Site BIM for Aviation

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CV4944-P

This class presents an entirely new strategy for managing data throughout the course of the multiyear contracts that aviation-focused civil engineers engage in. Currently there is no initiative to merge proposed/as-built designs into an overall model. InfraWorks software enables this 3D model to be created and updated throughout the course of a contract, and the software system creates new opportunities for sharing conceptual design ideas. Creation of this model per client constitutes a tangible reason for aviation clients to remain with civil firms beyond current reasoning. Furthermore, this enables all conceptual design or project follow-up to happen in 3D. Additionally, this enables the creation of shareable models for aviation facility operations and maintenance personnel. This course will introduce strategies and software techniques for merging data within larger data sets. Lastly, this course will briefly present Vehicle Tracking software with aviation capabilities specifically addressed.

Learning Objectives

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

- Learn how to create an InfraWorks software model of an aviation facility using existing geographic information system (GIS), survey, and LiDAR/Point Cloud data
- Learn how to create an Aviation Layout Plan (ALP) using InfraWorks software and AutoCAD Civil 3D software
- Discover approach planning in 3D using InfraWorks software
- Learn how to import as-built and design data to InfraWorks software, presenting effective practices

About the Speaker

Christopher Roberts, PE, MBA, LEED AP BD+C, is a 10-year veteran of the site design industry. He holds a BS in Civil and Environmental Engineering from the University of North Carolina at Charlotte and an MBA in sustainable business from Green Mountain College. Chris has presented extensively on the subject of using technology as a differentiator in the volatile and competitive private developer market. Chris works as a civil application engineer for TPM in Charlotte, North Carolina. He is a highly rated and enthusiastic instructor who specializes in strategic technological workflows as a creator of competitive advantage, and he has extensive experience with strategic corporate change. Chris also holds a 3rd-degree black belt in Jun Fan Jeet Kune Do, Bruce Lee's original martial art, and he is a senior instructor with the International Martial Arts Academy and has taught martial arts to people of all ages and backgrounds for almost 20 years. You can reach him at croberts@tpm.com, or @crobertsnc on Twitter and LinkedIn.

Before we get started:

I have created a website that will include all of the information housed here, but will include videos (that are referenced in the document) to help with some of the steps included. Also at that location you'll find a PDF download of this document as well as downloads of a ton of the "extras" created for this presentation (like 3ds models of approach envelopes). After the 26th of November all subsequent revisions will only be posted to the webpage, and content will likely be added right up to (and possibly after) AU. If you'd like to receive an email with updates I post after AU please email me: croberts@tpm.com or ensure I have your business card before we depart from AU. I can't wait to meet you all, and walk through this process – it's really cool, and it's been a lot of fun building this presentation.

Webpage is here: http://www.tpm.com/au2014sitebim

The page will remain under a password until November 25th, 2014 at 5pm EST, as I'll be making frequent updates until that point.

Now, back to your regularly scheduled program

Revision 1: Dated November 14, 2014

Revision 2: Dated November 21, 2014

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Introduction

The *major* differentiator between a 2D design process and a BIM design process (presented here) is **design validation**. This, in fact, is one of the major differentiators between a 3D and 2D design process. My argument for utilizing this process is simple:

> *Using a BIM-centric design process from the initial phase of an aviation project (the ALP) will allow for thorough validation of design parameters and lead to: greater client buy-in, greater and more efficient regulatory compliance, less design changes during creation of construction documents, reduced RFI during construction, and less liability during construction. It does you and your client a disservice to bring a concept plan that is non-constructible or financially inviable further into the design phase of the project.*

Feel the need to make a "tweet-able" version: Don't create construction documents for a site without a validated design! #BIMisBetter #changewhileitseasyandcheap

The other (semi-non-BIM) workflow change here, at least for many people, is what I like to call "closing the digital loop". If you create something that can be used later, take the few minutes needed to do it right, and then save it for future use. This will require having best practices in place for where these files will live, and how they will be named. Be generic, and flexible. This is obviously for components, the same is true though for entire models – think of models as no longer just "design", but "for the lifecycle". This entire presentation is built around this concept – don't design something, don't create anything needed and then just forget about it!

Find your Inner Aggregator (Creating an InfraWorks Model from Many Different Data Sources)

Introduction

One of the most difficult parts of beginning to create any aggregated model is “where can I find the data”. This is particularly true on aviation facilities if previous design consultants (or you) have not been diligent about document management – a topic for a different class, and time. The follow process will lead you through a semi-well documented procedure, but will include some additional components that are more relevant for aviation facilities.

During this portion we will discuss different model aggregation sources and their associated workflows for import, as well as adding additional information about each of the resources – and a few from experience lessons, for good measure.

Procedure

The following steps take you through aggregating a model using InfraWorks and InfraWorks 360; pointing out the specific point the strategies collide.

Part I: Model Aggregation using InfraWorks (GIS)

Start with Topography – this is commonly orthophotography or GIS contours. The USGS National Map has topographic data for the entire United States. Please visit my webpage for a video showing key steps on making it through this process. When deciding upon what to download the “shapefile” designation is the best for topography:

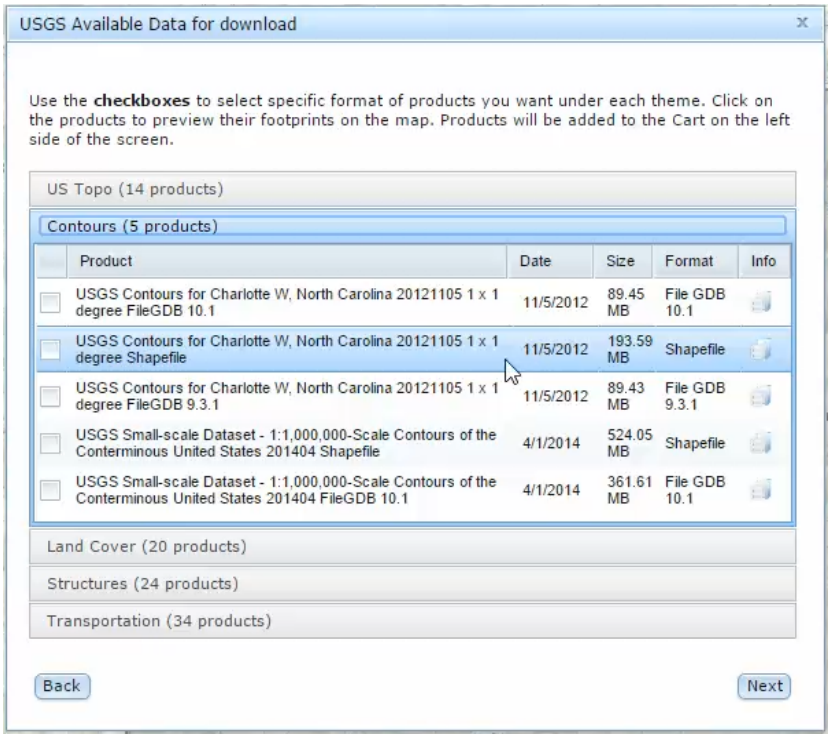


Figure 1: National Map Download Screen

In general, for more than topography and imagery a local resource is required. Local municipalities typically have better structure, transportation, and hyrdaulic planimetrics. If you're very lucky you can find utilities information. Download as much as you can! Hold onto it and use it, you'll need it at some point. This is particularly true if you're only worried about one facility. Also, bookmark those pages as this data is updated with some regularity.

Pro tip: check the email from USGS and use the (beta) *Bulk Download Manager*! It's much faster (particularly with imagery) and allows you to see thumbnails before downloading. Very cool!

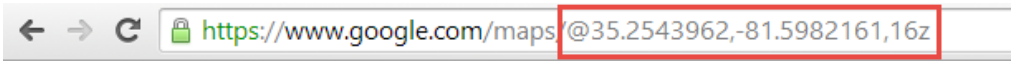
Note: If using InfraWorks 360 you can utilize the (in preview) Model Builder functionality which allows for the creation of the model using nothing more than a map. Generally this produces reliable topographic, aerial, major hydraulic, and transportation information. Structures are spotty.

Either method, though, allows for "building on" using additional resources. Don't feel like poor structures planimetrics through should limit your model…..

