

PM122478

Capturing the Reality of Your Facility

Steve Olson
MESA, Inc.

Learning Objectives

- Understand how to import and register scan data in ReCap
- Explore point cloud utilities in AutoCAD, one of which will generate sliced sections of the point cloud
- Explore workflows between ReCap, AutoCAD, AutoCAD Architecture, and Inventor to develop a 3D model of the facility
- Discover how to place and author Assets into the Factory Design Utilities layout

Description

Maintaining an accurate facility layout can be a big challenge. The drawings are normally out of date, and it can be time-consuming to get the measurements and update the drawings. All of these tasks are typically low-priority activities for most companies. Instead capturing the reality of your facility will demonstrate an efficient workflow for going from scans of the facility to a 3D model. The class will demonstrate how you can use ReCap to generate a point cloud of the scan data. Then we'll use point cloud utilities in AutoCAD Architecture to generate sections of the point cloud. Finally, we'll use Factory Design Utilities in Inventor software to locate equipment in the facility.

Speaker

Steve Olson is the Manager of Training Services at MESA Inc., a professional services company and Autodesk Reseller serving Western Pennsylvania, Ohio, and beyond. He has over 12 years of experience with a variety of Autodesk products, which include Inventor, Fusion 360, Vault, AutoCAD, AutoCAD Civil 3D, InfraWorks, ReCap, and more. Steve gained industry experience during his 5 years as a draftsman and Vault administrator for Fleetwood Folding Trailers, a manufacturer of RVs. At MESA, Steve teaches classes, develops and runs training programs, supports Autodesk products, and consults with customers regarding their use of Autodesk products. He is an Autodesk Certified Instructor and Inventor Certified Professional. Since 2015, he has been serving as a member of the Autodesk Authorized Training Center Leadership Council. Steve has spoken at AU and MESA sponsored Events. He contributes course content to 3DTraining.com and operates the It's A CAD World blog and YouTube Channel.



Factory Design Utilities and ReCap

Several years ago, Autodesk introduced the Factory Design Suites. The main focus of this suite of products was to give customers a set of tools to help them model their facility and analyze product and material flows through the factory. These have since evolved into the Factory Design Utilities included in the Product Design and Manufacturing Industry Collection. The most common use of the Factory Design Utilities is to use AutoCAD and Inventor together to model and place factory assets in either a 2D or 3D design environment.

A more recent addition to the Autodesk portfolio, and more specifically, the Product Design and Manufacturing Industry Collection is ReCap Pro. ReCap Pro will take scan data and build a 3D point cloud. This ability, when added to the Factory Design Utilities, greatly improves the capacity of all these products to capture the current state of your facility and build 2D and 3D representations of your manufacturing environment.

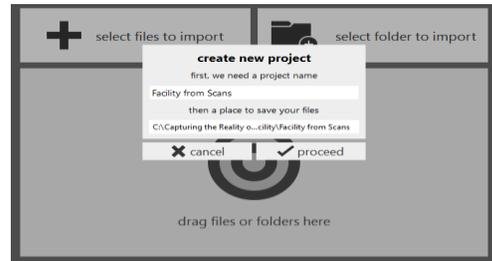
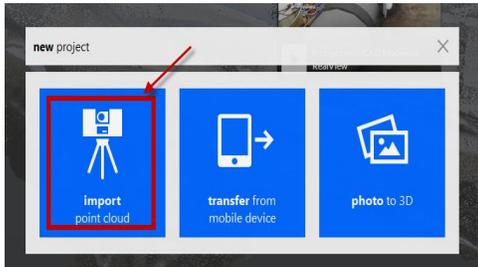
This course will focus on the scan-to-3D model workflow, after the scans have been taken. The following is a high-level overview of the process:

- Build a ReCap model by importing the scans
 - Set the model origin
 - Assign points to Regions
- Start a new layout in Inventor
 - Place the facility point cloud
 - Place Assets in the layout
 - Standard
 - Custom
- Open the layout in AutoCAD Architecture
 - Edit or place Assets
 - Extract Sections
 - Extract point and edges
 - Create Architectural elements
 - Walls
 - Columns
 - Doors
 - Windows

ReCap Pro

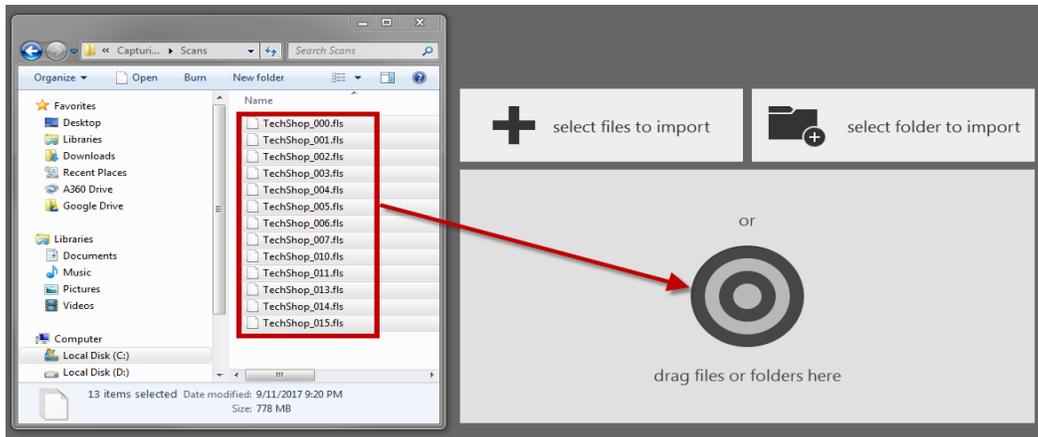
ReCap Pro is where individual scans will be combined to make a point cloud of the entire facility. The following is a walkthrough of the process.

1. Create a ReCap Scan project

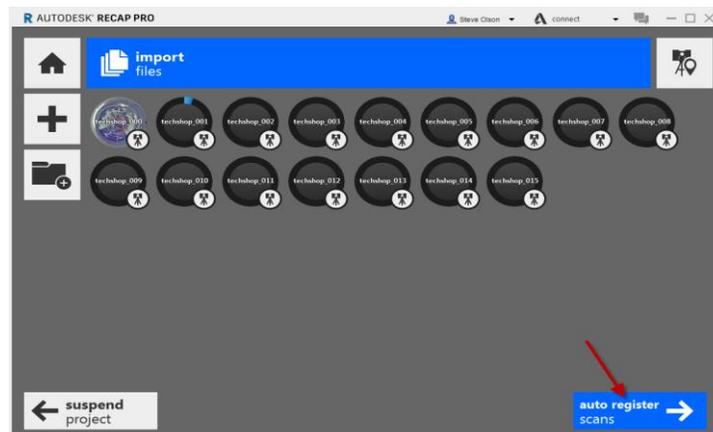


2. Import Scans

This can be done by browsing to the scans or dragging and dropping them into ReCap

