AUTODESK UNIVERSITY 2014

Merging the Model with the Field: 3 Applications for Model-Based Layout and As-Builts

Scott Cloud – Brasfield & Gorrie
Shawn Mancill – Brasfield & Gorrie
Cathi Hayes – Leica Geosystems
Carl Singleton – Leica Geosystems

CO5712: Attend this class to learn about 3 real-life construction projects that utilized Point Layout software in 3 different workflows: as-built documentation, self-perform concrete layout, and a quality assurance application. Beyond the exciting use cases, learn how to add construction layout points from the perspective of a contractor who self-performs concrete. You will learn how to add control points for aligning model data in the office and in the field; add points to Revit families and other components; and sort, filter, and edit points. You will learn how to prepare data for the field inside of Revit software so that data flows efficiently into the Leica MicroSurvey Layout field software that controls the Leica iCON robot. You will also learn how to add as-built points and bring them back into Revit software to assess deviations in the field.

Learning Objectives

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

- Learn how to add project control points in Revit software with Point Layout software
- Learn how to add construction layout points to Revit software families and objects
- Learn how to prepare points data, plan underlays, and reference models for the field
- Learn about as-built points and how to send them back into Revit software efficiently

About the Speakers

Scott Cloud

With over 10 years of experience in the construction industry, Scott Cloud is the director of Virtual Design and Construction (VDC) at Brasfield & Gorrie, LLC, and he oversees the company's Eastern Regions, including offices in Atlanta, Georgia; North Carolina; and Texas. He leads a team of VDC coordinators and works with others throughout Brasfield & Gorrie to implement VDC during early design phases, throughout construction, and for post-construction owner turnover. He has successfully implemented various levels of Building Information Modeling (BIM) on over $2.1 billion worth of work, including healthcare, industrial, commercial, and institutional projects. He also acts as a key member to a select group of employees dedicated to research and development of new construction technology paving the way for future workflows across the company.

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Shawn Mancill

Shawn Mancill works for Brasfield and Gorrie as a VDC Coordinator. His primary role is to implement project specific BIM Execution Plans with a principal emphasis of building systems coordination. He works with project teams including project managers, architects, engineers, and subcontractors to develop and implement Project BEP's as they relate to 4D scheduling, coordination, and model management. In terms of innovation, Shawn consistently strives to be on the forefront of the industry implementing new workflows that provide efficiency throughout design and construction and an overall better quality.

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Cathi Hayes

Cathi Hayes is an architect, building information modeling (BIM) pioneer and strategy leader with more than 20 years of experience developing and implementing workflow improvements in various facets of the building design & construction industry. As BIM business manager for Leica Geosystems, Cathi focuses on helping building contractors achieve greater success in BIM through the adoption of leading-edge solutions for 3D pre-construction as-builting, BIM enabled construction layout and "progressive scanning" for quality assurance. Cathi is a trusted BIM advisor and a leading voice on BIM throughout the North American construction industry. She holds Architecture degrees from North Carolina State University and the University of Kansas.

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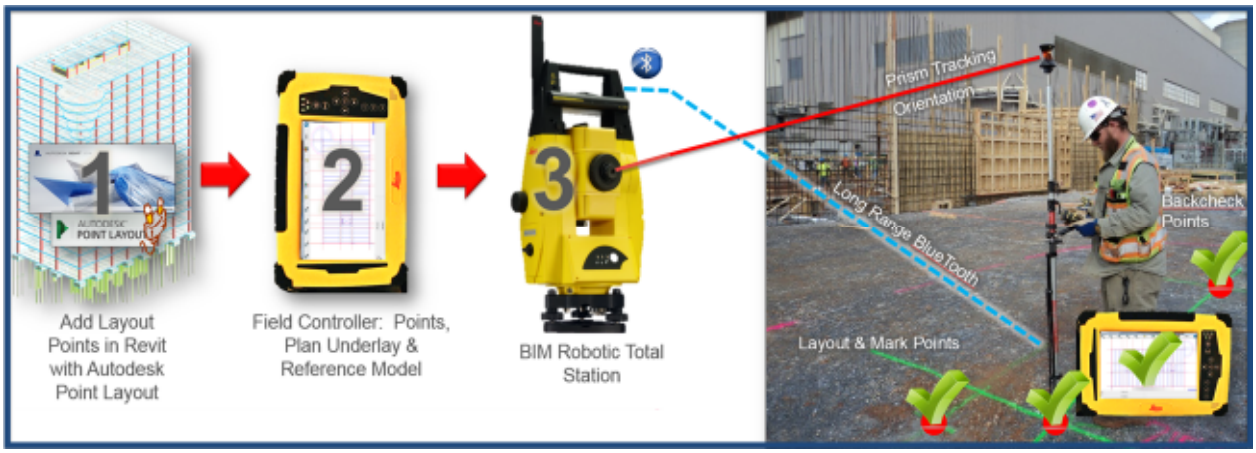
Carl Singleton

Carl Singleton earned his bachelor's degree in Surveying Engineering from Ferris State University and spent several years as a survey crew chief before joining Leica Geosystems in 2004. As a training manager and application engineer, Carl helped professionals learn and understand surveying and construction solutions to maximize efficiency and productivity. Carl is currently Leica Geosystems product marketing manager for Building & Construction in North America, where he focuses on bringing value to the construction process with customizable hardware and software solutions that increase profitability by improving workflows.