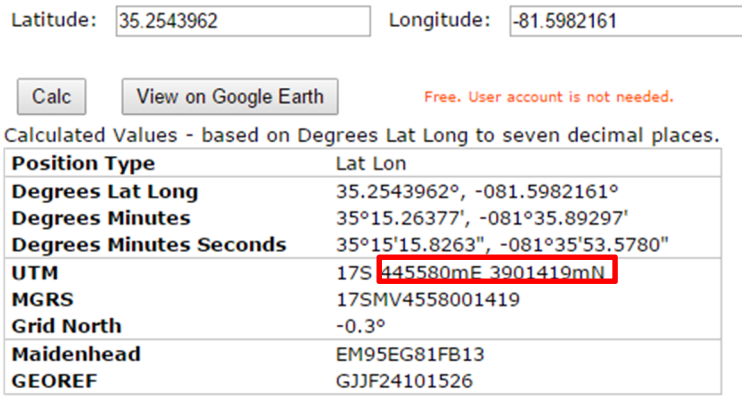
When Structures Data is Just Not Enough

One of the many tools available to you as part of the Infrastructure Design Suite (specifically Civil3D/Map3D) is Geolocation. Here's a quick step-by-step on making your own buildings for import into InfraWorks (remember: this is a "when all else fails" type of workflow, which means it's not pretty):

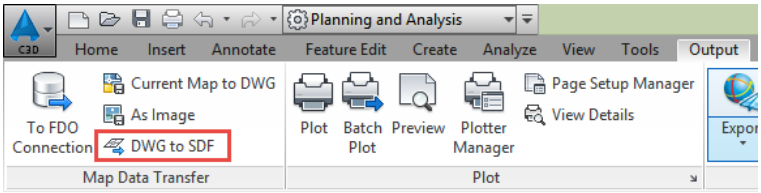
1. Locate your piece of land on Google Maps
2. Copy out the Lat and Long, which can be found in the address bar:



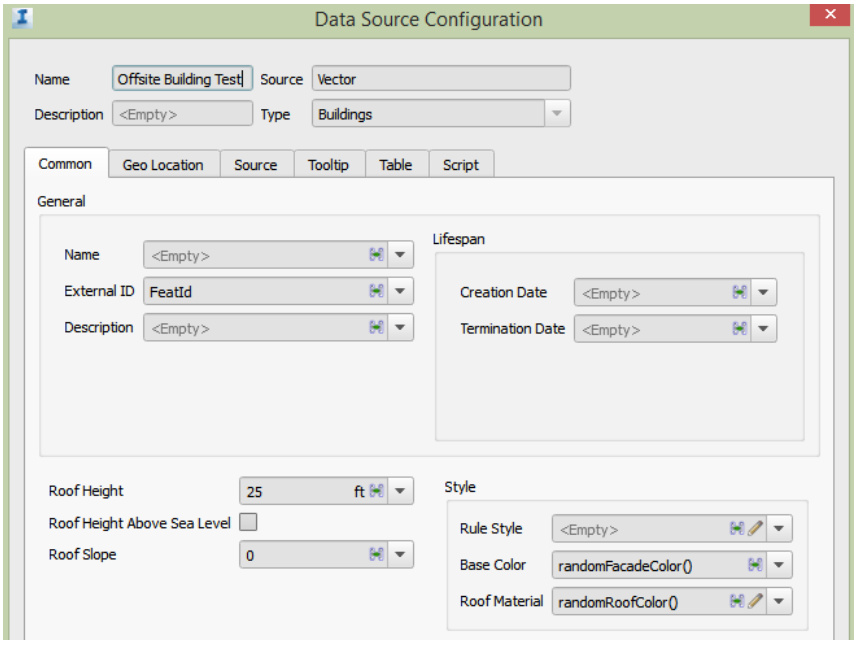
3. Use a web service such as http://www.earthpoint.us/Convert.aspx to find the X,Y coordinates of your area of interest



4. Open Civil3D/Map3D and create a new drawing
5. Set a coordinate zone (doesn't matter what you choose here since InfraWorks has all the same built in, just make sure it covers the area you intend to use)
6. Draw a Polyline from 0,0,0 to the coordinates you received from the webservice.
7. Turn on the aerial or hybrid view of Geolocation in Civil3D/Map3D
8. Trace the buildings you see in the aerial until you've covered as much area as you need
    a. Don't go crazy here. Think about your views and what will be important for communication and planning purposes. Alternatively, get an intern (I hear they're cheap)
    b. Use *polar snaps* and *rectangles* that are trimmed to make this much easier.
9. Isolate the layer you've just drawn on
10. Switch to the *Planning & Analysis* Workspace in Civil3D, and navigate to the *Output* Tab. NOTE: this is (essentially) Map3D so you have access to this product you can perform the same thing there without having to switch Workspaces



11. Use the *DWG to SDF* functionality to export your buildings to SDF
    a. Don't forget to manually select all of the objects, or the layer they're on
12. Go to InfraWorks and import an SDF
    a. Set the *Coordinate System* to the one previously chosen, set the *Type* to Buildings, choose random facades and roof materials, and make sure you ***drape*** the features on the topography



13. Viola! You now have offsite buildings shown in your InfraWorks model. It seems a difficult step, but it's very simple – once you get beyond the tediousness of tracing buildings

Sidenote

Don't forget about stylizing your buildings – particularly those that are offsite. The Base Color and Roof Material have a random function but you can always use Math.random() for the others. For example: Math.random()*25 for the Roof Height will give you some variety (between 0 and 25 ft), you can always edit an individual building if it's in your rendering and obviously incorrect.

Part II: Model Aggregation using InfraWorks (Architectural)

This is a very simple process, assuming the architect is (or you are) using Revit, but does require InfraWorks 360 as the Revit processing happens in the cloud. You can choose, provided you have Navisworks, to process locally – either option requires InfraWorks 360. My recommendation here would be to develop a shared coordinate system from the beginning so you can ensure placement into the InfraWorks model is done to precise coordinate. This is *absolutely crucial* if (when) the Revit model changes.

Of course you can always use Interactive Placement… on the Configuration Dialogue – just remember if you reimport for a change any design, any placement changes made within the model will be undone.

Sidenote

Let's talk naming conventions: in general I name all of the data required as a current name, then when things change I'll back that data up with a date and save the new data as the current

name. This saves me from having to select, locate, move, modify the new data every time and instead can just reimport the data. Example folder:

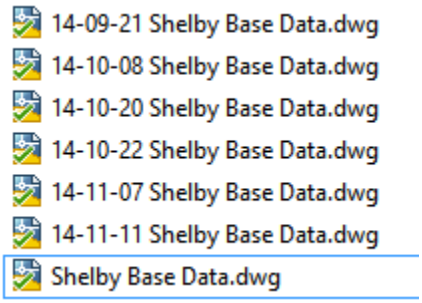


Figure 2: Example Source Data Folder

In this example all of the DWG files that have dates in the beginning are superseded data. I'm always linking (to InfraWorks, Revit, or Civil3D Data References) the Shelby Base Data.dwg file. This saves a great deal of time in realigning/recreating models. The date is first so the source data is always at the bottom.

Part III: Model Aggregation using InfraWorks (Point Cloud)

Stay tuned, this is a topic covered in greater depth later.

Part IV: Model Aggregation using InfraWorks (Imagery - Model Builder)

Now, you really want to get fancy – or you want to show your facility over a period of time (say the course of an ALP, which is covered in the next section). This will require different imagery, obviously. Before getting into this, one note: georeferenced imagery makes this process far less complicated; and that Data Sources are linked to the current Proposal, so set your Proposal before import.

Dig, Dig, Dig!

The internet is a vast wealth of knowledge and there are aerial imagery resources everywhere. A tried-and-true method for determining a good place for starting is Google Earth. It has a neat feature that shows you where the current imagery is sourced from. It also has a really great feature that allows you to go back in time to old aerials (I know, this isn't new news). The thing is: they work together! Take the old aerials and look for their reference location and head to that source for a look at what is available for download.

In North Carolina (where I live) there is a great resource called NCOneMap that is a great resource for imagery. Many local municipalities will allow for you to bring them a drive even and download a ton of imagery data onto a pocket drive. Look everywhere to find data.

InfraWorks is a great repository for imagery (supporting 25 different file types currently) so you likely needn't worry about whether your imagery is compatible – if you have to convert check out GIMP, it's a free, open-source, photo editing software. Assuming all images have the same

coordinate systems, put them all in the same folder and import them simultaneously so you can configure them at the same time. Once configured, uncheck “Clip to Model Extents” and the images will show up correctly.

Figure 3: Example of Google Earth Image Citation

Once you have your imagery files loaded and operational the Surface Layers Dialogue (located under the big, red “I”) will allow for editing which surface and image is viewed on top of which. For the Figure below the secondary imported image will be displayed above the information that came from the Model Builder:

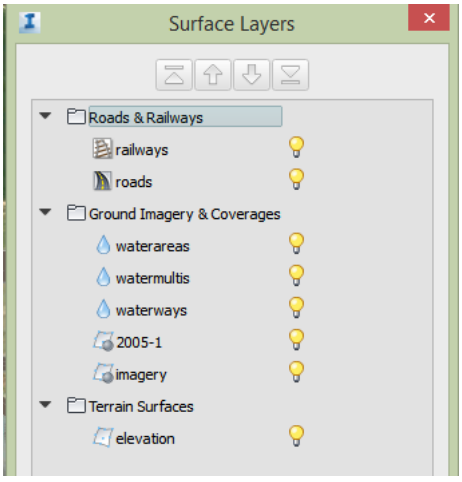


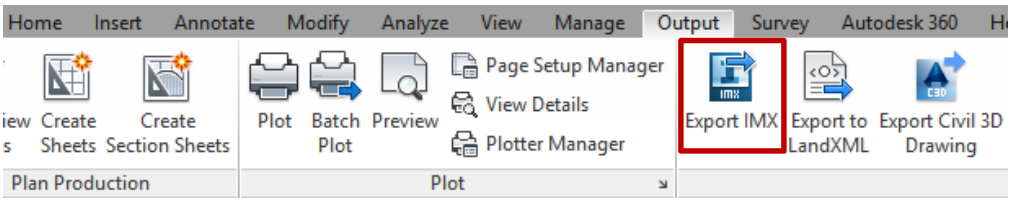
Figure 4: Surface Layers Dialogue

Notice here, specifically, the location of the 2005 aerial image – below the water layers and above the imagery from the Model Builder. This will ensure the new image shows, but the water

areas will show above. Also, pay *very close* attention to the current proposal as this will matter for where the image is able to be viewed. This is definitely a feature that can work for you, or against you. Just understanding how this works will help you immensely.

