AS322316

Get to the Point - A users guide to sourcing and using Point clouds for Revit

Kris McIsaac
Jacobs

Learning Objectives

- understand how a clients requirements may affect the capture and use of point clouds [Learning
- Brief your surveyors to provide a fit for purpose point cloud
- Utilize Point Cloud data inside the Revit modelling environment to produce fit for purpose models
- Create Revit families to improve existing conditions modelling from point clouds

Description

Point clouds are now very common but often they are provided without proper consideration of the end use or end users of the data. This class will demonstrate briefing processes for both your clients and surveyors to ensure the captured data is fit for your purposes and tips and tricks for using the data efficiently in Revit to produce models to satisfy any intended use

Speaker

Kris McIsaac
Jacobs Project Technology - Buildings and Infrastructure

Introduction

Pointcloud technology has been around for some time and has become mainstream in the last 5-10 years, however without being specific about the requirements and expectations from a laser survey the use of pointclouds in design or engineering processes can be less than ideal.

Pointclouds are typically generated by Laser scanners. These can vary in size and capability from small portable devices to large mobile systems mounted to a vehicle. As such the eventual output can also vary. By understanding these variations and the capabilities of the equipment we can work with our surveyors to produce the most suitable data from a laser survey.

Even with smaller more affordable systems most point clouds are still provided by surveyors. It is critical to communicate the requirements of the survey to ensure the received data will be fit for purpose.

With many advantages over traditional survey methods and modern hardware and software able to quickly process and read point cloud data it is becoming business as usual for many surveyors to produce.

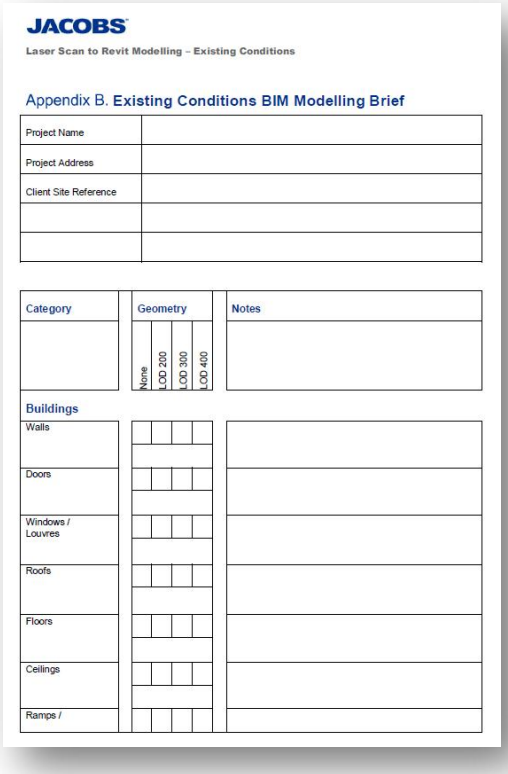
This presentation focuses on developing a brief of client requirements, conveying these requirements to the surveyors and then working with the received files to produce existing conditions 3D Revit models.

Client requirements and brief

It is critical to determine the key requirements of the eventual deliverables to ensure the survey captures critical items or areas. Different clients / users will have different requirements from the existing conditions models. Some may focus on fixtures and fittings while others may require detailed structural steel connections.

By documenting these requirements, you can successfully brief the surveyors to capture the right data as well as the modelers who will be converting from point cloud to Revit. This brief can then be used to audit the models before handover.

Failing to fully understand the future model use can lead to re-work, additional site survey or a less than ideal deliverable



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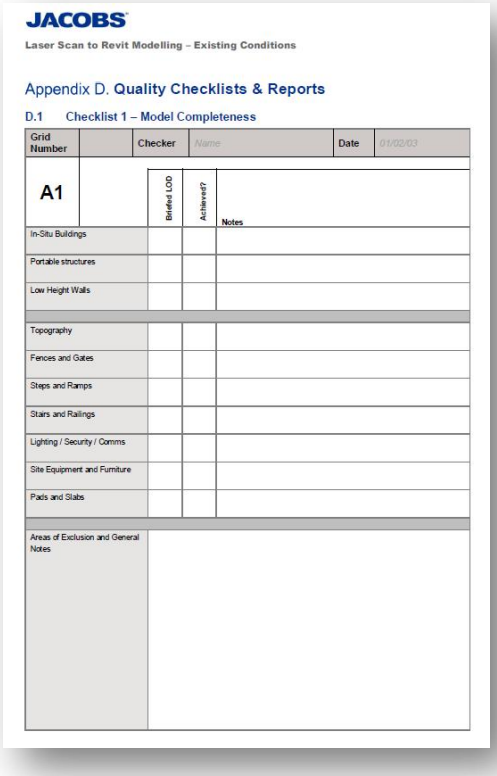
Laser Scan to Revit Modelling – Existing Conditions