Introduction

With the vast number of projects today being developed utilizing Autodesk Revit software from both design and construction professionals, a new workflow for model-based layout is starting to evolve across the industry. Autodesk Point Layout (APL) provides the ability to add points to a Revit file that can be used for layout in the field and for as-built verification. With this tool, a bridge is formed that merges the virtual project model in Revit to the real-life construction project in the field. This is accomplished by placing points in the model, exporting/importing those points to a field controller, also known as a data collector, and laying them out in the field with a total station or comparable piece of surveying equipment. This same process can be repeated in reverse by take existing, or as-built, points from the field and transferring them back in the model.

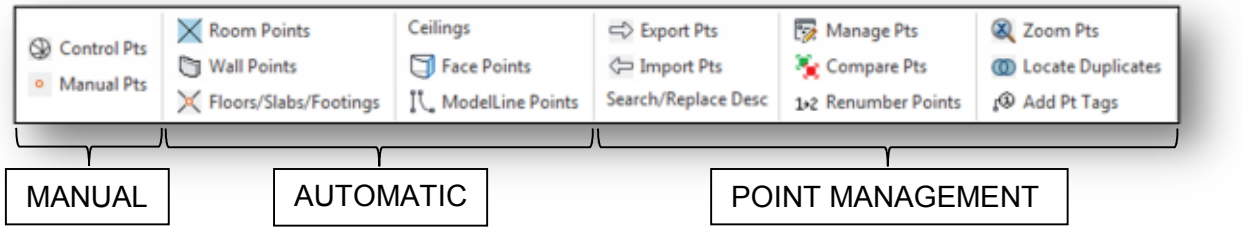
Robotic Construction Layout: 1-2-3



Step 1: Placing Points

There are 3 distinct ways to add points in APL:

1. Manually
2. Automatically
3. Nested within Families



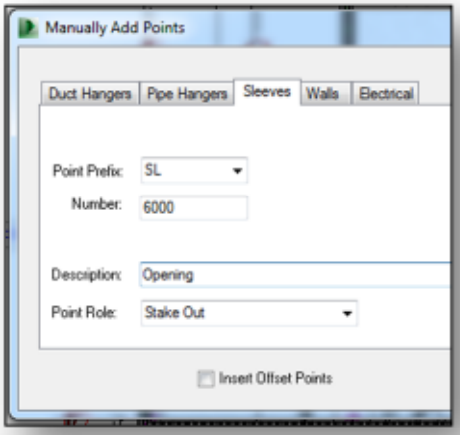
MANUAL POINTS

Control Points:

- Points that you add to your model that also exist in the field
- They "marry" the virtual (model) and reality (the field)
- Used for orientation of total station in the field
- Typically set by surveyors – "survey control"
- Often 5' offsets from column grid
- Can use relative coordinates in Revit or set to field coordinates

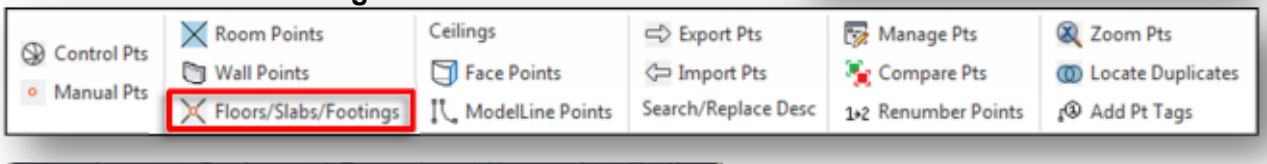
Manual Points:

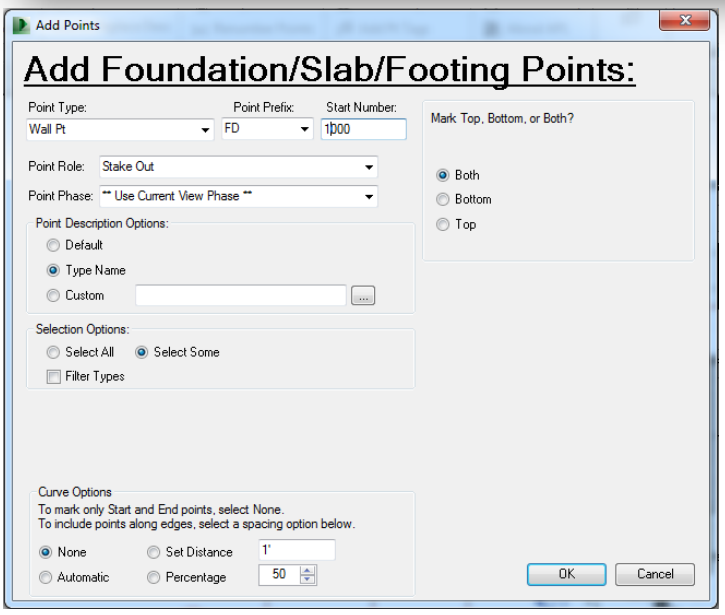
- Points that you add to any Revit "family" or element
- Can add a prefix to help identify the point type
- Can add Description (travels to field)
- Can add point "role" (does not travel to field)



AUTOMATIC POINTS

Foundations/Slab/Footing Points:

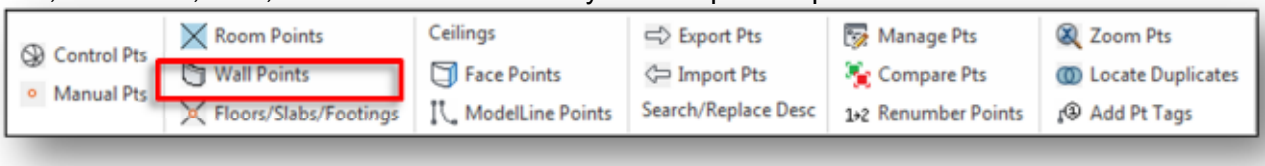


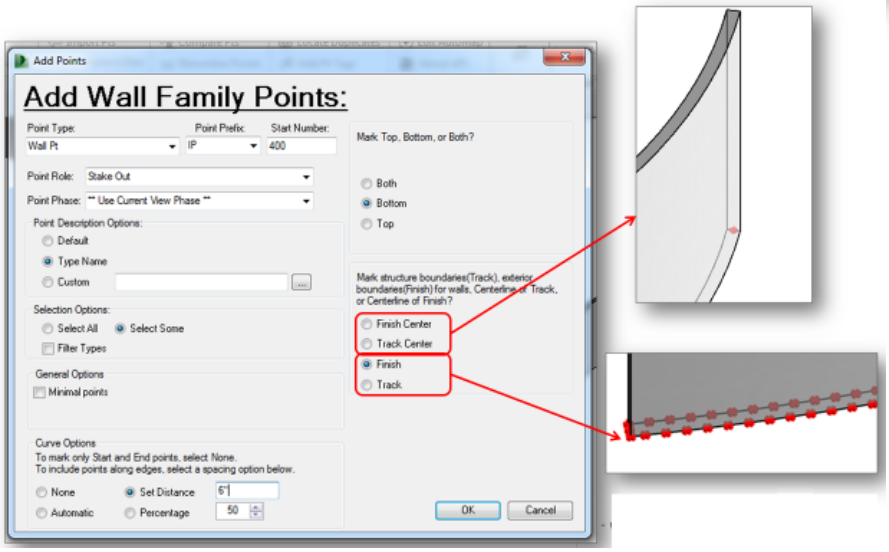


Adding Foundation points automatically is the easiest way to add points to foundation systems. You have multiple options for adding points whether to the TOP, BOTTOM, or BOTH sides of the Footing. You also have the option to add points to specific Revit Types or a custom selection.

Walls:

There are several variables when adding points to walls. Do you want points along the finish face, centerline, core, and at what interval do you want points spaced at?

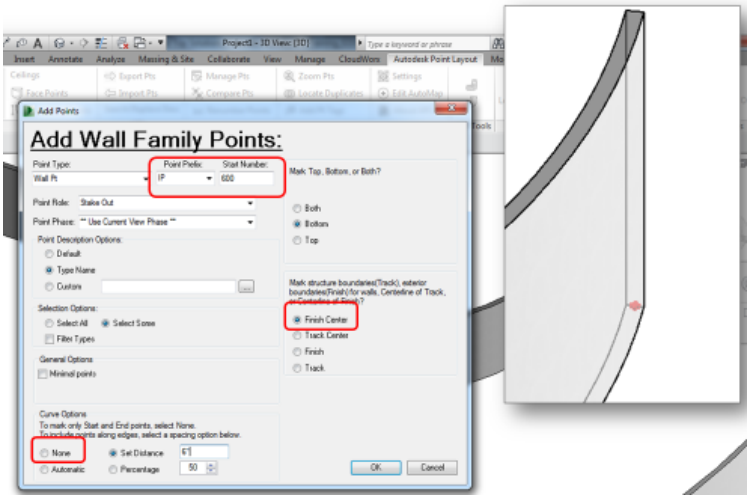




Adding points to walls automatically is based simply on the structure of the wall. The Layout options elected allows you to choose the center of the wall, the track edge for metal studs, or the overall edge of the wall base on the finish. The finish can be edge of Gypsum or concrete face depending on the wall construction.

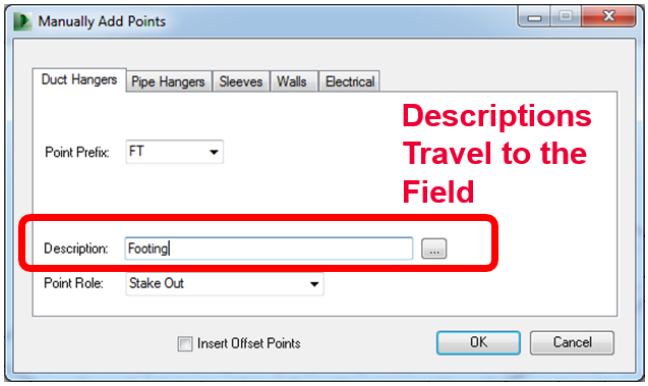
Naming wall points can prove to be critical when transferring information to the field. The point Prefix and the point number are how field engineers identify what they are laying out and often where they are laying out.

Many projects have curved architectural walls or even curved retaining walls. APL give you the option of applying points along a curve at defined intervals.