Part V: Model Aggregation using InfraWorks (Survey data from Civil3D)

The IMX file format is going to be the key to conducting any kind of data transfer between Civil3D and InfraWorks. From Civil3D the IMX file format will allow you to import surfaces, alignments, corridor surfaces, and pipes. There's a great deal of data that comes through from Civil3D to InfraWorks. To export an IMX from Civil3D, visit the Output tab.



This will create an IMX file in the same location as the drawing you're creating the IMX from, so that's where to go to look.

Upon import to InfraWorks the data will be automatically organized into the appropriate sources – selecting the green Refresh Data Sources icon will reload all of the sources and the imported information will appear in the model. Along with all of the data the Coordinate Zone is automatically imported for IMX.

This workflow will suffice for all 3D data, for all other survey data you will have to use the DWG to SDF functionality. For Furniture (items like fire hydrants, park benches, etc) you can simply create a small coverage area for each and apply a 3D model where they exist on the site.

Part VI: When all else fails…. Draw!

You have the ability to sketch anything inside of InfraWorks – for example the tarmac in the model view below:

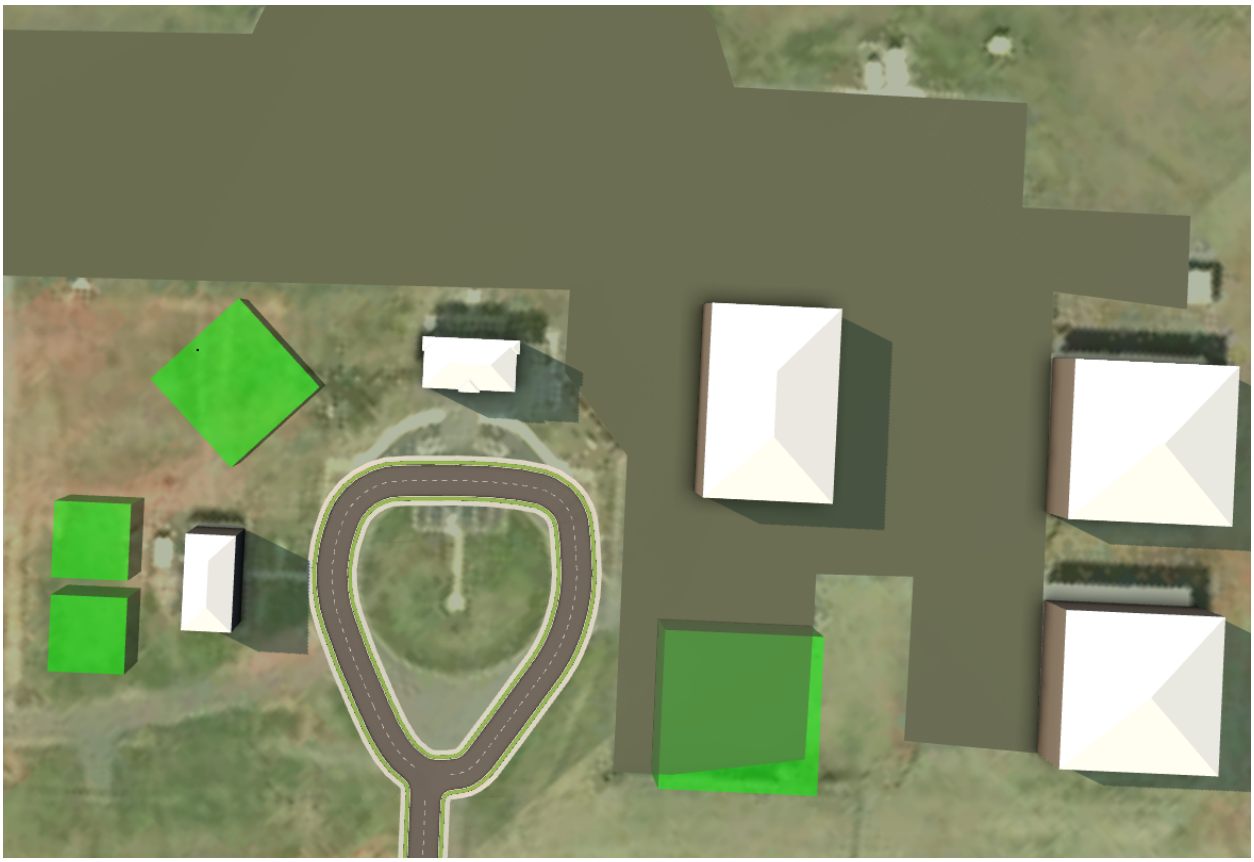


Figure 5: Tarmac Sketched as Coverage in InfraWorks

All of this functionality can be found under the Create Conceptual Design Features heading in InfraWorks (& 360). Of note though is the lack of accurate modeling tools. Tools like: Trim, Fillet, Offset, Align, etc. If you need accuracy use the same method laid out previously using the DWG to SDF functionality.

Climbing the ALPs (Area Layout Planning using a BIM Methodology)

Introduction

According to the FAA all aviation facilities are to “keep the ALP up-do-date at all times”, and list a number of possible reasons ALP’s can become out-of-date. These include: “[ALPs] do not adequately provide for future needs, do not conform with current airport design standards, do not accurately reflect existing features, do not reflect airport and critical land use changes which may affect the navigable airspace or the ability of the airport to expand”. ALPs are essentially the conceptual planning phase of any aviation facility; but, they should also the ongoing aggregated model that all operations and maintenance professionals would love to have!

The section will provide some go-to conceptual planning techniques and how they relate back to having a “BIM-centric” process. There are a few software limitations in this section, in terms of their ability to model in 3D exactly but with some tweaking and out-of-the-box processes we can do most anything in 3D.

In many places this procedure is using the tactics presented above to aggregate data needed to be able to adequately present an up-to-date ALP at any time. In this case though the information being added will likely be proposed in nature so they look and feel will want to be different for planimetric data. For proposed runways/taxiways/parking areas/vehicular access though there are tools at your disposal to validate your design as you move through the ALP creation process.

Procedure

First, ensure you create Proposals to work through this efficiently. Proposals will ensure you are placing the information you wish to show in the correct place. It will also allow for greater control of elements between ALP Proposals and Operations & Maintenance model elements.

Creating Proposed Planimetrics

The general procedure here is the same as above: import what you want using the different formats available. For buildings Revit is preferred here obviously. If you have a Revit model use the method prescribed above, and use that shared coordinate. If you only have AutoCAD data, and access to only AutoCAD that is where things get a bit more complicated.

Using Styles

From a presentation standpoint, often showing existing vs proposed is desired. For the purposes of the ALP using simple colors is usually the most straight-forward method, unless you have exactly the materials you want from a Revit/DAE/OBJ model. To apply a new style:

1. Open the Style Palette
2. Navigate to Materials>Colors
3. Find a Color with Transparency
4. Drag-and-drop onto the buildings you want to show as planned/proposed

Of note here is the lack of capability to handle materials modifications for 3D models. Because of this I find it is more effective to use the DWG to SDF functionality in Map3D/Civil3D since it will take a 2D closed polygon and create a 3D model inside of InfraWorks therefore allowing you to manipulate the materials as you wish.

The other option to work around this is to use Revit to build a quick massing and apply materials directly (either in Revit or InfraWorks), or use 3ds Max and apply the materials before import of the model – the annoyance here has to be changing materials through 3ds Max. Stay tuned though, there's discussion about this integration in the next section.

Figure 6: ALP with Planned and Existing Buildings Shown

Runway and Taxiway Planning

Runway and Taxiway planning should utilize the design tools built into Roadway Design for InfraWorks 360. They will require some custom styles to be built, though.