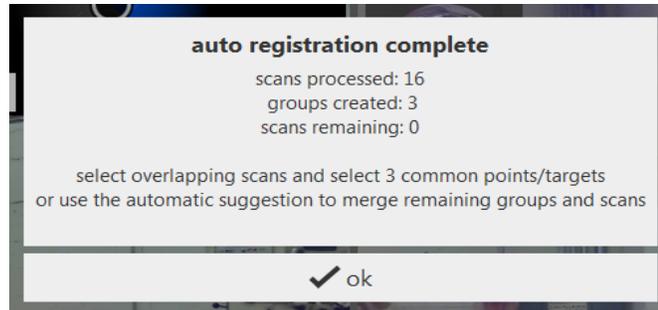


3. Users are then able to allow ReCap to Auto Register or Manually Register the Scans

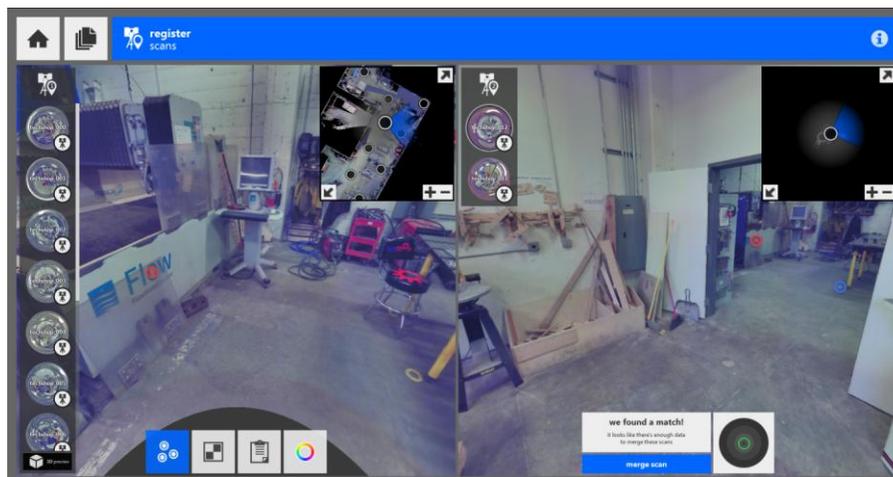


Note:

In some cases, the software will not be able to Auto Register the scan data.



In those cases, the user can pick 3 common points in two scans. As the user is picking points, the software is working to merge the scan into the project. It is recommended that the user pick points on separate planes. However, it is not necessary to have the exact point. The software is smart enough to recognize the association as long as the points are close. Below is an example of ReCap's manual registration workflow.

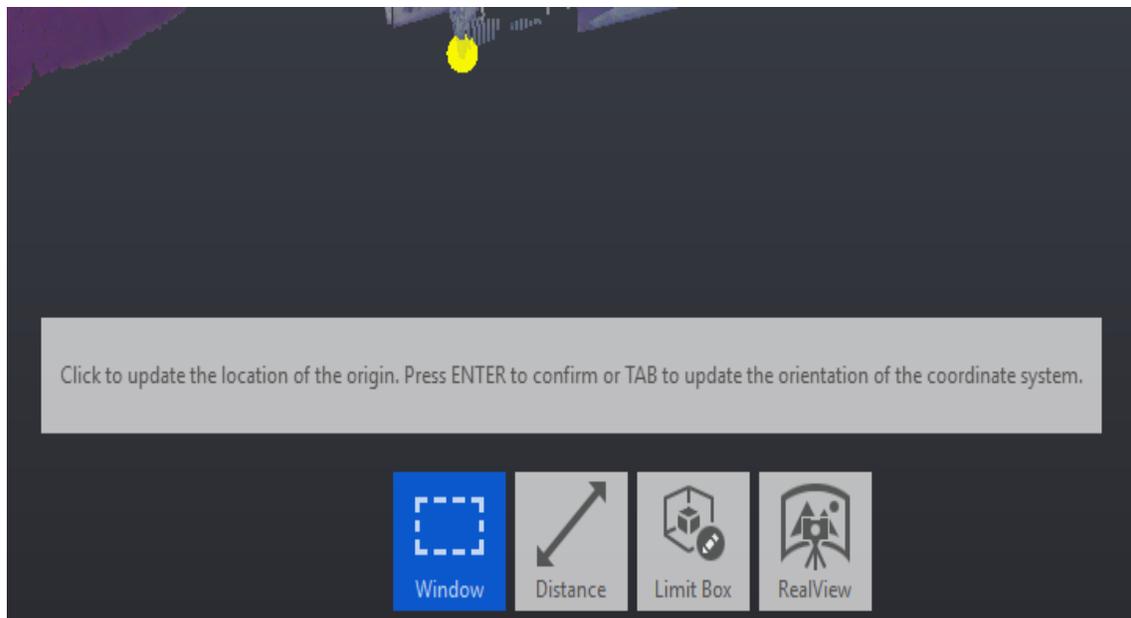
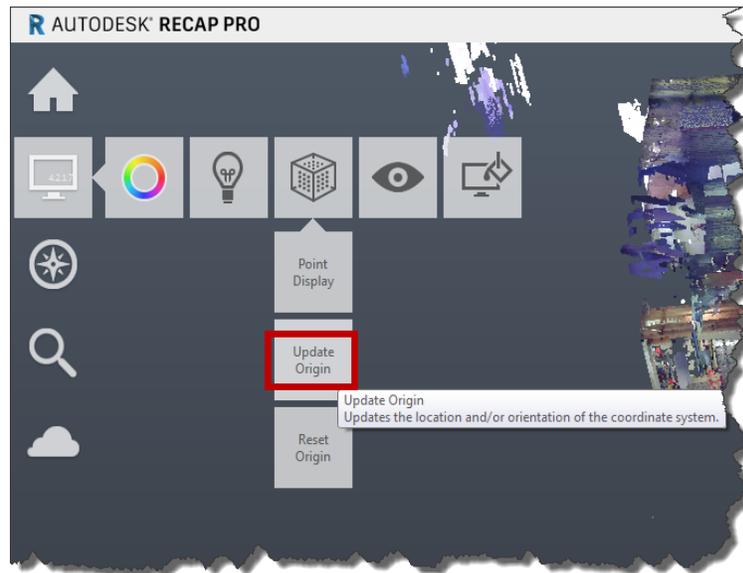


After all the scans are registered, ReCap can display or export a report of the accuracy of the model based on overlap of the scans.

4. Set the point cloud origin

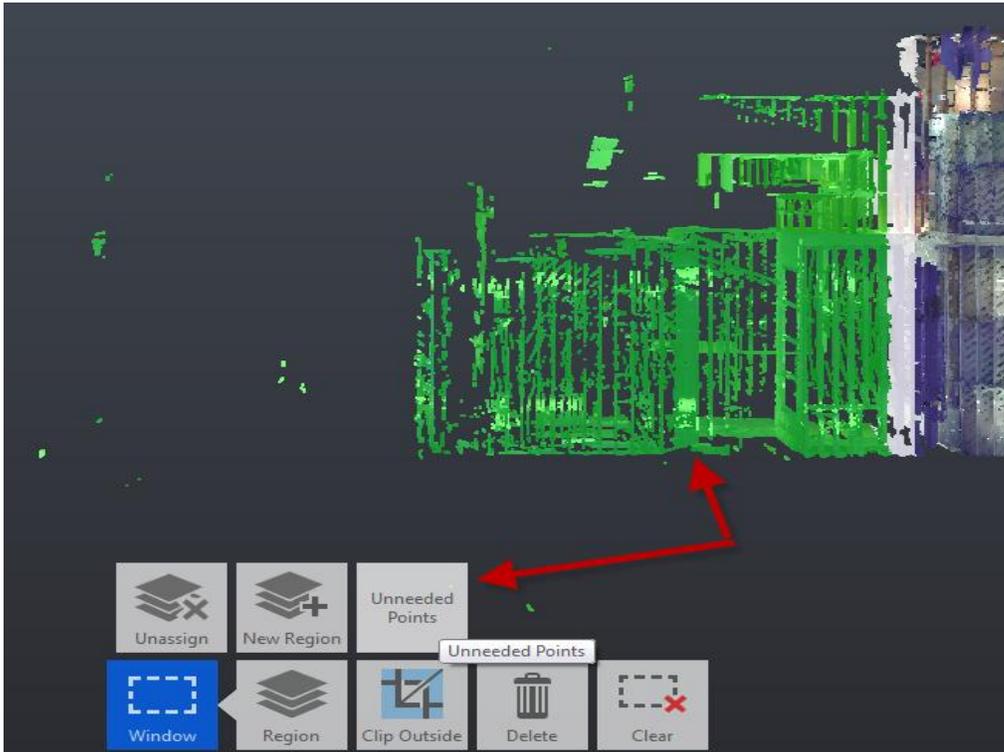
Typically the origin of a point cloud, from scans, will be the position of the first scan. With Inventor and AutoCAD, it will be helpful for the origin to be at a different location.

