feet from the next dialog box and click OK



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AMG-3DDSGNRD01.bak		6/5/2018 12:45 PM	BAK File	1,069 KB
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AMG-3DDSGNRD01_2.ba	ak	6/5/2018 1:37 PM	BAK File	1,070 KB
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#### Existing Surface Export to LandXML

#### AMG-3DSURFACEEX.xml



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Project Description	EXISTING SURFACE
Export Options	Export Both 🗸



#### Existing Surface AMG-3DSURFACEEX.xml

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		AMG-ALGNBL98.xml	6/4/2018 3:19 PM	XML Document	16 KB	
		AMG-3DSURFACEPR-SR61.xml	6/6/2018 9:51 AM	XML Document	3,886 KB	
		AMG-3DSURFACEPR-BL98.xml	6/6/2018 9:52 AM	XML Document	1,064 KB	
		AMG-3DSURFACEEXISTING.xml	6/6/2018 9:54 AM	XML Document	1,622 KB	

 Verify that the file is created in the 3DDeliverables folder



### Creating 3D Deliverables continued

#### **Proposed Surface**

- Create Terrain from break lines located in your AMG-3DSGNRDXX.dgn
- Export to LandXML



#### Create the AMG-3DSURFACEPR.xml

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#### Steps to create the Existing Surface AMG-3DSURFACEPR.xml

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	AMG-ALGNFRDSHP_1.xml	6/4/2018 3:20 PM	XML Document	2 KB
	AMG-ALGNBL98.xml	6/4/2018 3:19 PM	XML Document	16 KB
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			Feel free to send any comments, suggestion sessions contact: Michele Schiele.	is, and questions to CADD Support. To suggest	topics for future	e webinar
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E FDOT Applications Related to ...

This webinar will cover the three new tools released with FDOT2015.C3D and FDOTSS3 MR1 related to Digital Delivery. These are: the XML Signing application, the LandXML Visualizer, and the Create3DDeliverables application. These will be presented in the context of Digital Delivery. 2015/04/08 Bruce Dana



This Video accompanies the "EDOT Applications

2015/04/08 Bruco Dana

## 3D Deliverables folder files

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#### Validate LandXML

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• Many of the processes shown today are outlined in our training manuals. These are available at the website listed below.

1. FDOT Roadway Design and 3D Modeling for SS4

Chapter 10 Takes you thru exercise of how to create 3D Deliverables

These manuals are available on our website at the following link:

http://www.fdot.gov/cadd/main/FDOTCaddTraining.shtm



#### FLORIDA DEPARTMENT OF TRANSPORTATION FDOT Financial Project Number Date: Phase/ Submittal EOR:

#### 3D Engineered Model QC Checklist

Implementation Items	Originator	Reviewer	Comments
	Initials	Initials	
Geographical Coordinate System has be defined in the model(s)/design file			
3D Baseline/Centerline has been displayed in the model(s)			
Referenced 2D model break lines match the 2D planimetric lines			
kererenced ob moder break intes materi die 20 planimetric intes			
Review of model(s) for completeness, visually:			
<ul> <li>Gaps along the model</li> </ul>			
<ul> <li>Spikes or lips along seams</li> </ul>			
<ul> <li>Overlapping components</li> </ul>			
<ul> <li>Transitions between corridors and templates</li> </ul>			
<ul> <li>Transitions between varying slope values</li> </ul>			
<ul> <li>Slopes harmonization with existing surface</li> </ul>			
<ul> <li>Median Crossovers</li> </ul>			
<ul> <li>Separator Islands</li> </ul>			
Component Depths match the Typical Section:			
<ul> <li>Pavement Layers</li> </ul>			
<ul> <li>Driveway</li> </ul>			
o Sidewalk			
<ul> <li>Concrete</li> </ul>			
Verify Station Offset Elevation at Critical Location:			
<ul> <li>EOP at Drainage Nodes</li> </ul>			
<ul> <li>Begin / End Taper Transitions</li> </ul>			
<ul> <li>Begin / End Radius</li> </ul>			
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Verify Cross Slopes:			
<ul> <li>Pavement Lanes</li> </ul>			
<ul> <li>Shoulders</li> </ul>			
<ul> <li>Sidewalk</li> </ul>			
<ul> <li>Cross Over Medians</li> </ul>			
o Slopes			
Vertical Clearance			
Clash Detection - Interference Checking			
3D Deliverable Created			
XML files for Corridor Alignments			
<ul> <li>XML files for Existing and Proposed Surfaces (verified against 3D decign).</li> </ul>			
<ul> <li>Dan or Dwa files for 2D and 3D lines</li> </ul>			
Join of Dwg mes for 2D and 3D mes     Join file for OpenPoads Design Delivery			
other			
ourci			

## 3D QC Checklist



#### TRIMBLE SOFTWARE

#### Background: "Trimble" Business Center - HCE

## New Recommended Software to replace Multiline

#### Why?

- •CADD Manual Updates in 2018
- Outdated Software
  No upgrades since 2006
- How was Trimble Chosen?

How can you download Trimble?