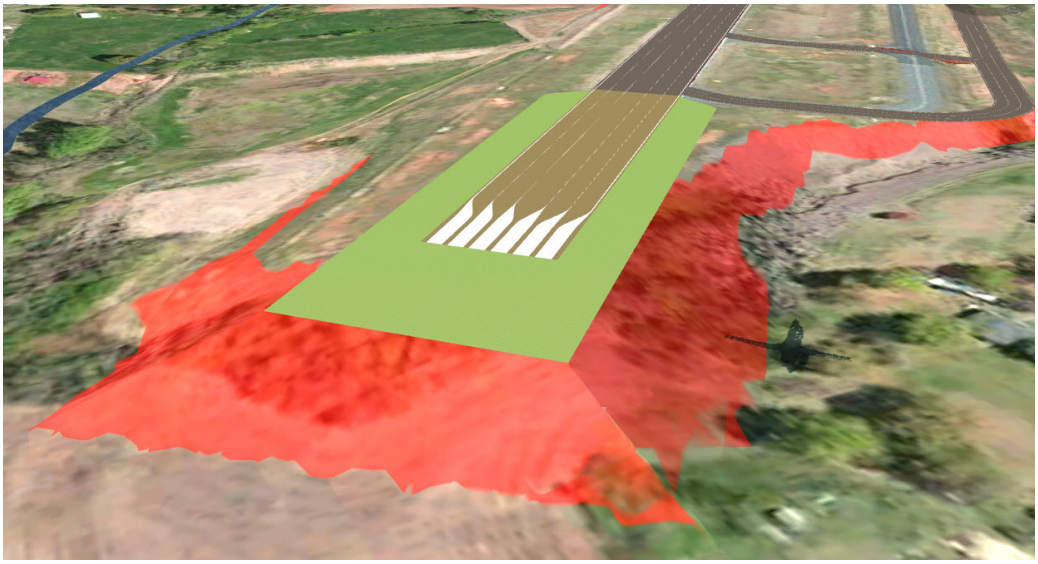
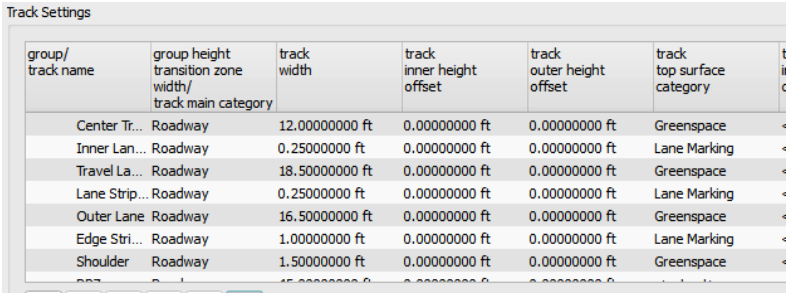


Figure 7: Runway Planning in InfraWorks 360

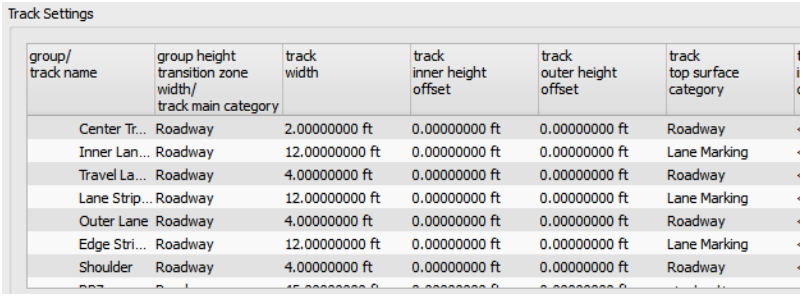
For the purposes of runway planning in InfraWorks 360, runways are just roads with a specific style. In the example above I'm using 3 different custom styles, described below:

1. A 190 ft wide roadway style with the normal "Roadway" Top Surface Category type replaced with "Greenspace" and 45 ft shoulders on each side with the Top Surface Category set to "<not set>". Why <not set>, you ask? It makes the areas that are just grading highlighted bright green. Alternatively, you can create a new Material Group and apply this to the runway design road (as I've done in the figure above)


Track Settings

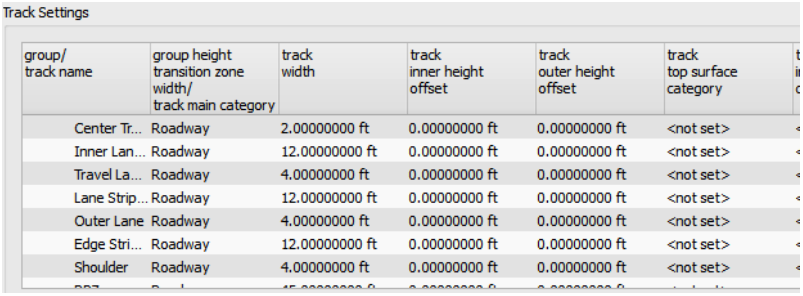
group/ track name	group height transition zone width/ track main category	track width	track inner height offset	track outer height offset	track top surface category
Center Tr...	Roadway	12.00000000 ft	0.00000000 ft	0.00000000 ft	Greenspace
Inner Lan...	Roadway	0.25000000 ft	0.00000000 ft	0.00000000 ft	Lane Marking
Travel La...	Roadway	18.50000000 ft	0.00000000 ft	0.00000000 ft	Greenspace
Lane Strip...	Roadway	0.25000000 ft	0.00000000 ft	0.00000000 ft	Lane Marking
Outer Lane	Roadway	16.50000000 ft	0.00000000 ft	0.00000000 ft	Greenspace
Edge Stri...	Roadway	1.00000000 ft	0.00000000 ft	0.00000000 ft	Lane Marking
Shoulder	Roadway	1.50000000 ft	0.00000000 ft	0.00000000 ft	Greenspace

2. A 190 ft wide roadway style with large "Lane Marking" Top Surface Category applied to show the beginning of the runway more clearly and 45 ft shoulders on each side with the Top Surface Category set to "<not set>"


Track Settings

group/ track name	group height transition zone width/ track main category	track width	track inner height offset	track outer height offset	track top surface category
Center Tr...	Roadway	2.00000000 ft	0.00000000 ft	0.00000000 ft	Roadway
Inner Lan...	Roadway	12.00000000 ft	0.00000000 ft	0.00000000 ft	Lane Marking
Travel La...	Roadway	4.00000000 ft	0.00000000 ft	0.00000000 ft	Roadway
Lane Strip...	Roadway	12.00000000 ft	0.00000000 ft	0.00000000 ft	Lane Marking
Outer Lane	Roadway	4.00000000 ft	0.00000000 ft	0.00000000 ft	Roadway
Edge Stri...	Roadway	12.00000000 ft	0.00000000 ft	0.00000000 ft	Lane Marking
Shoulder	Roadway	4.00000000 ft	0.00000000 ft	0.00000000 ft	Roadway

3. A 190 ft wide roadway style with the entire width Top Surface Material set to “<not set>”; notice below that the Groups are maintained, just their Top Surface Category changed to “<not set>” (this process keeps InfraWorks from trying to figure out which group relates to which group from the previous Style Zone


Track Settings

group/ track name	group height transition zone width/ track main category	track width	track inner height offset	track outer height offset	track top surface category
Center Tr...	Roadway	2.00000000 ft	0.00000000 ft	0.00000000 ft	<not set>
Inner Lan...	Roadway	12.00000000 ft	0.00000000 ft	0.00000000 ft	<not set>
Travel La...	Roadway	4.00000000 ft	0.00000000 ft	0.00000000 ft	<not set>
Lane Strip...	Roadway	12.00000000 ft	0.00000000 ft	0.00000000 ft	<not set>
Outer Lane	Roadway	4.00000000 ft	0.00000000 ft	0.00000000 ft	<not set>
Edge Stri...	Roadway	12.00000000 ft	0.00000000 ft	0.00000000 ft	<not set>
Shoulder	Roadway	4.00000000 ft	0.00000000 ft	0.00000000 ft	<not set>

Sidenote

Don’t forget when you create a style it stays with that model. Export them and put them in a shared location so you don’t have to create them again. The efficiencies gather steam the more folks are creating. Idea for naming: Type_CrossSectionWidth_LandUse_AddInfo.styles.json. Take the few minutes to save this where to go – it will save you time later, many additional times.

Resuming, draw the runway as a Design Road that attaches into the existing Sketch Road (which was created as a part of the existing conditions creation in Section 1. You’ll need to draw this Design Road to include any in-line grading that will need to be conducted as a part of the Runway Extension. Once you have the roadway drawn add two Style Zones to be able to control the styles between Grading Only, Runway Beginning, and Runway Extension.

Figure 8: Runway Extension Showing 3 Style Zones with Grips

Modeling these all as one roadway allows you to be able to edit the overall grading in the Profile View. For purposes of planning this is a vastly superior method to having to manually draw and assume that the design will work. Most importantly you'll be able to immediately understand if there are any major constraints that will preclude the type of expansion being proposed, and have ability to use the Profile Optimization functionality within InfraWorks!

Understanding the Implications of Design

Now that you have an InfraWorks Roadway for the runway let's see if we can validate this design's design-ability and constructability, using Terrain Themes and Civil3D.

To check for terrain problems in InfraWorks, use Terrain Themes!

Once you have opened the Terrain Themes Editor, you can add using the big, green plus sign. Within the Theme Properties you have the ability to perform a variety of checks. Figure 7 above, for example, is showing everywhere the slope is above 30%. Important note here: the slope values are in Degrees *not* percentage. So you have it: 25% = 14.04º, 33% = 18.26º, 50% = 26.57º. You can always use Degrees = Tan^{-1}(decimal slope).

For validation in Civil3D use the process below:

1. Export this design road to Civil3D

   a. You have two options here: Civil3D Drawings, and IMX – use IMX for this
2. You'll end up with two Surfaces and an Alignment
3. Use these two surfaces to understand dirt movement required for this concept
   a. Create a Volume (from TIN) surface
4. If you really want to flex your validation muscles:
   a. Create a series of pre-developed assemblies in Civil3D and add them to a tool palette for future use (as before, just save them as you create them so you always have access)
   b. Create a Corridor with the alignment, profile, and pre-defined assemblies and daylight
   c. Create a Volume (from TIN) surface to get an understanding of volumes
   d. Use QTOs built into Civil3D to understand your materials usage and print a report
5. Revise, if required
6. Ship to NavisWorks for staging and concept planning for construction means and methods – this will help determine the constructability of your proposed design (there's a video on the website that walks through how this would look)

Taxiway Line of Sight Validation

One of the coolest validations that can be conducted in InfraWorks is sight distance analysis. From a roadway perspective you can look at stopping and passing site distance. For aviation, you can play with the conditions and just look at "Decoration" obstructions to ensure there are no visibility issues on the taxiways. When the analysis is conducted including Decorations the software will look at anything obstructing vision: grading, trees, building, lighting, fire hydrants, really anything that would be within the site envelope.