To set the origin, pick the command from the menu. Then select a point. ReCap will have prompts at the bottom of the screen specifying how to accept the input, or further define the origin with additional selections.



5. Set up Scan Regions

Scan Regions are used to classify points into regions, or classes, of similar points. For example, the scan will likely include points that are unwanted or unneeded. By putting those points into a region named “Unneeded Points” ReCap can then control the visibility of those points as a group. These same regions are also controllable downstream in Inventor and AutoCAD Architecture.



With this data set, it would make sense to have the following regions

- Area of Interest (or Facility)
- Ceiling
- Unwanted Points
- Table (or a specific object I want to recreate)

It is also worth noting that a point can be only in one region. Alternatively, some users would rather delete the unwanted points. That works well too.

This is the end of ReCap's portion to this work flow. Its main purposes are creating the point cloud, setting the origin to a desirable location, and classifying the points for ease of use downstream.

Inventor

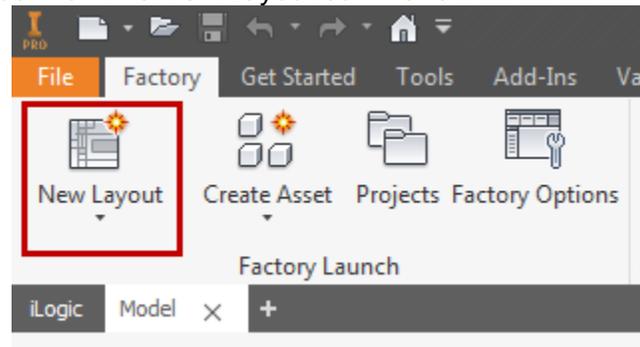
The next step is really up to the user. The Factory Design Utilities will allow the user to start their design in AutoCAD Architecture or Inventor. As the model progresses, the Factory Design Utilities will coordinate the files between the two pieces of software.

So the next step is just a matter of what you want to do next and what you feel more comfortable doing. In this case, Inventor will be the next step.

In Inventor, the facility layout is started. Inventor can place the ReCap point cloud and facility assets from the Factory Design Utilities Libraries. Inventor can also create Work Planes and

Points from the point cloud, which can be helpful when trying to reverse engineer assets captured in the point cloud.

1. Set the appropriate Inventor Project file
2. Start a new layout from the New Layout command

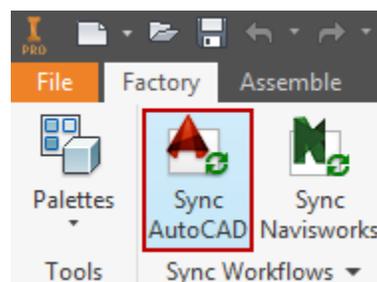


3. Save the new layout
4. Insert the Point Cloud using the Attach command from the Point Cloud panel



This will require browsing to and selecting either an RCP or RCS, depending on what format the point cloud was saved in. After the file is selected, the user has to click to place the point cloud. Then Inventor will ask the user to confirm its location. In that dialog, there is an option to insert the point cloud at the origin. This is recommended so that there is a common origin between the different models. Also, ReCap and Navisworks have a connection for collaboration, which will work best if the Inventor model has the same origin as the ReCap model.

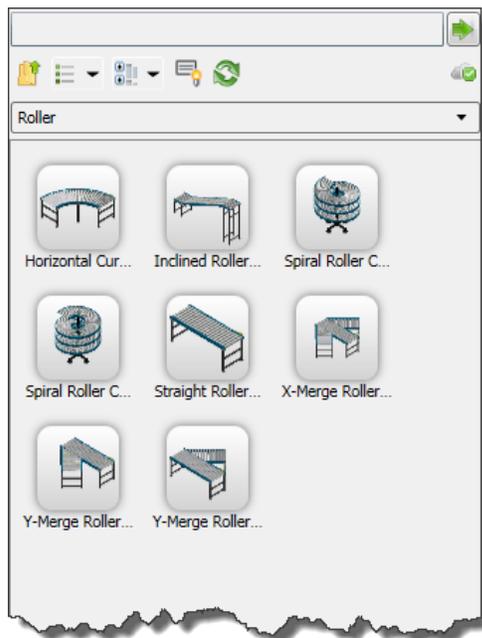
5. To generate the AutoCAD file associated to this layout use the Sync AutoCAD command



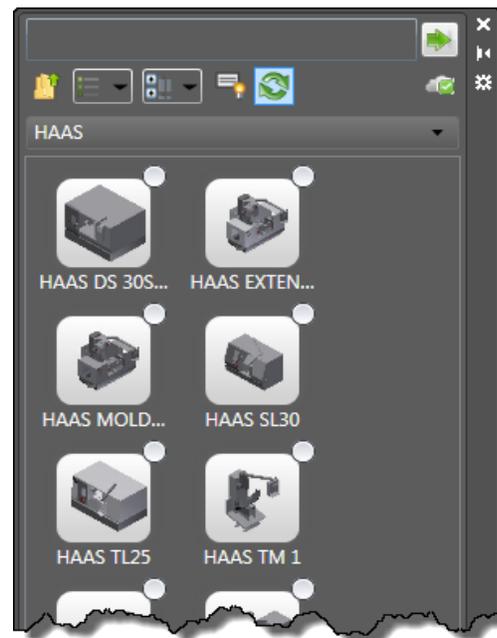
Inserting Factory Assets

Factory Design Utilities allow for two types of assets to be inserted into the layout; System and User. System Assets are either preloaded or downloadable assets that can be placed. Most of these assets are parameter driven to, which users a wider variety of assets without increasing quantity of files the user could need to download. User Assets give users the option to model and author their own custom assets. Most assets will have a 2D representation for AutoCAD workflows and a model for 3D workflows.

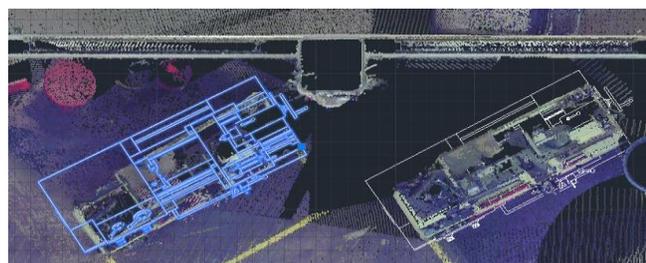
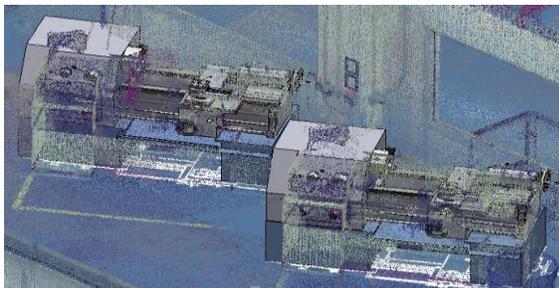
Inventor



AutoCAD



Placing the assets can be accomplished by dragging the desired item into the model and then following the prompts to locate them. Assets will have a ground definition to help them land on the correct model surface. If the model is parameter driven, the Factory Properties will give the user access to those values. The key difference between the two workflows is that AutoCAD will place a 2D block that is associated with the 3D asset and Inventor will place a 3D model of the asset. Some of the real magic to this workflow is that after syncing the products together, both products will show the asset in the proper location, using either the 2D or 3D representations.