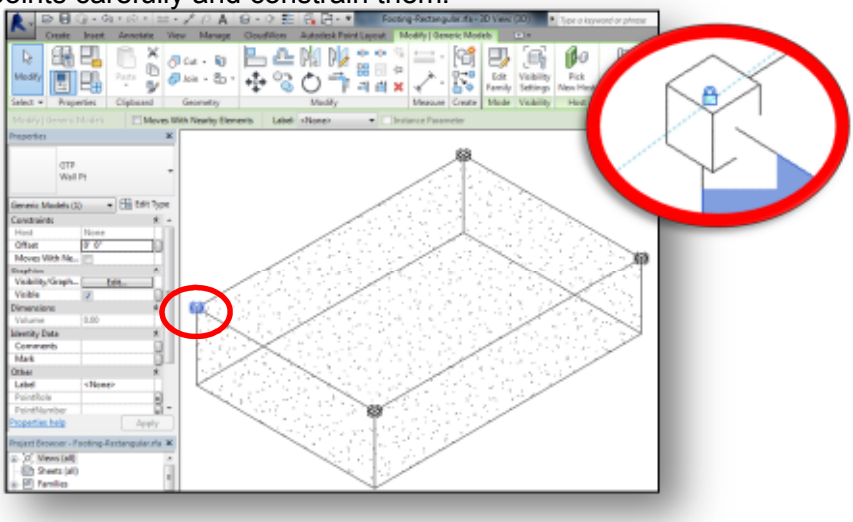


NESTED WITHIN FAMILIES

1. Open family editor to edit the family
2. Manually add points to the family
    a. Make sure the Description is filled out. This travels to the field.
    b. Choose a prefix that makes sense.



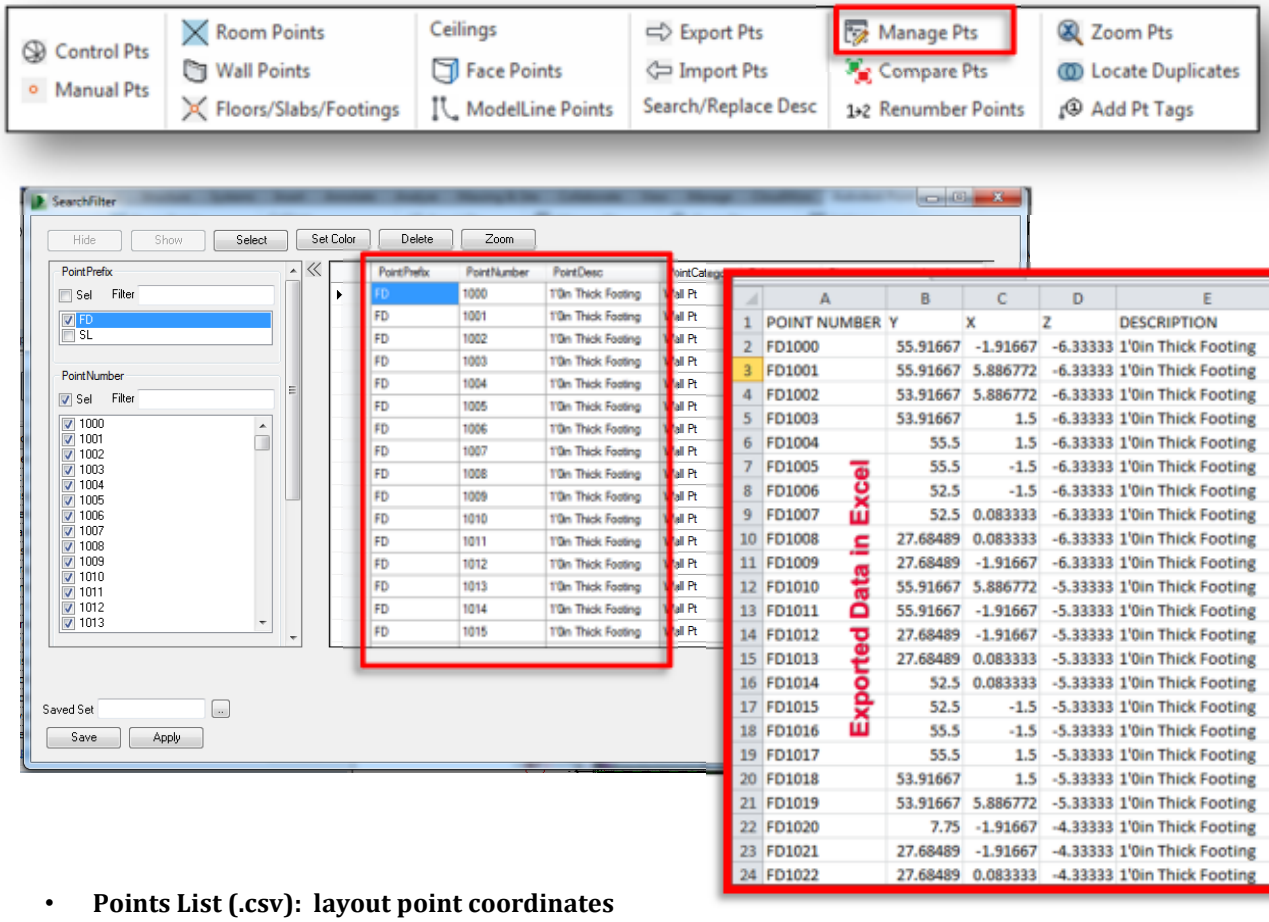
3. Place points carefully and constrain them!