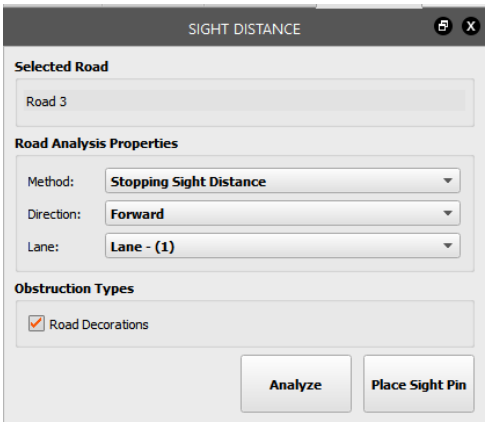


Figure 9: Sight Distance Settings

Of course, you must first play with some deep modifications to make the design criteria applicable for Aviation (or ship to Civil3D where you have full control and conduct the analysis there). The files you'll need to modify are location in C:\ProgramData\Autodesk\InfraWorks

360\Resources\Standards\Roads\DesignStandards and can be opened with the notepad. I'm not going to recommend specific edits here as there is a lot of code happening and is beyond the scope of the course – just know that's the place to head and modify values.

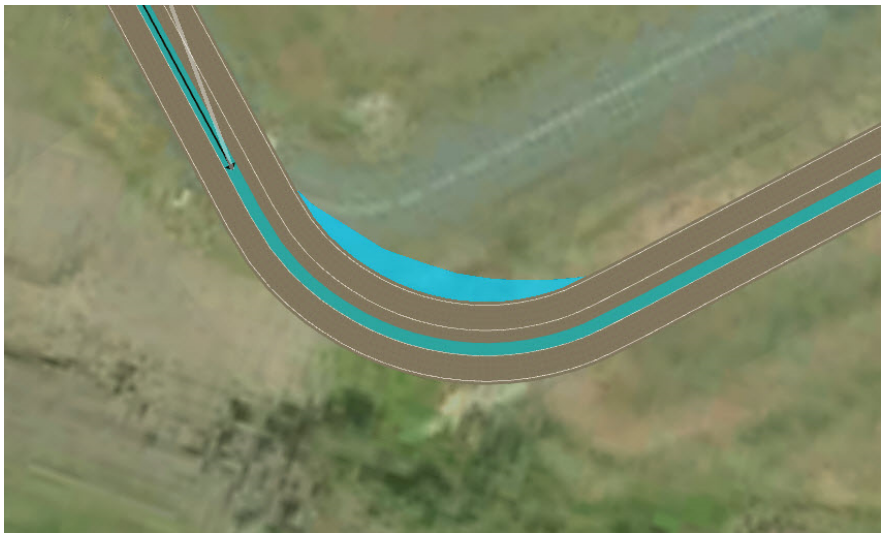


Figure 10: Final Result of a Successful Sight Distance Analysis (no obstructions)

Part II: Site Planning for Aviation Facilities

Overall, the process here is the same:

1. Use InfraWorks and AutoCAD/Map3D/Civil3D/Revit to do initial planning
2. Send to Civil3D for Volumetric, QTO, and Site Distance analysis
3. Send to NavisWorks to understand the implication of design

There are, however, some simple extra things you can do to really make your site plans show up in the ALP in the best way possible.

Showing Parking Areas/Spaces in InfraWorks (and using Vehicle Tracking to do them)

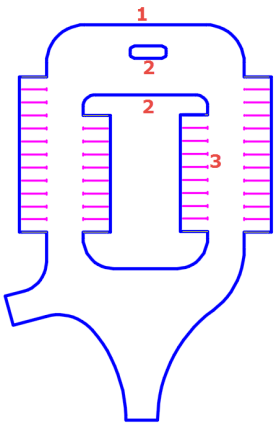
InfraWorks is not a site design product, this is true for commercial sites and for aviation facilities. The ability to conduct runway-level design validation is non-existent in the current version of the software for sites. Don't despair though! You can use Autodesk Vehicle Tracking, and the previously presented DWG to SDF functionality to get your complete ALP or proposed design into this 3D model.

Getting Parking and Landscape Areas from Civil3D/Map3D into InfraWorks

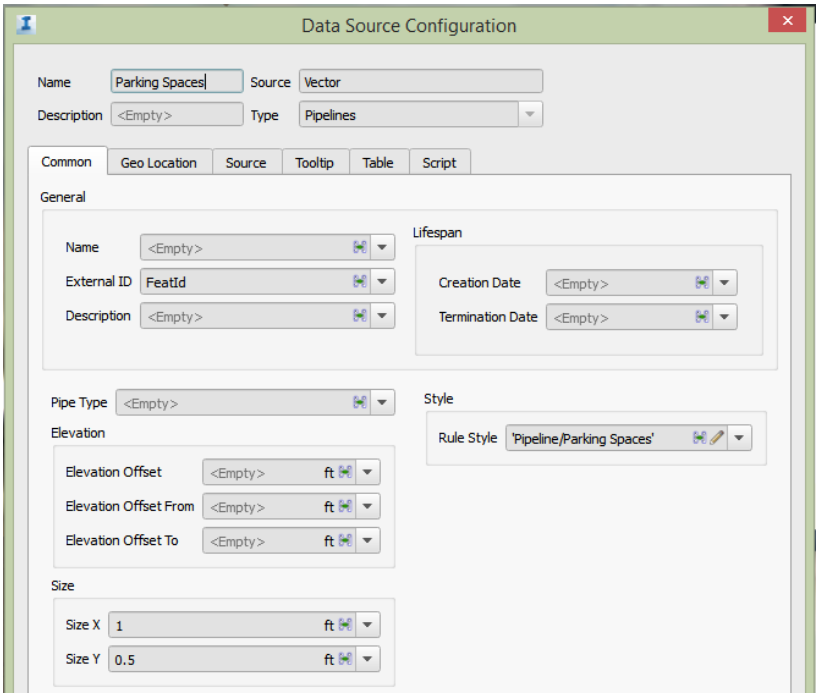
In order to have your site entities show in InfraWorks:

1. Draw your site plan in Civil3D (using Vehicle Tracking to make the parking space easier, and validate turning movements) – don't forget your Tie Down planning
2. In Civil3D, isolate the objects (by LAYISO, not the Object Isolation functionality) you want in InfraWorks (like the parking area, landscape areas, and the parking space)

3. Ensure that any area you'll want in InfraWorks (like a parking lot) is a closed polyline
4. Use MAPCLEAN to remove any duplicate vertices, etc. This is a crucial step, as it will solve the vast majority of import/draw issues
5. Use the DWG to SDF functionality of Civil3D/Map3D to export linework.
    a. The trick here is this: think of each land use as a separate area (for the plan below the line labeled '1' and the lines labeled '2' would be exported to separate SDF's – one for the outer area, and another for both island areas. Since these areas stack on top of each other you'll need to ensure you have them all readied as such.



    b. The last SDF created here will be the parking spaces (labeled '3' above) – these can just be Polylines (if you used Vehicle Tracking, make sure you explode the parking bays to make them just polylines). The Tie Downs would be the same
6. Import all three SDFs into InfraWorks individually
    a. The parking lot area comes in as a Coverage Area with an asphalt Style
    b. The island areas come in as Coverage Area with a grass Style
    c. The parking spaces come in Pipelines. Copy the default rectangular pipe, and make its color yellow, this is the best to use for parking spaces. Use the following settings for correct configuration:



7. Use the information in the following section to reorder the surfaces in order to show the correct order of the surfaces, you want existing the lowest, then Parking Area, then Landscaped Islands