Creating Customized Factory Assets

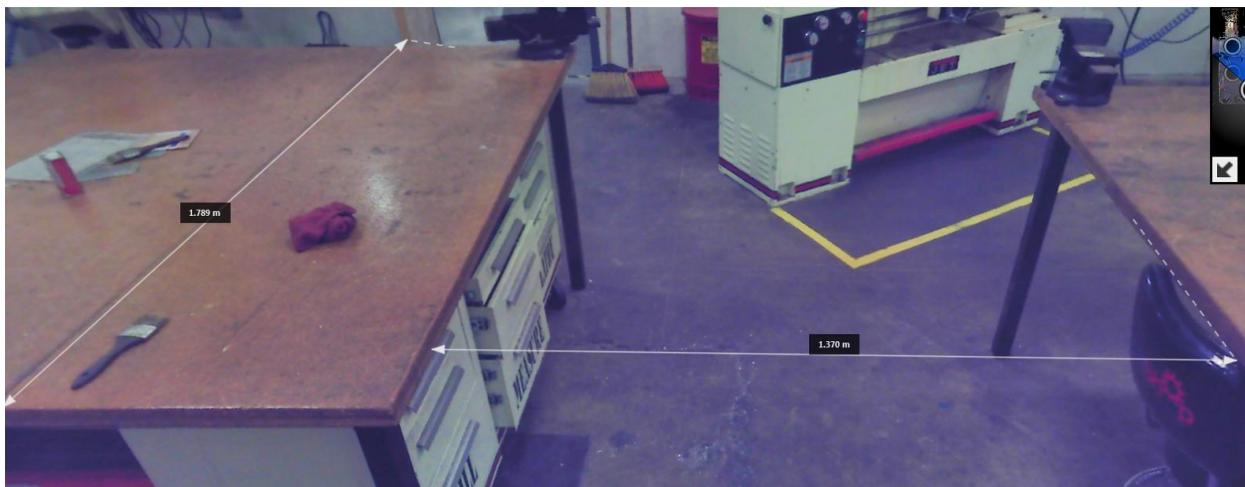
The process for creating customized Factory Assets is really as easy as modeling the object and then running the model through an authoring process. The process can be done in either Inventor or AutoCAD. It is recommended that every custom asset contain a 2D representation for AutoCAD, and Inventor can even create that representation if necessary.

One of the biggest burdens of modeling the customized assets can be getting the measurements. ReCap goes a long way to alleviate that burden because those same measurements can be obtained from the ReCap point cloud or associated scans.

ReCap has a measurement tool that is capable of different types of dimensions. One issue that some users dislike about measuring in ReCap is that in many dimensioning scenarios, the selection is based on points to the cloud. So they feel a level of uncertainty that they are truly getting a point on the edge.

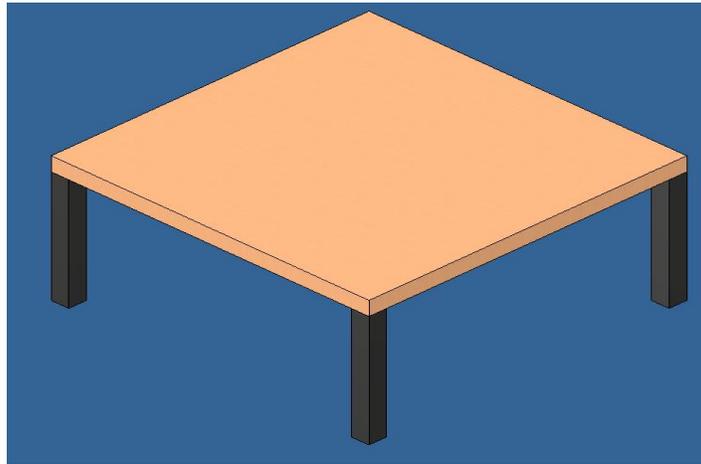


Using Real View, ReCap will display an actual scan. Measurements can be taken in this environment as well.

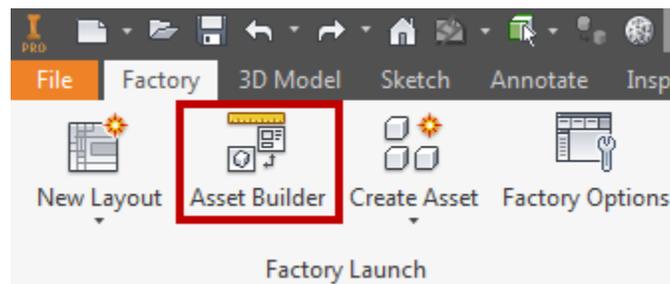


Once the measurements are taken, it is just a matter of modeling the asset, using normal Inventor techniques.

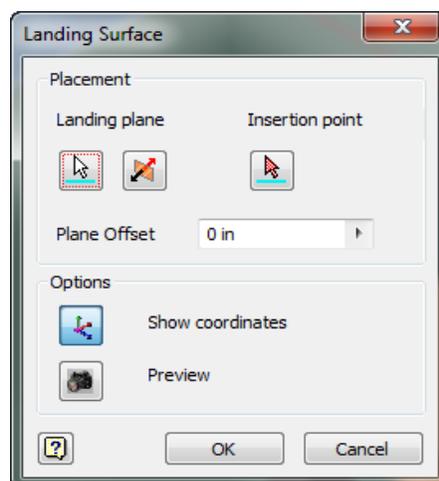
1. Start a model from a standard Inventor Template
2. Model the asset using sketches and standard features



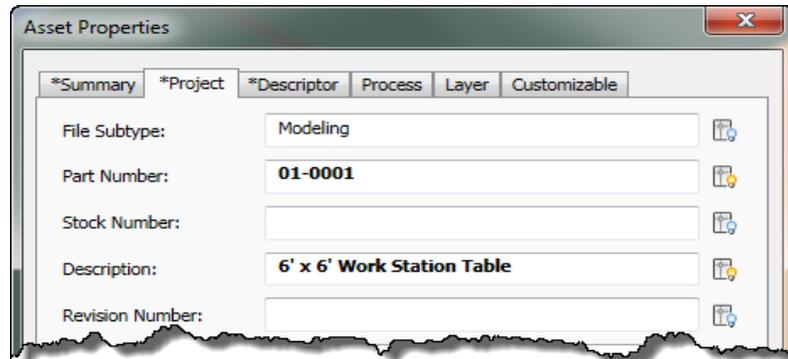
3. From the Factory Tab, launch the Asset Builder



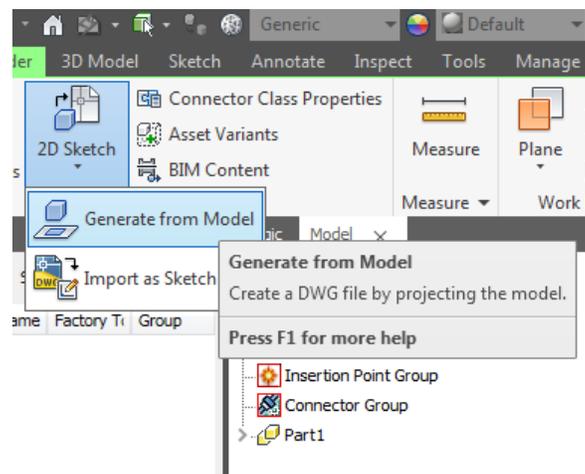
4. Define the Landing Surface, so Inventor will place the asset on the ground