4. Load family into project (overwrite if previously existed)

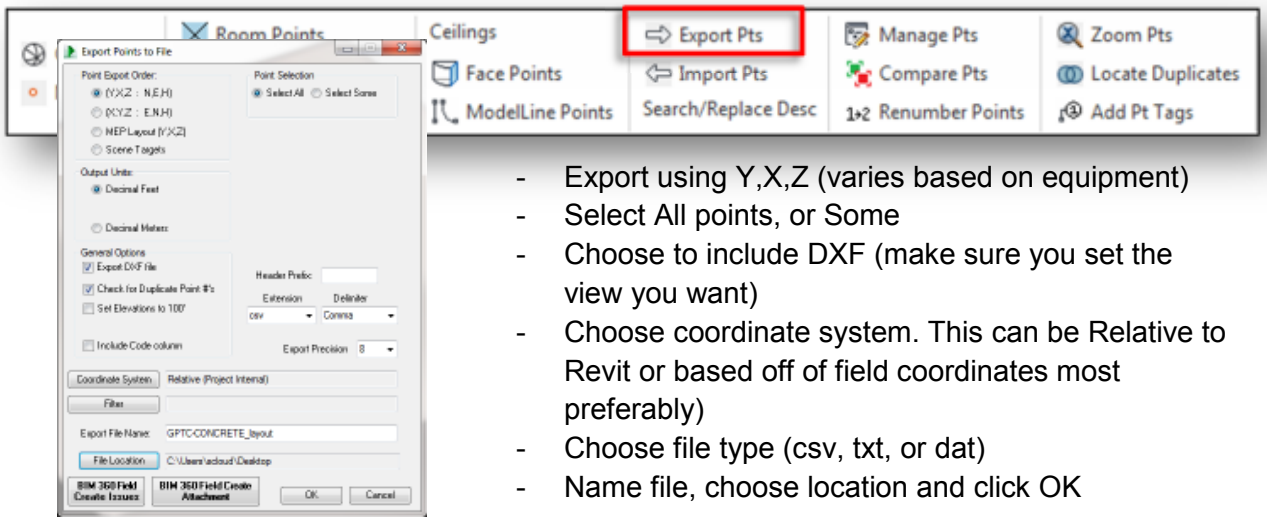
Step 2: Export Points

Exporting points is a simple way to get the information out of the model and to the field to layout. Autodesk Point Layout makes it easy to export data from the model in industry standard data formats for import into the MicroSurvey Layout field layout software. Points are exported in a simple .csv or .txt file. A plan underlay is exported in DXF format. Directly in Revit, you can determine exactly how points will display in the field by setting up a standard library definition that is exported in a .csv format. A reference model can also be exported in the format needed for the model platform in use in the field.



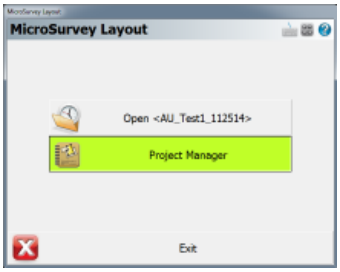
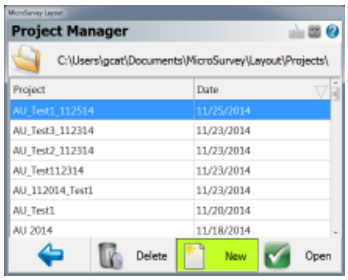
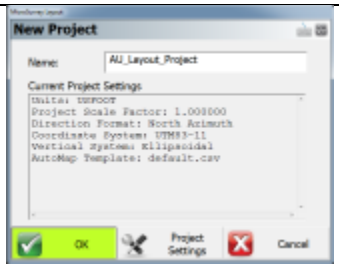
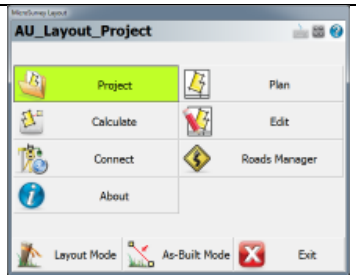
	A	B	C	D	E
1	POINT NUMBER	Y	X	Z	DESCRIPTION
2	FD1000	55.91667	-1.91667	-6.33333	1'0in Thick Footing
3	FD1001	55.91667	5.886772	-6.33333	1'0in Thick Footing
4	FD1002	53.91667	5.886772	-6.33333	1'0in Thick Footing
5	FD1003	53.91667	1.5	-6.33333	1'0in Thick Footing
6	FD1004	55.5	1.5	-6.33333	1'0in Thick Footing
7	FD1005	55.5	-1.5	-6.33333	1'0in Thick Footing
8	FD1006	52.5	-1.5	-6.33333	1'0in Thick Footing
9	FD1007	52.5	0.083333	-6.33333	1'0in Thick Footing
10	FD1008	27.68489	0.083333	-6.33333	1'0in Thick Footing
11	FD1009	27.68489	-1.91667	-6.33333	1'0in Thick Footing
12	FD1010	55.91667	5.886772	-5.33333	1'0in Thick Footing
13	FD1011	55.91667	-1.91667	-5.33333	1'0in Thick Footing
14	FD1012	27.68489	-1.91667	-5.33333	1'0in Thick Footing
15	FD1013	27.68489	0.083333	-5.33333	1'0in Thick Footing
16	FD1014	52.5	0.083333	-5.33333	1'0in Thick Footing
17	FD1015	52.5	-1.5	-5.33333	1'0in Thick Footing
18	FD1016	55.5	-1.5	-5.33333	1'0in Thick Footing
19	FD1017	55.5	1.5	-5.33333	1'0in Thick Footing
20	FD1018	53.91667	1.5	-5.33333	1'0in Thick Footing
21	FD1019	53.91667	5.886772	-5.33333	1'0in Thick Footing
22	FD1020	7.75	-1.91667	-4.33333	1'0in Thick Footing
23	FD1021	27.68489	-1.91667	-4.33333	1'0in Thick Footing
24	FD1022	27.68489	0.083333	-4.33333	1'0in Thick Footing