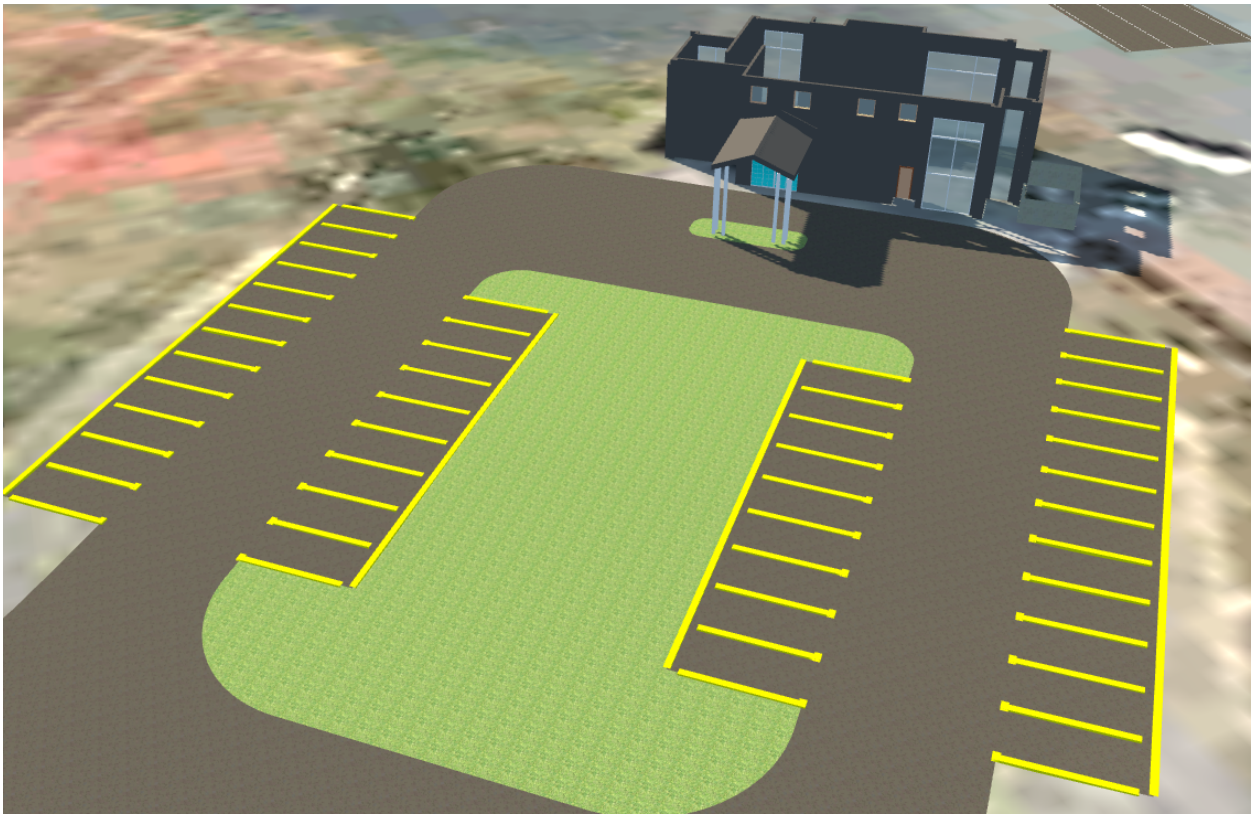


Figure 11: Example Site Plan in InfraWorks

Dealing with Multiple Surfaces in InfraWorks

Use the Surface Layers Dialogue to control which surfaces take precedence. What's neat here is the ability control the water areas independently. That's to say, if you're making modifications to an existing water feature you can actually show that change in InfraWorks. This Dialogue is located under the large, red "I".

To control how items are rendered, and how surfaces work just select an object and use the Up and Down buttons at the top. This also works for different imagery (as used above), and proposed Surfaces (as used below). Here is how the Figure above was configured:

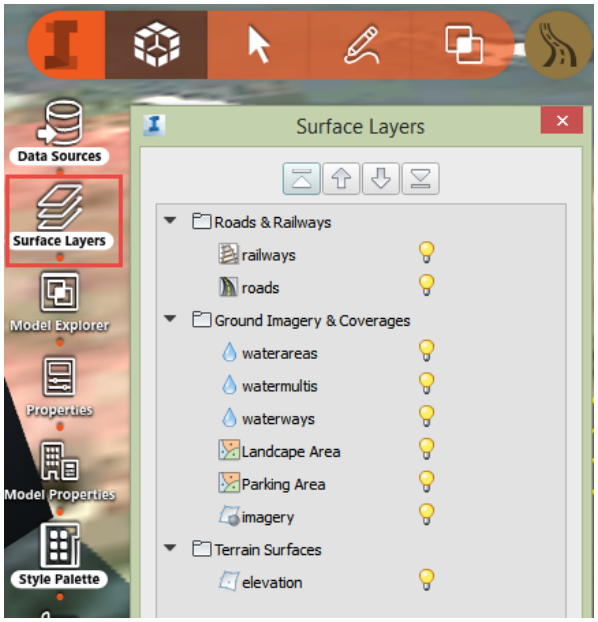


Figure 12: Surface Layers Dialogue Box for Site Planning

Making a Retaining Wall

The process here is fairly simple, just requiring you to make a style of sketch road that is very skinny and concrete. There will be a video on the website that will walk through this process as it not easy to explain with words.

I Like the Way you NavisWork(s) it

One of the more interesting undertakings of the last year was efficiently incorporating civil design data into the NavisWorks model used for construction. More importantly, this model should be used internally before ever being shipped to a contractor in order to ensure the existing grade, mass grade, erosion control grade, and the final grade all work together as a matter of means and methods. This procedure absolutely falls into the 'once you utilize, you'll never do another project without' category. Not to mention many companies are not utilizing this resource so it is a competitive advantage with a low barrier of entry.

Rendering Photorealistically

InfraWorks obviously has built in rendering, and for quick views and non-edits need shots it's great. However, if you really want to push the rendering to a high level or edit something in such a way as cannot be done in InfraWorks then 3ds Max is the way to go. Pulling a portion of your model into 3ds Max via the FBX export is the way to go here.

Hey, Wait, Come Back! (Approach/Departure Planning in InfraWorks)

Introduction

Approach and Departure planning surfaces are standard sizes that are given by the FAA. As such, they represent a possibility for digital compilation and future use. The idea behind these surfaces is to establish the location and penetration of any obstructions within this space. Current methodologies require multiple steps through Civil3D in order to ensure all possible obstructions are shown in plan and profile. This isn't changing as a part of this process. What is changing is you won't have to conduct that fairly tedious step on any designs that haven't already been conceptually validated!

Overall, planning for runway expansion approach and departure surfaces seems a quickly check-able standard – particularly if the following tips are followed. In general, this process requires (like the previous) to be diligent about saving the items you build for one project for use later. Often it's not advantageous to build everything all at one time, but over time until you have everything you need. Develop this habit now, and save yourself a ton of time!

Procedure

Conceptually, this process is tremendously simple: create a 3-dimensional model of the approach and departure surface and place them into your InfraWorks model.

In 3ds Max:

Procedure to create approach and departure mass, use the following steps:

1. Set local units (decimal feet), and good Grid Spacing (10')
2. Create a Box Element the overall size you need, and with 2 Width Sections
    a. For Type 2: X=700', Y=5000', Z=250' (this is to make sure the void cuts into the earth)
3. Add and Edit Poly Modifier and select Points to modify, and modify their X, Y, and Z coordinates to create the void you'll need
4. Apply a material (with 30% Opacity) so it's obvious, but doesn't cast a shadow
5. Save, and Export as a .3DS file type

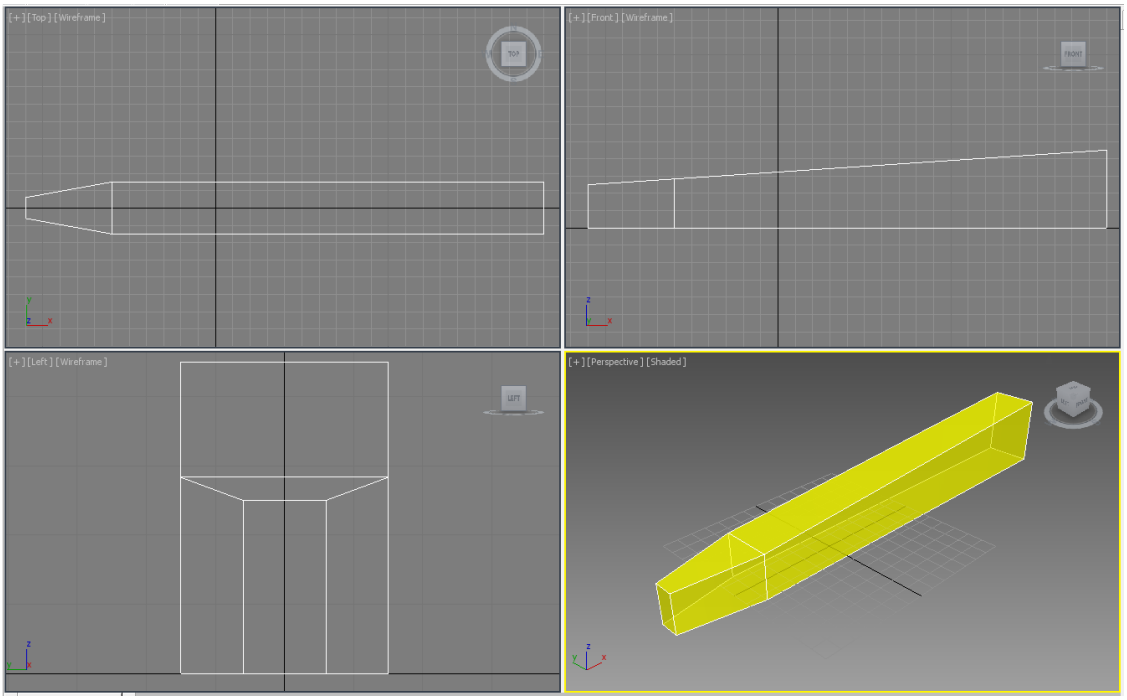


Figure 13: 3ds Massing for Approach Void

Create these masses as you need them until you have all of them built. If the regulations change, you can always come back and modify where needed. Lastly, create each of them with a transparent material so you can actually move through them in InfraWorks.