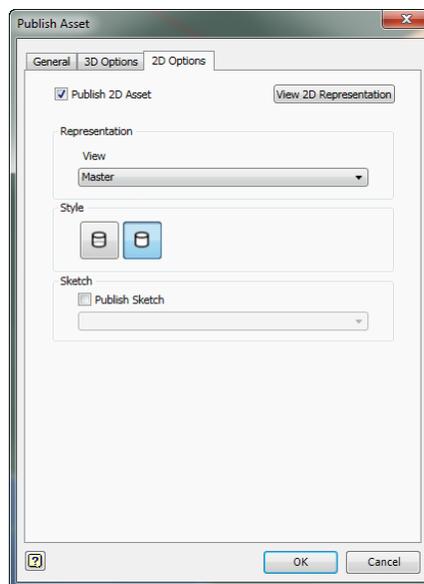
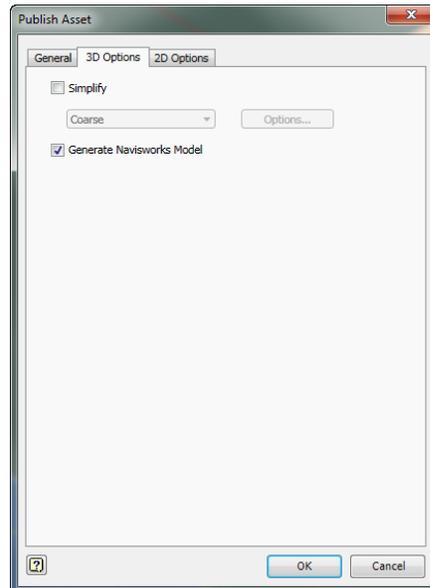
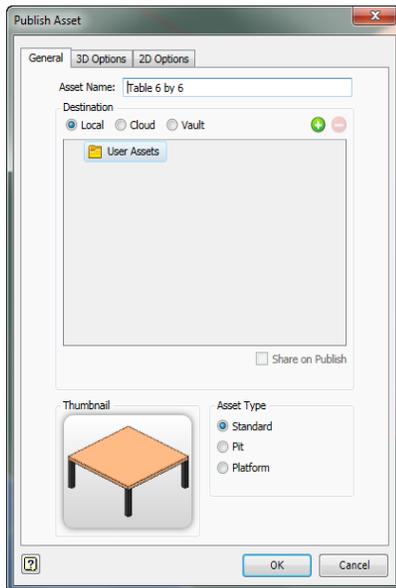
5. Set the Asset Properties



6. Since each asset should contain a 2D representation for working in AutoCAD, it can be drawn or generated from the 3D model. Start the Generate from Model command



7. Inventor will prompt for a name of the DWG it will save the representation as
8. Launch Publish Asset
 - a. General Tab will ask for a name and a Publish location
 - i. The Publish location can be default location on the C drive or a Library location from the Inventor Project
 - b. The 3D Options tab allows you to choose to publish a simplified version of the model and to Generate the Navisworks model
 - c. The 2D Options tab allows users to publish the 2D Asset as well and control the representation used



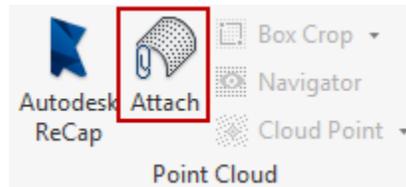
9. Finish Publish Asset
10. Finish Asset Builder

Reverse Engineering Items from the Point Cloud

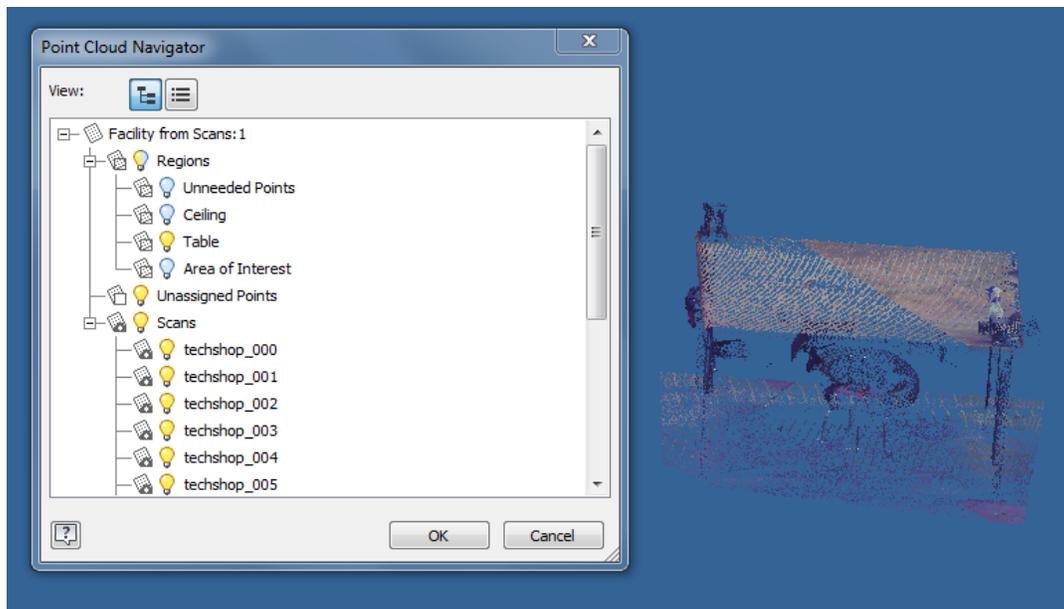
Inventor and AutoCAD provide tools for extracting geometry from point clouds. So it is possible to reverse engineer assets captured in the point cloud. When creating regions in the ReCap model, it is helpful to create regions that show just that asset.

The steps below demonstrate recreating a work table from the scans in Inventor. This model then could be published as an asset. It is worth noting that a scan region of the table was created when in ReCap.

1. Start a new model from a standard part template
2. Use the Attach command to import the point cloud



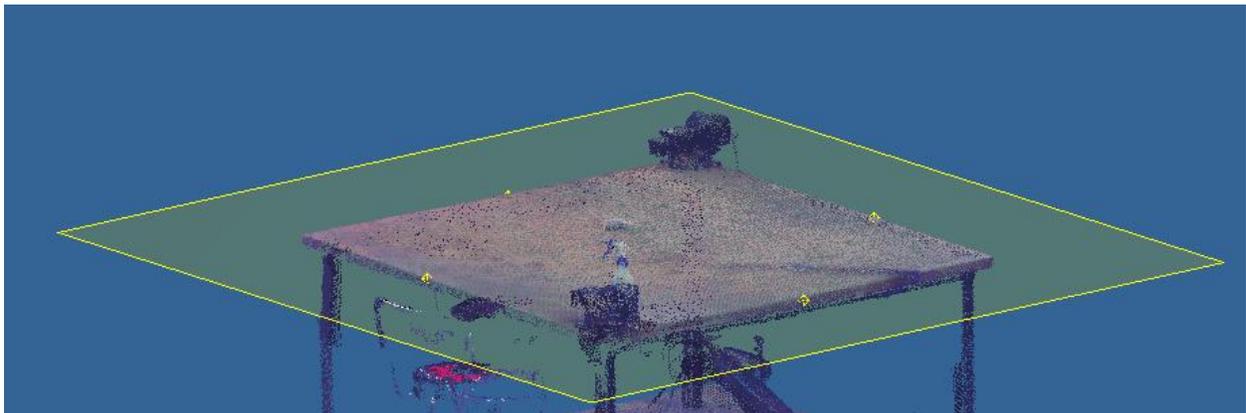
3. Locate the Point Cloud as desired
4. Using the Point Cloud Navigator, it is possible to turn off or on certain regions



Once the point cloud is placed, Inventor has the Cloud Point and Cloud Plane commands for extracting geometry from the cloud. The Cloud Point command creates a Work Point at a Cloud Point location. The Cloud Plane command reads all the points in certain regions of the point cloud and creates a Work Plane from reading trends of the points in that area.