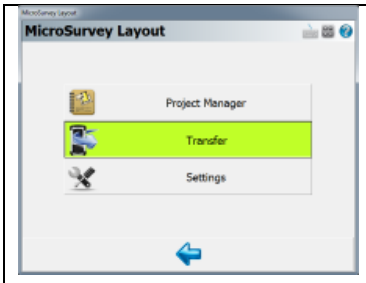
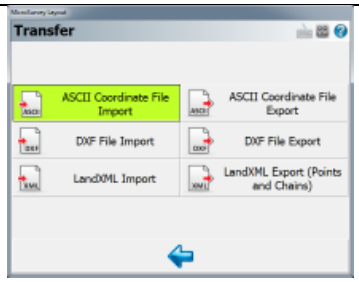
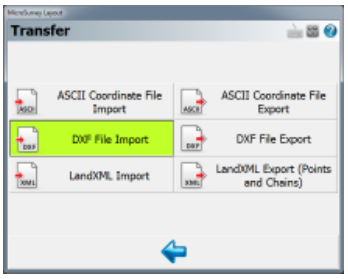
- **Points List (.csv): layout point coordinates**
  Definition file for how points display in field software (.csv)
- **Plan Underlay (.dxf): Plan view to give context to layout points**
- ***Reference Model with Points (.dwf): Building model for viewing points in 3D context**



- Export using Y,X,Z (varies based on equipment)
- Select All points, or Some
- Choose to include DXF (make sure you set the view you want)
- Choose coordinate system. This can be Relative to Revit or based off of field coordinates most preferably)
- Choose file type (csv, txt, or dat)
- Name file, choose location and click OK

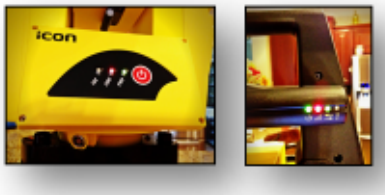
Step 3: Load Points into Data Collector using MiroSurvey Layout

	Create a new project using the project manager		Select New
	Name the new project		Setup the new project

	Prepare to import data from the office using "Transfer"		Import points by using "ASCII Coordinate File Import"
	Import DXF file underlay using the "DXF File Import"		Copy the "default.csv" from the office to the field controller in the same folder structure to utilize the point definitions (color, symbol, layers) created in the office

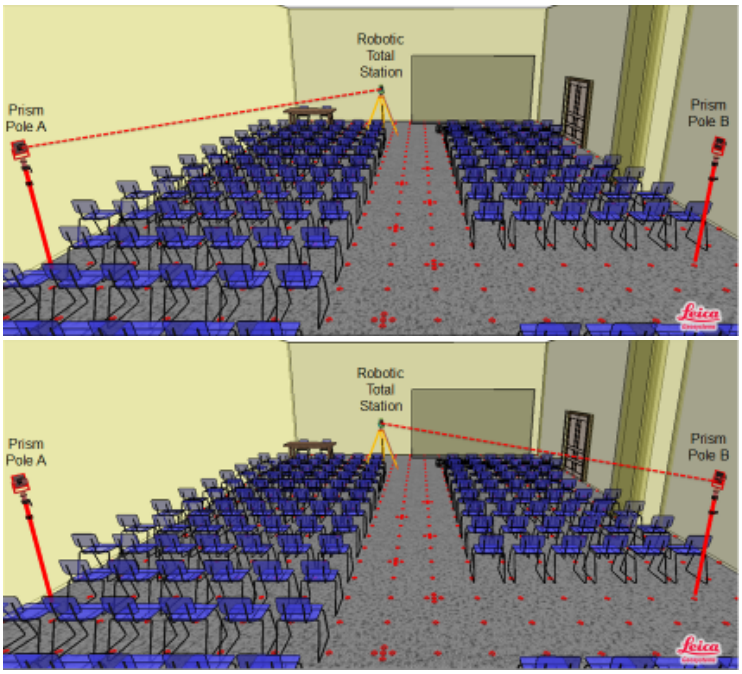
Step 4: Setup & Position Total Station Using Control Points