In InfraWorks

Once you've created these masses they can be directly imported into InfraWorks as a .3ds file. These come in most efficiently, and retain the materials applied in 3ds Max. Interactively place the approach at the desired location and play with the Z and Rotation Y values to line it up. Alternatively, you can move it around using the Gizmos, but if you place this with another approach mass (say, because the runway type changes) you'll have to move that around manually upon secondary import. What does this look like?

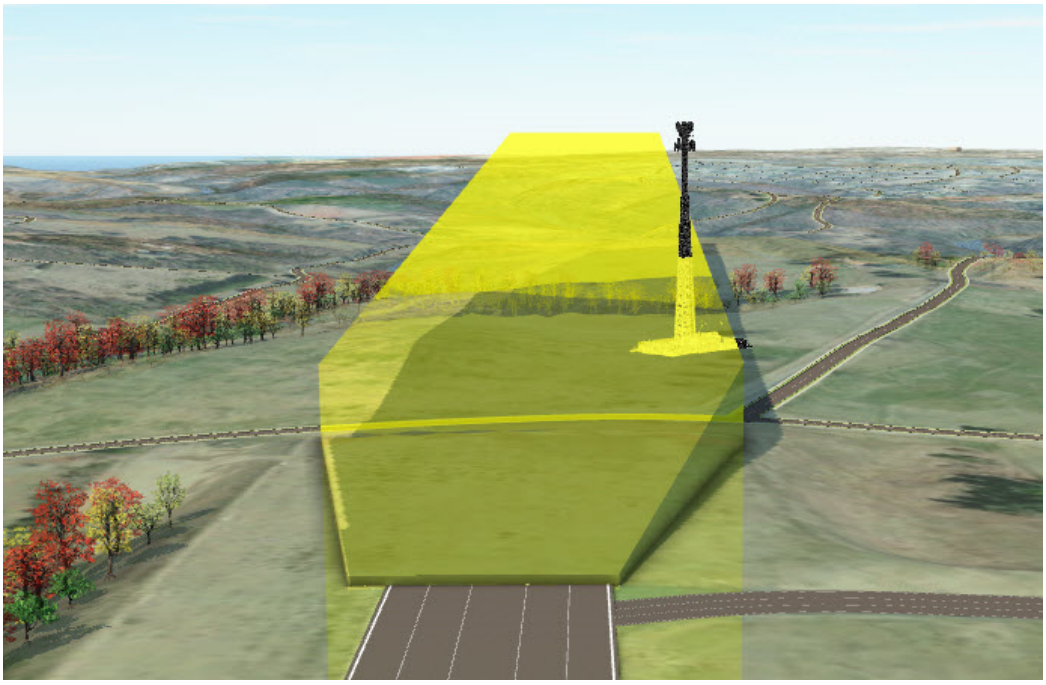


Figure 14: Approach Mass in InfraWorks

The major benefit to this approach is the ability to literally fly through the Approach Mass and determine the presence of obstructions (notice the radio tower above is literally turned yellow to show the penetration into the flight path).

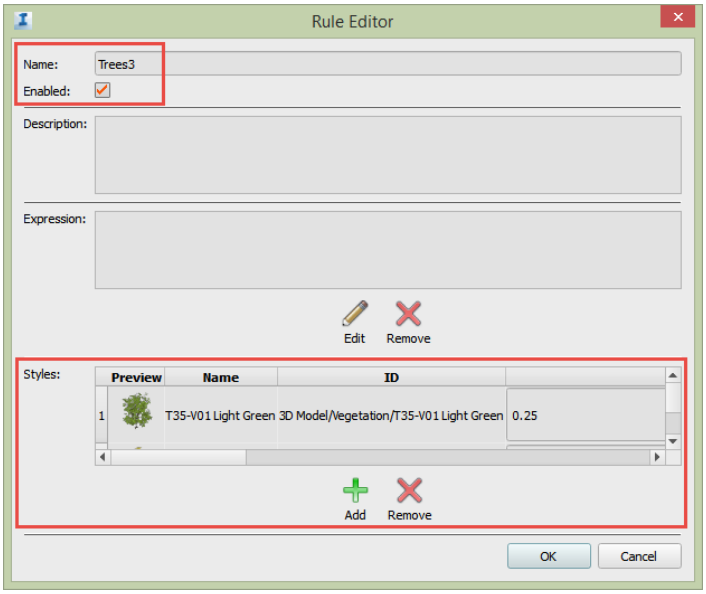
Adding realism to this portion of the model helps this process dramatically. There are great models on line for things like Radio Towers and Water Towers. You can also just manually draw a large mass (a Building) to represent any of those items. LiDAR or Laser Scanning data can be used to determine the tops of a tree canopy. Having the most realistic conditions as is practicable here will help long-term – just think of the first conversation you have a regulatory agent where you can prove that something works when they think it doesn't.

Let's Put a Little Happy Tree Right There

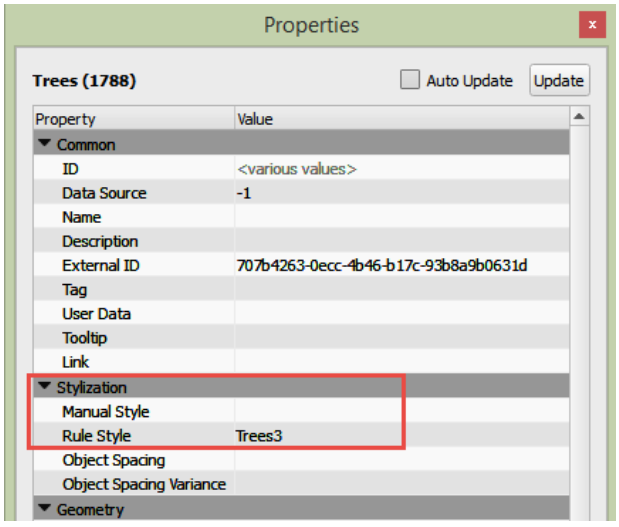
Let's put the final touches on existing data for the purposes of this model. Vegetation, of course, is an important component of approach and departure planning. There are really two things to work with here: random vegetation, and editing individual components of known height. The latter of these operations is very simple: just use the blue conical-ish gizmo on the top of an individual model. The second takes a few steps:

1. Under the Create Conceptual Design Features, select Style Rules
2. On the left-hand side of the Style Rules Palette, scroll down to Trees
3. Select the big green Plus Icon to create a new Style Rule, this will open the Rule Editor Dialogue box which has four sections, the first and fourth are important for this

4. Give the Rule a name (an easy one) and then go to the bottom to add styles that will be used when this Style Rule is applied
5. Also, set the probability of each – these are in decimal form and are a number between 0 and 1, you'll want your numbers to add to 1. Most visually appealing is putting vegetation of different sizes and different colors to give a lot of depth



6. Select OK to close, then select the Commit button at the bottom of the palette
7. Draw a Stand of Trees
8. Open the properties for this Stand
9. Delete the Manual Style
10. Type the name of the Style Rule in the Rule Style entry