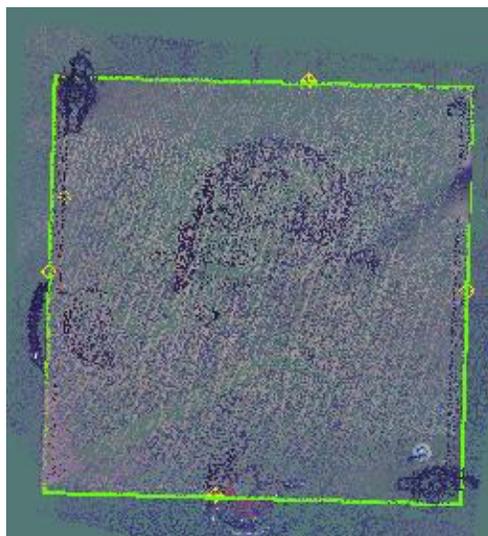


This image shows points created from the Cloud Point Command

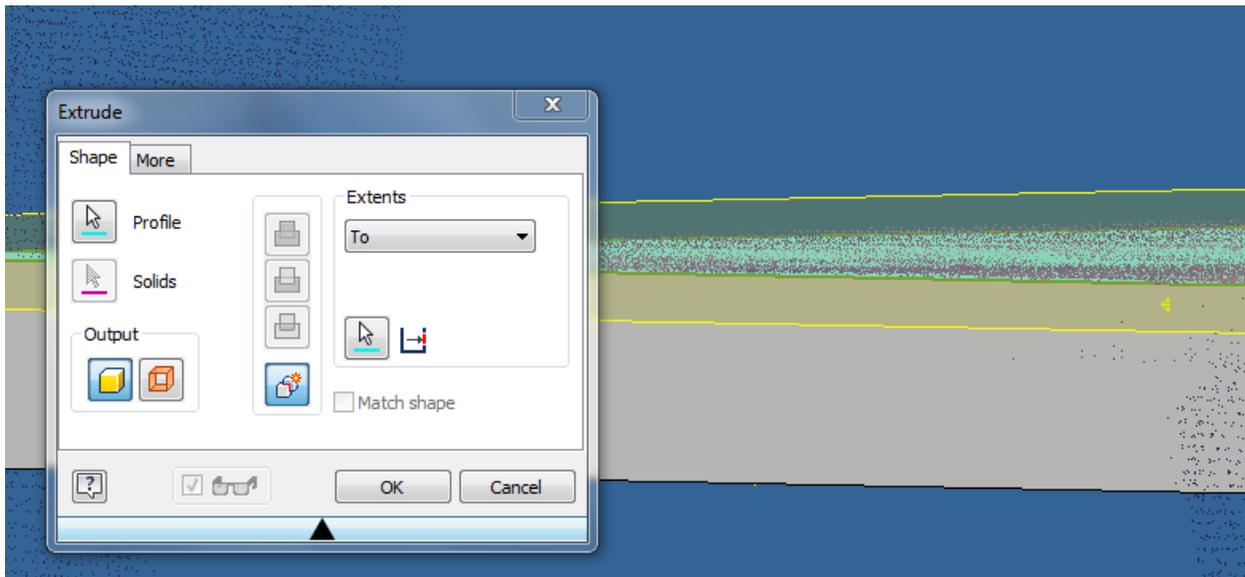
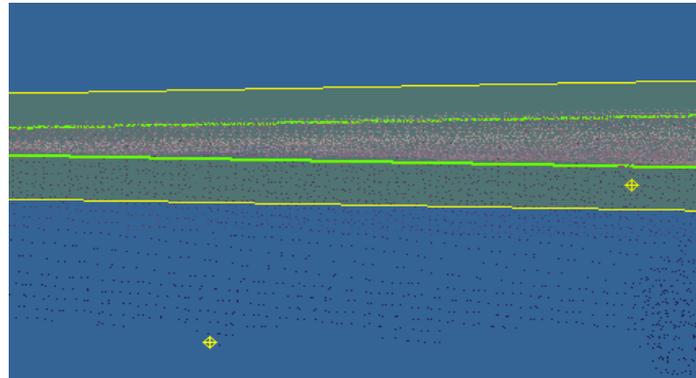


This image shows a Work Plane created from the Cloud Plane Command

In the case of the table, a sketch can be created on the Work Plane that has a rectangle running through the points.

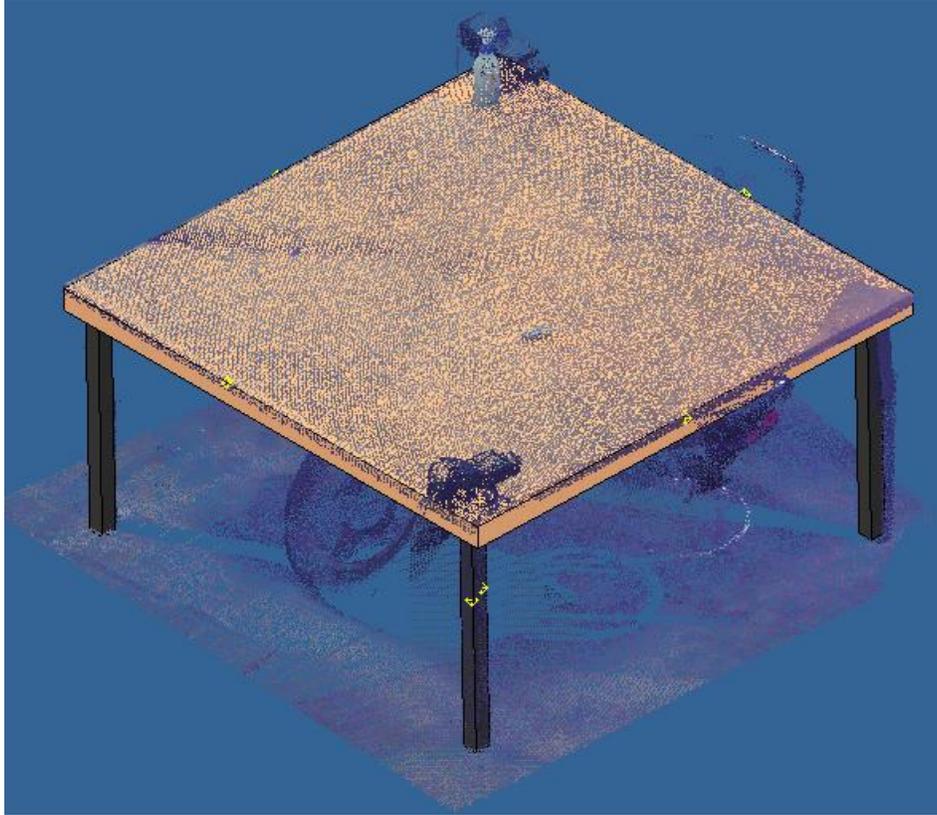


Then another plane or point can be created as the termination of the Extrude feature that will be the table top.



The same process can be repeated to get points from the legs and extrude those.

The Cloud Point and Cloud Plane are the only two commands available in Inventor. It can be tricky to get the right planes and points, but it is possible to get an accurate model from the cloud using these tools.

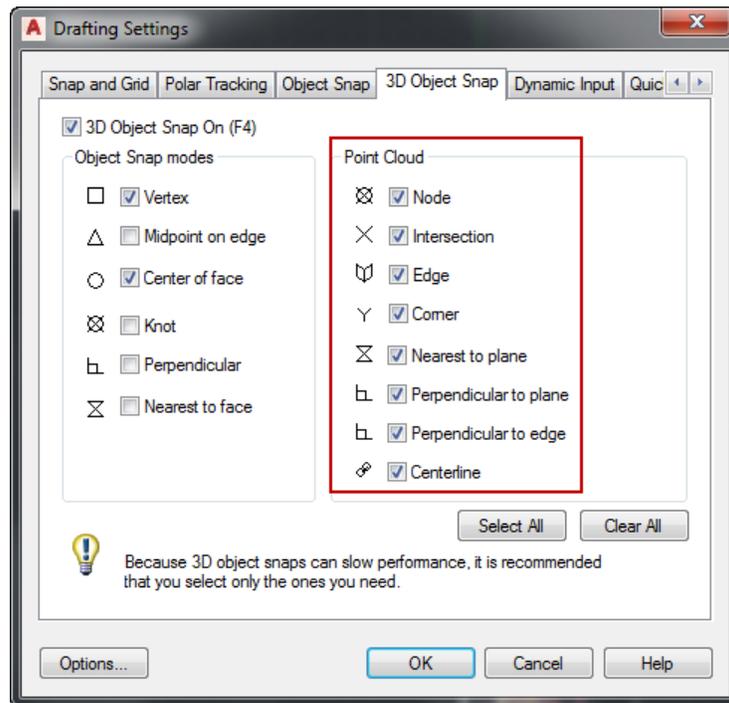


AutoCAD Architecture

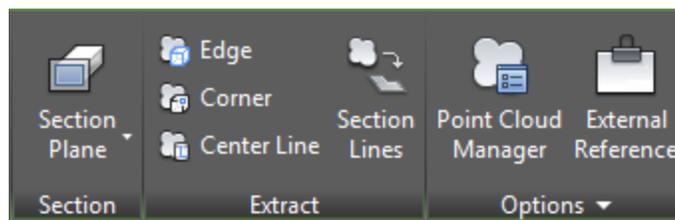
Up to this point, the workflow has been focusing on Inventor; however, AutoCAD could have been where most of the previous steps were taken as well, with a few minor differences. The Factory Design Utilities do have a special role for AutoCAD Architecture; so looking back on all of the references to AutoCAD, they did not specifically mean AutoCAD Architecture. The rest of the workflow is going to focus on adding walls, doors, and windows to the facility, so from here on out, the workflow is going to focus on AutoCAD Architecture.