1. Turn on the robot with Long-Range Bluetooth enabled



2. Level equipment and shoot control points. Lock instrument to prism.

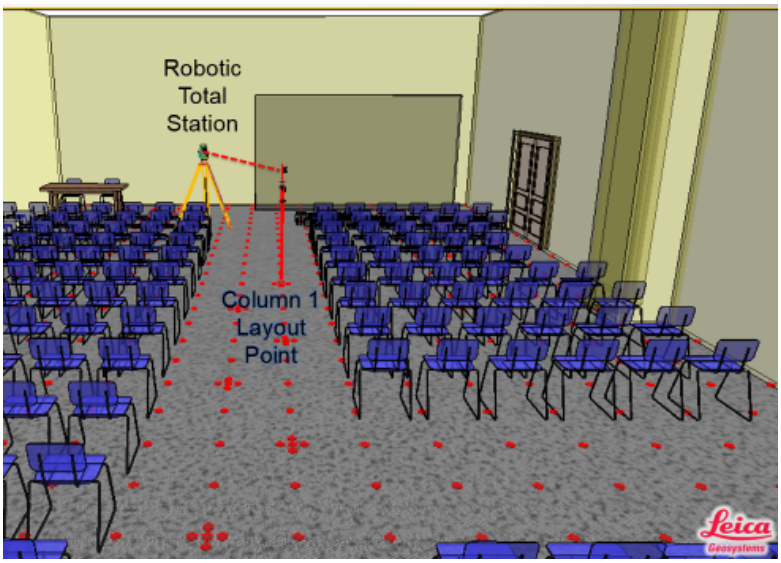
3. Shoot control points to orient the robot (must be in model and in field in the exact same location).

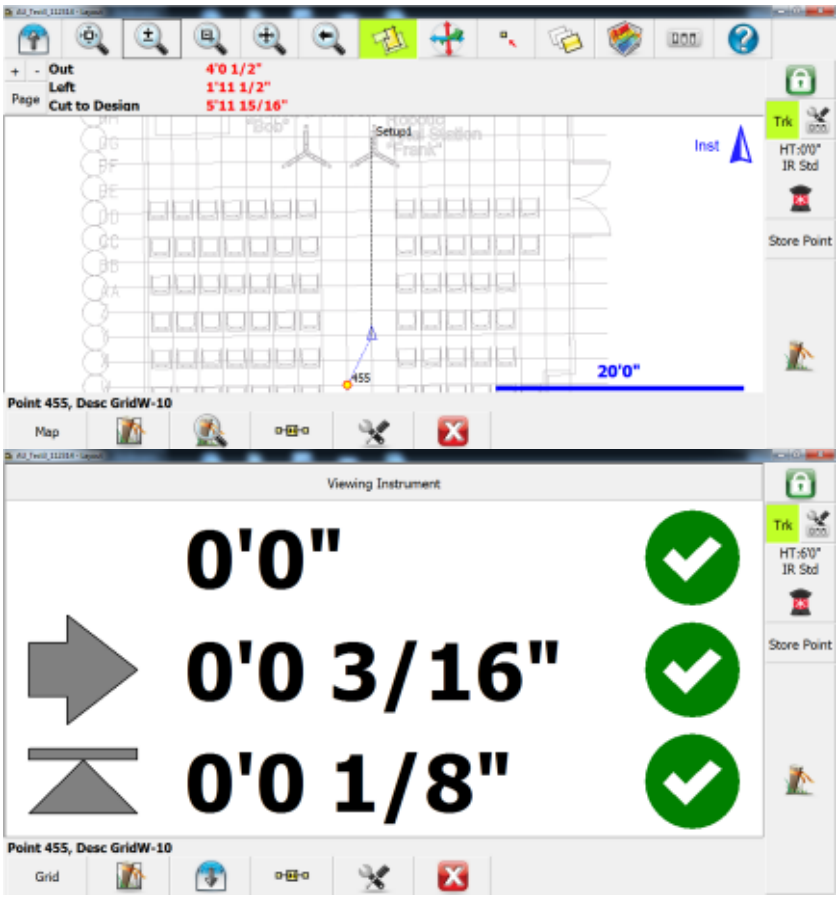


Now the robot is oriented and knows it location in the space and is ready to layout points in the exact location as specified in Revit with Autodesk Point Layout.

Step 5: Layout Points

Laying out construction points is simple – select the point to layout and the field software will guide you directly to the point using arrows or a map view



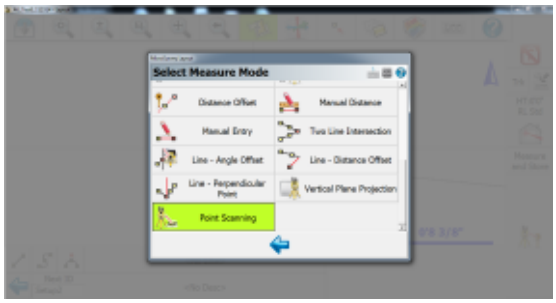


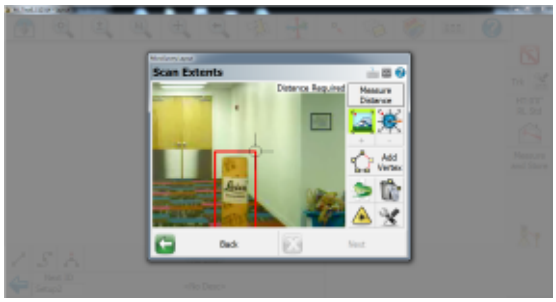
Step 6: Back-check & Area Scanning

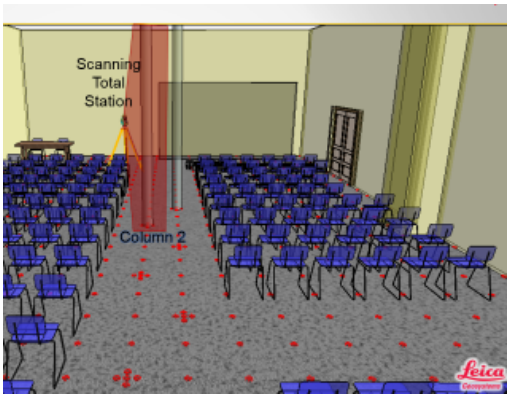
Once all points are placed and work is installed, the physical construction can be back checked for quality assurance. Points from Autodesk Point Layout or lines and arcs can be utilized to validate the location of work in place. The MicroSurvey software will tell you exactly where the work was installed compared to where it was planned.