11. Select Update
12. Go back to the Style Rules Palette and select Run Rules to apply

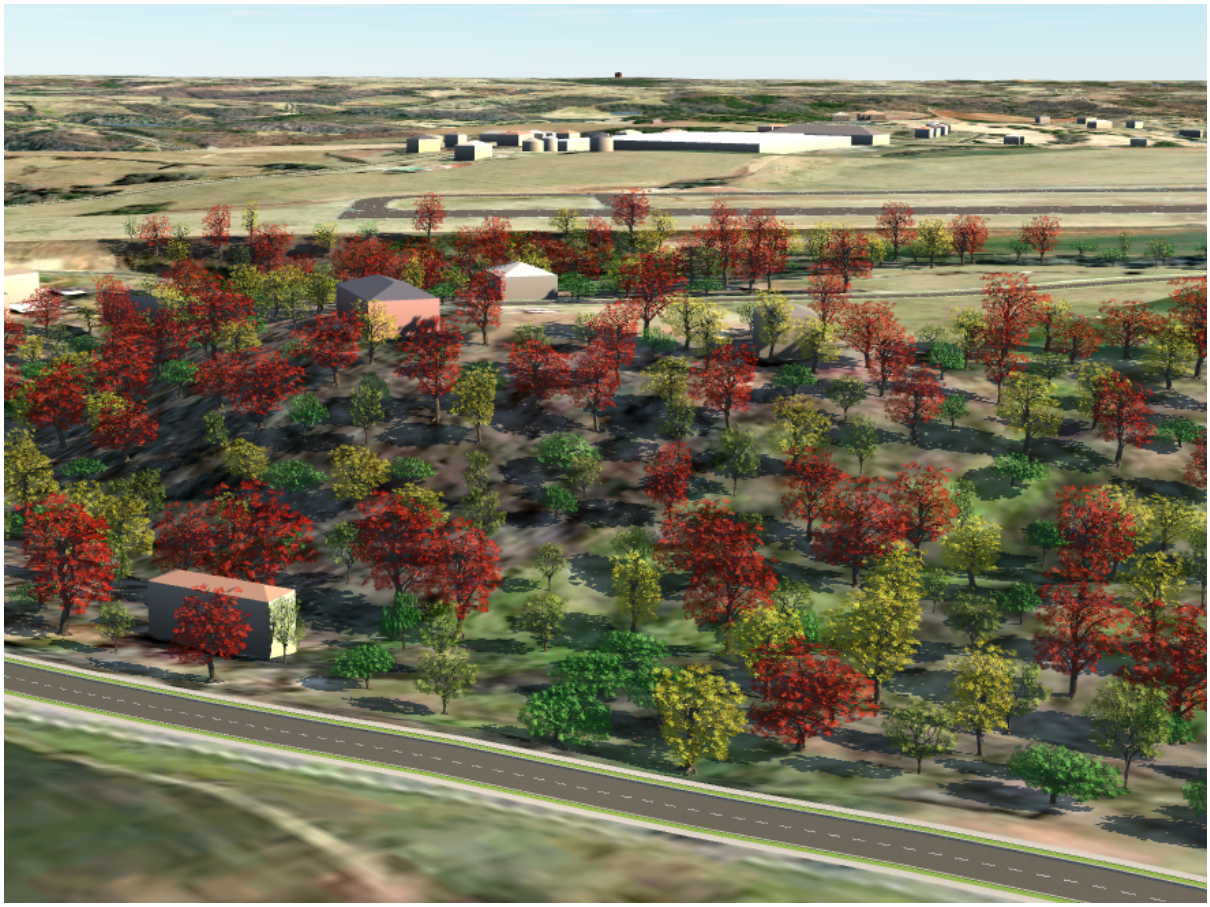


Figure 15: InfraWorks Model with Random Vegetation

You can simply use the location of wooded areas on the aerial image of model builder to place the Stands of Trees where they are on the ground.

Keep Me Up-To-Date, Please! (Incorporating Constructed Data into the ALP InfraWorks Model)

Introduction

This is where you model takes the next step in terms of effectiveness. Incorporation of construction data into InfraWorks allows you to be able to have a true understanding of the aviation facility and allow for this models usage for Operations and Maintenance needs as well as future planning/construction endeavors.

This section will introduce viewing sub-surface utilities, recap utilizing methods previously discussed for this purpose, best practices for incorporating Civil3D design data, and provide information about best practices for using existing conditions laser scanning and the point clouds they create.

This is really the final step of the design and construction process. You've done Conceptual Design in InfraWorks, passed to Civil3D, validated constructability in NavisWorks, and incorporated Revit. You've built the site and completed your final punch list – now it's time to close the project by ensuring you have an up-to-date 3D model and InfraWorks is the best place for this; particularly since you'll need this data later.

Procedures

Incorporating final design data such as Revit files and Civil3D surfaces/parking has been covered in previous sections here. The key here is to create Proposals from the correct location to include all future planning. Creating Duplicate Models can also be effective here since you can have a backup of the database before any proposed data has been added. The other thing to remember here has to do with ensuring your surfaces are displayed in the correct order.

In general the first step to incorporating design data is to bring the Civil3D design entities back into InfraWorks as their actual design values. The best strategies for this is using the IMX file format. This output can be found under the Output Tab of the Civil3D Ribbon. This functionality will export all Civil3D design data to an external file that will be imported into InfraWorks. Before conducting this process clean out all design data not desired for import as the IMX import into InfraWorks will not ask what data you want, it will all be imported.

What's Under There? (Sub-Surface Utilities)

You will have two different pieces of data per pipe network imported into InfraWorks – the pipes and the structures. The pipe and structure sizes will follow the actual design values in Civil3D, as do the depths. Unfortunately, there is not a way to stylize the pipes by inner diameter (unless you want to break a Gravity Network to many based up size, which doesn't seem worth the effort. Once you have your pipes in there, turn on your Surface Opacity (under the Create and Conduct Icon) and you can see them more efficiently

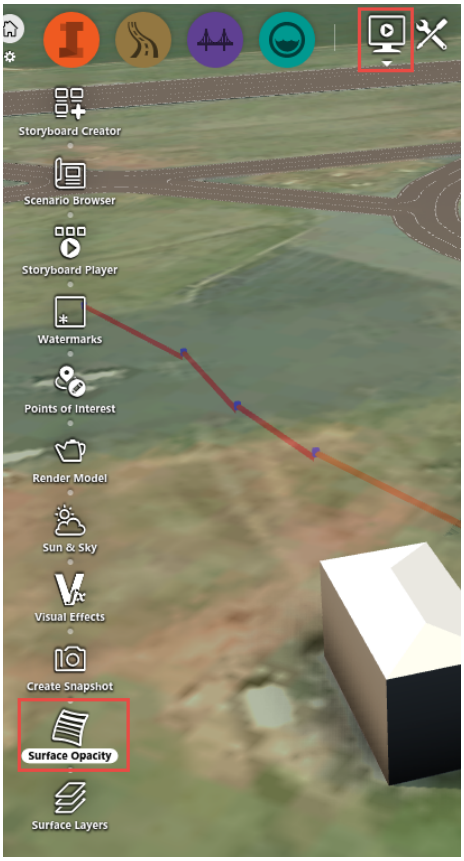


Figure 16: Surface Opacity Turned On, Pipes Underneath

On the Surface

When the DWG was cleaned up, you likely ended up with just one final surface, and that is all you want. The mass grade, erosion control, and existing conditions are all either for planning in NavisWorks, regulatory compliance, or already in the InfraWorks. Once imported just use the Surface Layers Dialogue to ensure the most recent surface is shown on top.

So, what's the Point?

Point cloud technology is becoming more popular, particularly in the construction industry. Incorporating this technology into the design and aggregation. In order to incorporate this data you'll need a ReCAP project (.rcp). This does not mean you have to use ReCAP to register your scans, just index the final cloud and create a ReCAP project.

One major lesson-learned here: clipping boundaries are no good for this import. If a clipping boundary is applied in ReCAP the point cloud import will fail. Also, use XY-M as your Coordinate System as ReCAP works in meters for the actual cloud.

The best way to ensure you have the best data here is to ensure your scan includes some kind of existing data to ensure you can line the point cloud up well – geolocation is possible with the point cloud, but it never hurts to have a “second opinion”. For the model shown the adjacent hangar was picked up.

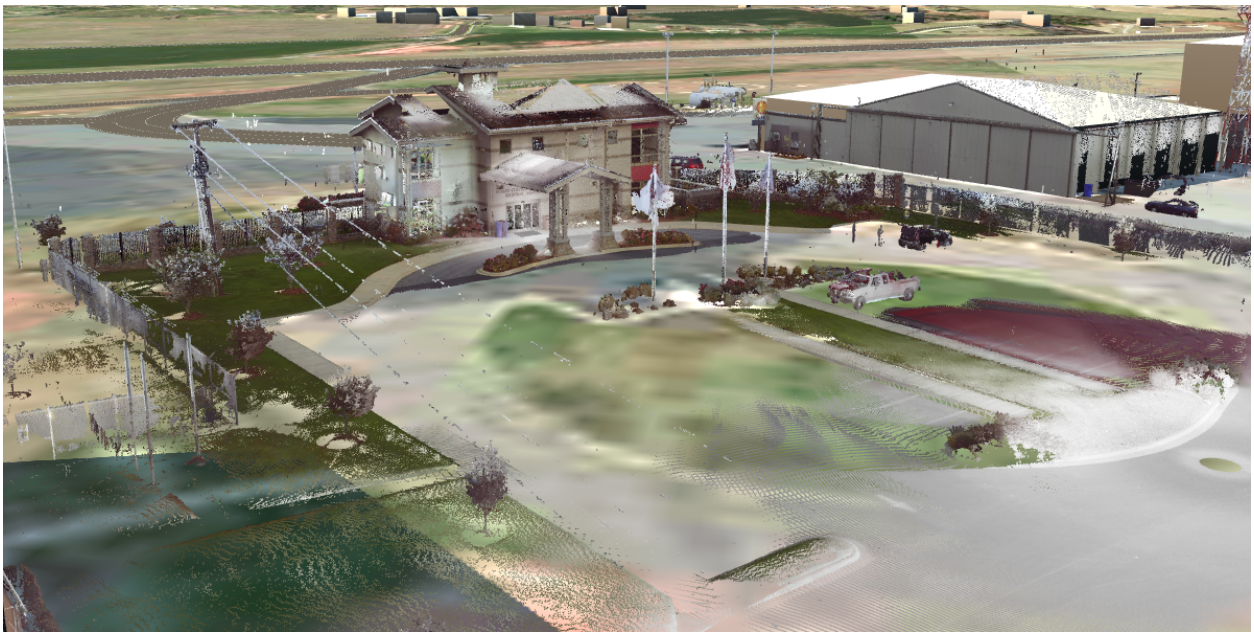


Figure 17: Point Cloud in InfraWorks

Sidenote

Be *very* careful with point clouds, as every time they are imported/updated they are saved to the project folders (.files/resources/point cloud), even after deletion. Go to this folder and delete the point cloud files before bring more in – as an example, the point cloud shown above is 2.5GB an three imports of this adds up.

Conclusion

This workflow process through many different Autodesk applications ensure one thing above all else: validation of design elements before they are passed to the next phase of design. I hope this course has been informative and challenging to your workflow practices and has given you some good take aways for extending your usage of Autodesk applications as they really do introduce a vastly superior design and planning methodology than many are currently utilizing.