As long as the Sync AutoCAD command has been run from Inventor, there should be a DWG file that represents the layout of the facility. This file is where are going to start in AutoCAD Architecture.

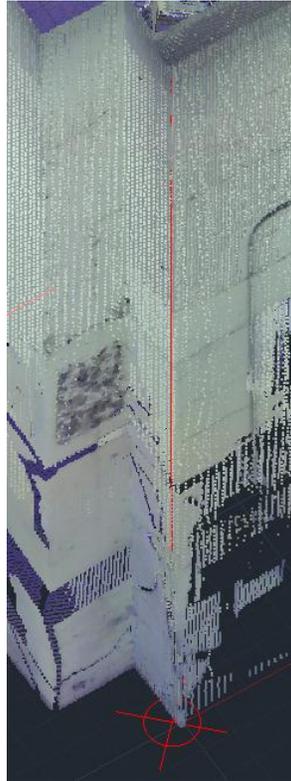
AutoCAD Architecture offers great tools for simplifying the addition of walls, doors, and, windows to the model. When it comes to placing these items, AutoCAD will snap to different points in the cloud if the Point Cloud Object Snaps are enabled.



Since the quantity of points in the model can be so numerous, it can be difficult to snap to the correct point. AutoCAD, just like Inventor, has tools to extract corners and edges from the point cloud. AutoCAD has also added a tool where it can extract geometry from a section.

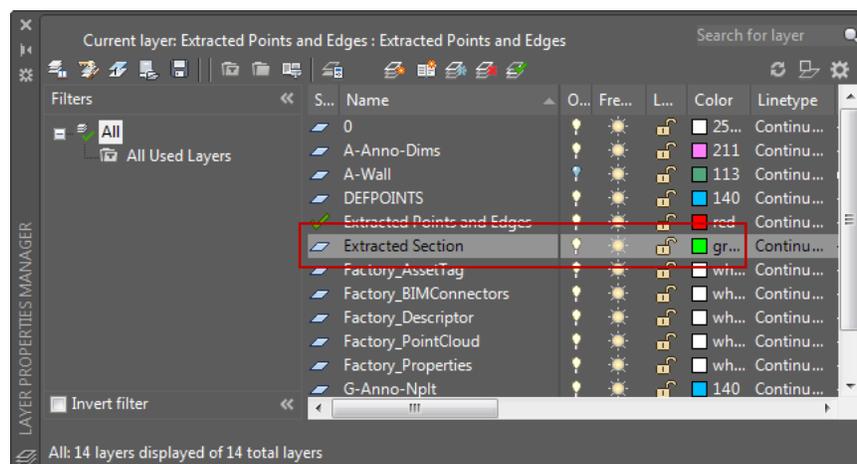


With a point cloud selected, in AutoCAD, the ribbon will change to a Point Cloud contextual tab, shown above. The Edge and Corner commands will create an edge or point based on two or three selection planes, interpolated in the point cloud. It is important to understand that not all point clouds are structured in a way to interpolate the planes. If you have trouble with this, consult with the person that gave you the point cloud. Any extracted geometry will go on the current layer, so you may want to create a layer specifically for extracted geometry.

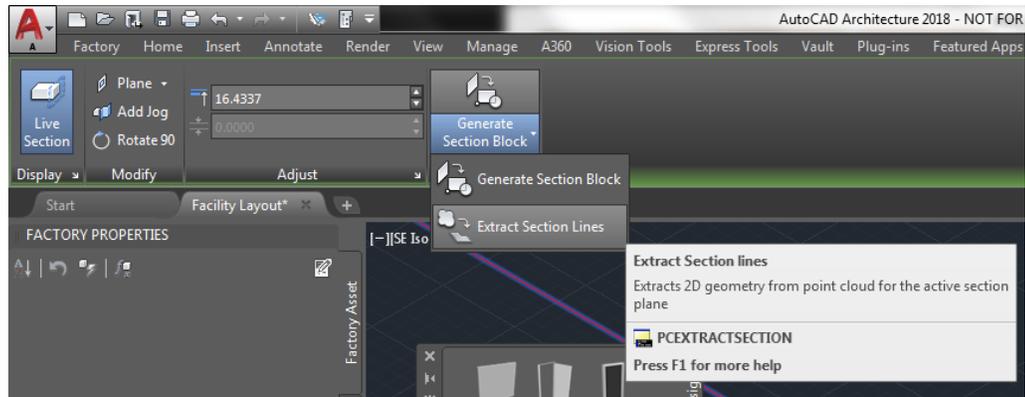


Using the Extract Section Lines Command

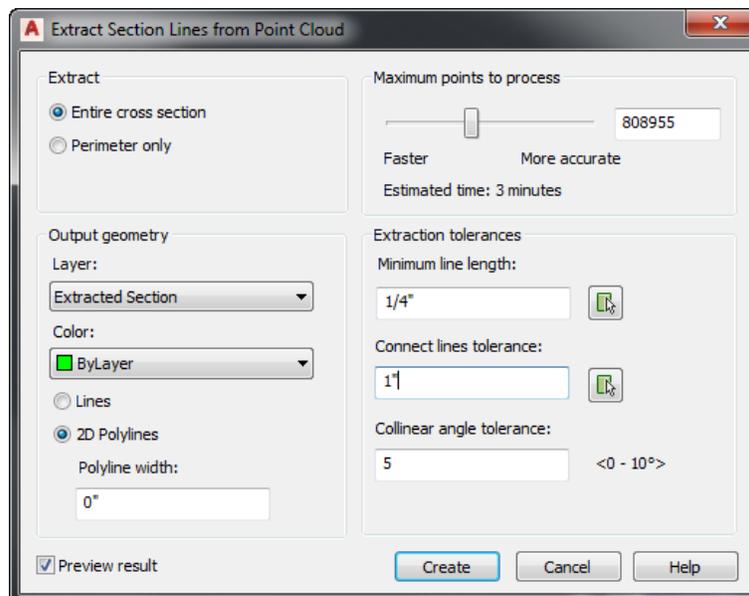
1. Create a Section of the Point Cloud using the Section Plane command from the Point Cloud contextual ribbon
2. Set the elevation of the section
3. Create a layer for the geometry to be extracted to (this is not mandatory, but will help after the extraction)