The blue triangle shows us the work in place is not where it was planned. The display at the top of the screen tells us the column is out to the left 2.5". That is out of tolerance, so we will scan the column for the office to assess the issues and determine the impact and corrective action.

Since the MS50 is a scanning robot, it knows it's oreintation at all times. This orientation information is used to automatically register or stitch together point clouds aleviating the need for post-processing in the office.



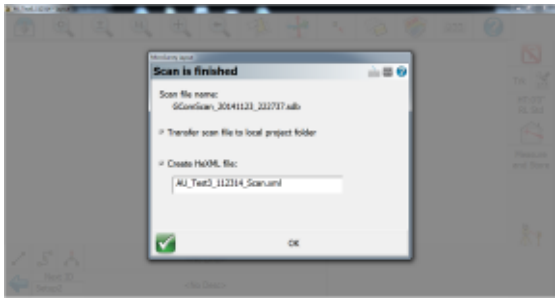


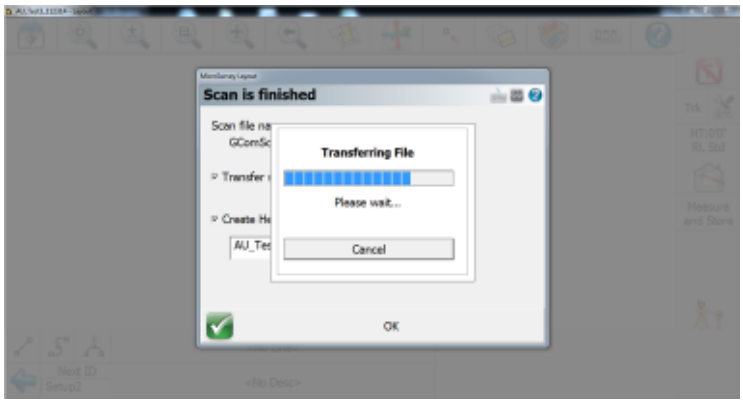


Step 7: Export Area Scan

Area points clouds can be digitally transferred to the field tablet computer via Bluetooth. MicroSurvey Layout will automatically create the scan files and HxML file that can be read

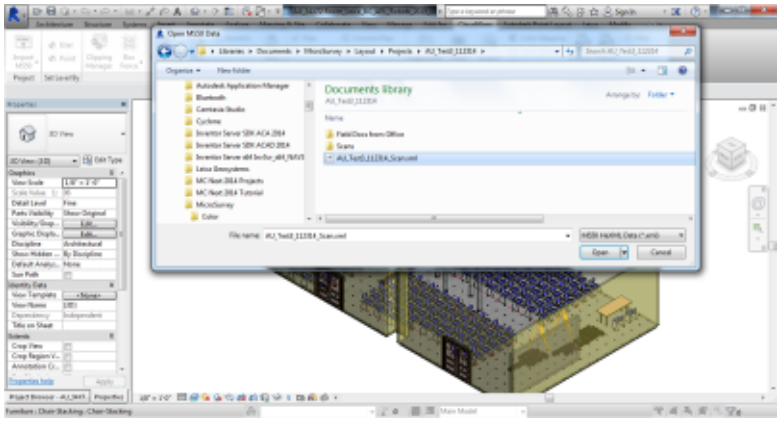
directly into Revit with the Leica Cloudworx for Revit plug-in.

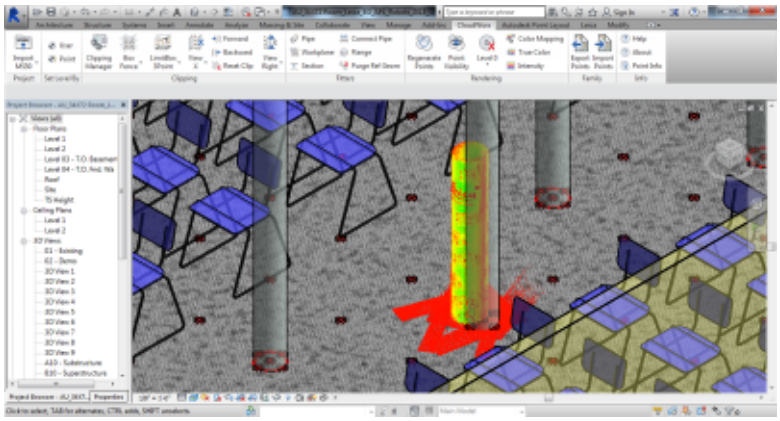




Step 8: Load Pre-registered & Pre-oriented Point Cloud into Revit

HxML scan files can be imported directly into Revit with the Cloudworx for Revit plug in by selecting “Import MS50” from the Cloudworx menu.





All scans are imported and automatically aligned to the model coordinate system with no post-processing or data manipulation. Congratulations - You have now completed a BIM Field Trip!