#### **TRIMBLE - DOWNLOAD**

- How?
- Where?

http://www.fdot.gov/construction/eCon struction/Trimble.shtm

#### Construction

Office of Construction / Programs & Services Trimble Business Center - HCE



The FDOT CADD manual release, in January 2018, no longer requires designers to provide Multiline GEN files for use with the Department's Multiline Earthwork software. Due to this change, and the desire to use more efficient and contemporary technology, the-Multiline Earthwork software will no longer be supported and used for submitting and calculating earthwork quantities on construction projects. Trimble Business Center – HCE has been chosen by the State Construction Office as the recommended software for calculating earthwork quantities and generating earthwork reports, but we do not mandate its use by other stakeholders, as long as compliance with Department policies and procedures is maintained.

New to Trimble? Start Here  $\rightarrow$ 



#### Resources

Trimble Business Center - HCE Website Trimble Business Center - HCE Handbook Trimble Customization Downloads Trimble Demo Trimble FAQ's CADD Manual

#### News

The State Final Estimates Office is pleased to release the FDOT Trimble resources and information for your use. In an effort to continue improving the resources, please provide feedback and questions to the **State Final Estimates Office**.

t MyFlorida.com Performance Statement of Agency Web Policies & Notices



#### **TRIMBLE – Getting Started**

#### Trimble Download Page



and

#### Handbook

Trimble Business Center - Heavy Construction Edition (HCE)         Version 5.0			571	
Trimble Business Center – Heavy Construction Edition (HCE)         Version 5.0         Version       Change         Made By       Date         Image       Image         Image       Image		FD		5
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	Version	nble Business Center – Ve Change	Heavy Construction E ersion 5.0 Made By	dition (HCE)





#### TRIMBLE – Menu Bar

- Customized FDOT Menu Bar (Ribbon)
  - What is it?
  - Where is it?
  - How is this useful?



#### TRIMBLE Template files based on Florida Datum



Template folder:			Template properties:
C:\Users\ps972th\Desktop\Presen	tation for Const\Templates	۰۰۰ ۱۰۰	File name:
Template	Read Only	Default	
Blank Template>	✓	✓	
DOT_East 901 Datum			
DOT_North 903 Datum			
FDOT_West 902 Datum			
nternational Foot	$\checkmark$		
Metric	$\checkmark$		
íakeoff - US Survey Foot	$\checkmark$		
IS Survey Foot	$\checkmark$		
2.1.		011	
Delete		OK	

## **TRIMBLE – Requirements**

- WHAT DOES
   Construction Need from the Designer?
   ➢ Existing Surface
  - ➢ Proposed Surface
  - ≻Alignment

-		-	
	OCT.		
_			
			_

File Name	File Type
AMG-2DDSGNRD01.dgn	Micro Station
AMG-2DSGNRD01.dgn	Micro Station
AMG-2DSGNRD01.dwg	AutoCAD
AMG-3DDSGNRD01.dgn	Micro Station
AMG-3DDSGNRD01.dwg	AutoCAD
AMG-3DDSGNRD01_2.dwg	AutoCAD
AMG-3DSURFACEEXISTING.xml	LandXML
AMG-3DSURFACEPR-BL98.xml	LandXML
AMG-3DSURFACEPR-SR61.xml	LandXML
AMG-3DSURFACEPR.xml	LandXML
AMG-ALGNBL98.xml	LandXML
AMG-ALGNFRDSHP_1.xml	LandXML
AMG-ALGNFRDSHP_2.xml	LandXML
AMG-ALGNSR61 xml	LandXML
Existing_Ground.xml	LandXML



#### TRIMBLE – Requirements

- What Does Construction Need from Department Personnel in the Field?
  - Survey
    - LandXML file (most universal)
  - Survey TXT file
    - Point ID, Northing, Easting, Elevation, and Station





#### TRIMBLE Importing Data





## TRIMBLE Importing the surfaces





## TRIMBLE Validating Data





#### TRIMBLE Validating Data





## TRIMBLE Running the Report

	Со	rridor Ear	thwork Report	
Corridor name:		corridor	Start station:	4+00.00
Native material:		<undefined></undefined>	End station:	6+50.00
Fill material:	<undefined></undefined>		Account for curve adjustment:	Yes
			Account for shrinkage/bulkage:	Yes
Mass E	arthwork		Cut Quantiti	es
		Volume (yď)	Material	Volume (yd
Total available bank cut		1,839.0	<undefined></undefined>	1,839.0
Total fill supplied		1,839.0	Total	1,839.0
Total fill required		0.0		
Total excess (yd <sup>e</sup> )		1,839.0		

Station	Area (ft")		Volume (yd²)		Volume (yd²)		
	Available Bank Cut	Fill Required	Available Bank Cut	Fill Supplied	Fill Required	Excess/Defi cit	Excess/Deficit
4+00.00	156.9						
			503.9	503.9		503.9	503.9
4+50.00	387.3						
			693.8	693.8		693.8	1,197.6
5+00.00	362.0						
			641.4	641.4		641.4	1,839.0
5+50.00	330.7						
						0.0	1,839.0
6+00.00						,	
						0.0	1,839.0
6+50.00							

Density State Color Legend						
Bank density			A Shrinkage			
Loose density			B Hauling Bulkage			
Compacted density		A	C Hauling Compaction			



#### QUESTIONS AND COMMENTS THANK YOU FOR ATTENDING!

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