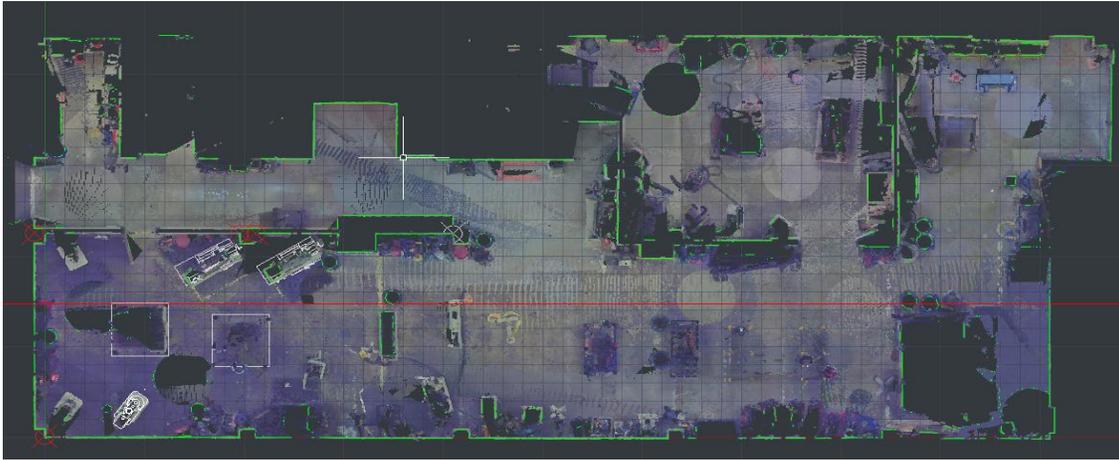
4. Run the Extract Section Lines command from the Section contextual ribbon



5. Select the point cloud to extract lines from
6. Enter the settings for the Extract Section Lines command



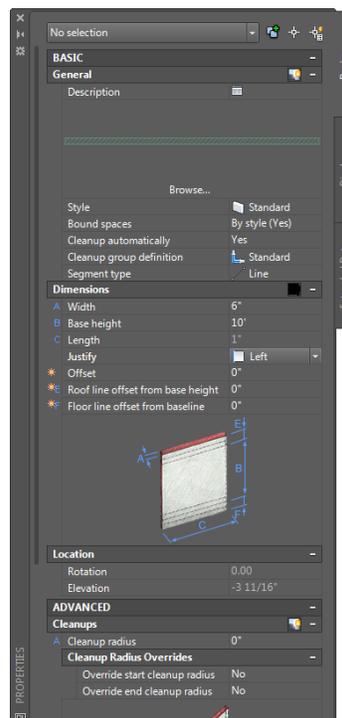
7. Accept the results



Both of these techniques will give great snapping objects when creating the walls and doors. The ability to snap directly to the point cloud can be nice; however, a better outcome seems to come from creating them from extracted points, edges, and section geometry.

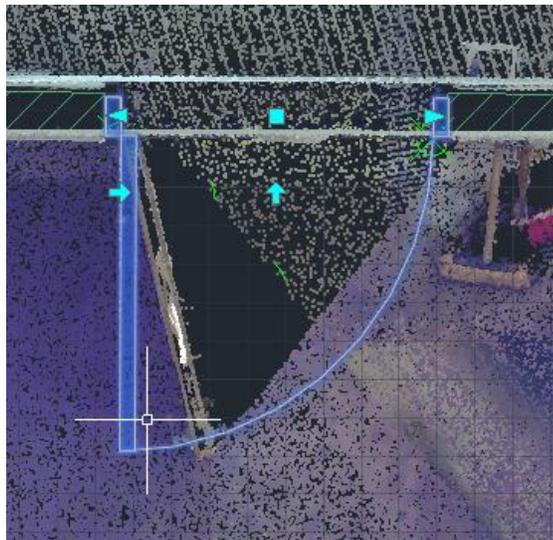
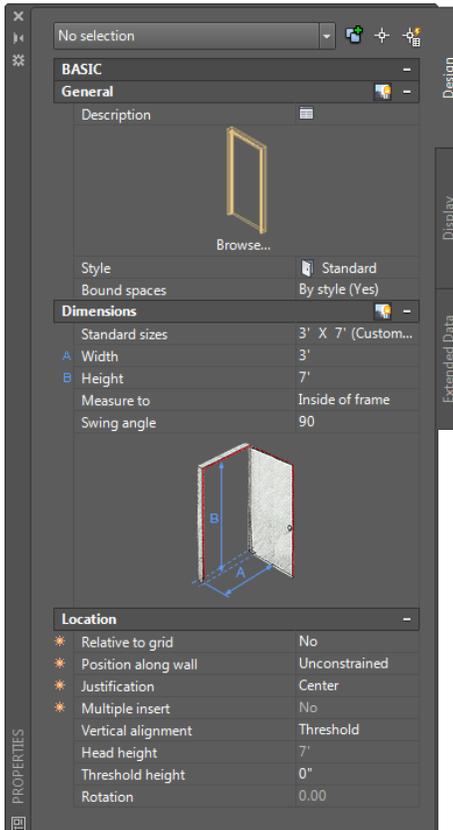
Walls

The process for creating walls in AutoCAD Architecture is as simple as drawing a line. After entering the command, the user can identify which side of the line they are defining and the wall will be placed, left, center, right, or baseline. The Wall Property dialog has several other attributes that should be defined or considered when creating the wall. Other than that, it is simply drawing a line.



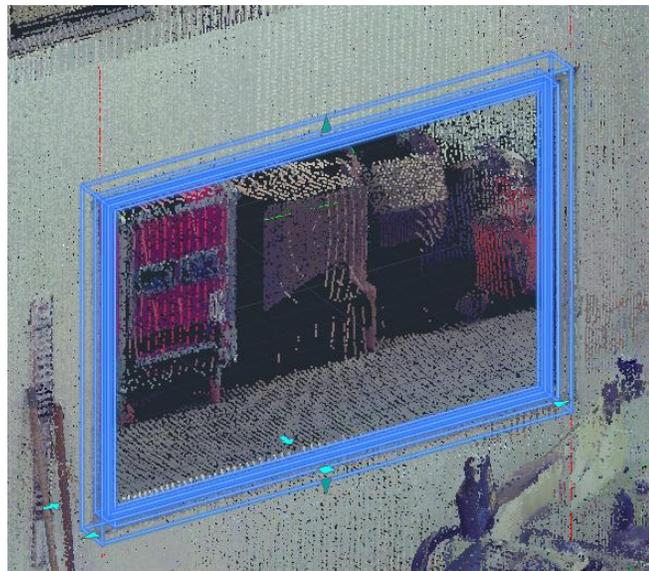
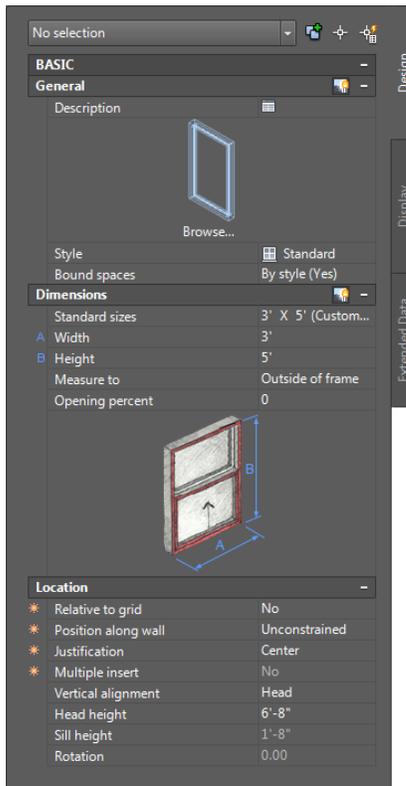
Doors

Creating Doors is similar to walls in that a properties dialog will list several editable attributes for the door, and then it is just a matter of placing the door. Typically this is done with one click inside the wall, at the hinge location. However, doors are a dynamic block, so there are plenty of options to flip the door and resize when placing it.



Windows

Creating Windows is similar to creating doors in that a properties dialog will list several editable attributes for the window, and then it is just a matter of placing the window. Typically this is done with one click inside the wall. However, windows are a dynamic block, so there are plenty of options to resize the window when placing it.



There are plenty of other architectural elements that can be easily added through AutoCAD Architecture, but these are the most common.

ReCap, Inventor, and AutoCAD Architecture really give users a lot of tools to accurately go from scan data to a 3D model, and 2D drawings of any facility. With the ability to leverage downloadable, premade assets or design your own, anything can go into the facility. Then AutoCAD Architecture's tools make it really easy to add the architectural elements to the building. So if leveraged properly, the model of your facility should come together very quickly.