Appendix B. **Existing Conditions BIM Modelling Brief**

Project Name	
Project Address	
Client Site Reference	

Category	Geometry				Notes
	None	LOD 200	LOD 300	LOD 400	
Buildings					
Walls					
Doors					
Windows / Louvres					
Roofs					
Floors					
Ceilings					
Ramps /					



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Laser Scan to Revit Modelling – Existing Conditions

Appendix D. **Quality Checklists & Reports**

D.1 Checklist 1 – Model Completeness

Grid Number		Checker	Name	Date	01/02/03
A1		Briefed LOD	Achieved?	Notes	
In-Situ Buildings					
Portable structures					
Low Height Walls					
Topography					
Fences and Gates					
Steps and Ramps					
Stairs and Railings					
Lighting / Security / Comms					
Site Equipment and Furniture					
Pads and Slabs					
Areas of Exclusion and General Notes					

Figure 1- example survey brief

Survey Brief

Surveyors naturally have their own typical workflows which may not align perfectly with your requirements. Without specific briefing they may capture as much of a space or asset with the least number of scans as possible. This may result in critical details or items being missed or not captured with the right amount of detail and at the other end of the spectrum, they might work on a 2mm tolerance with very rigid controls which will take longer than needed and potentially waste a stack of money.

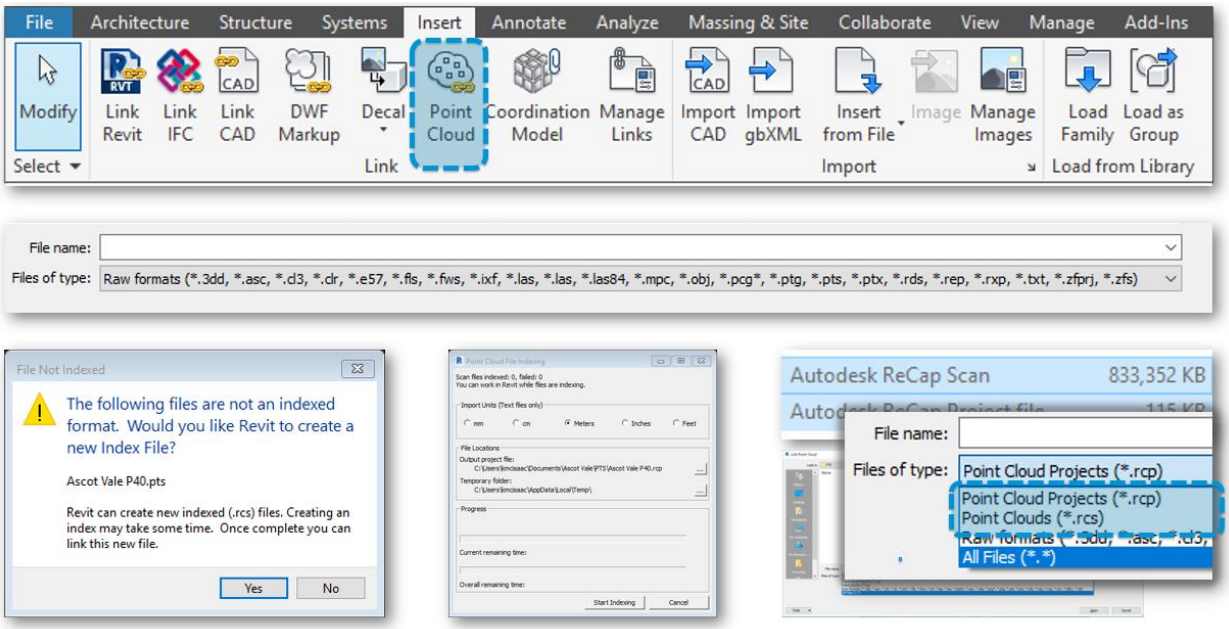
Tips:

- Discuss and create a plan of the space or asset and look at potential scan locations. Use a floor plan if possible. Look for potential obstructions
- Specify in writing what the key requirements are and explain what you will do with the models
- Discuss Point Cloud format and consider density and accuracy.
- For architectural projects a coloured point cloud is very useful

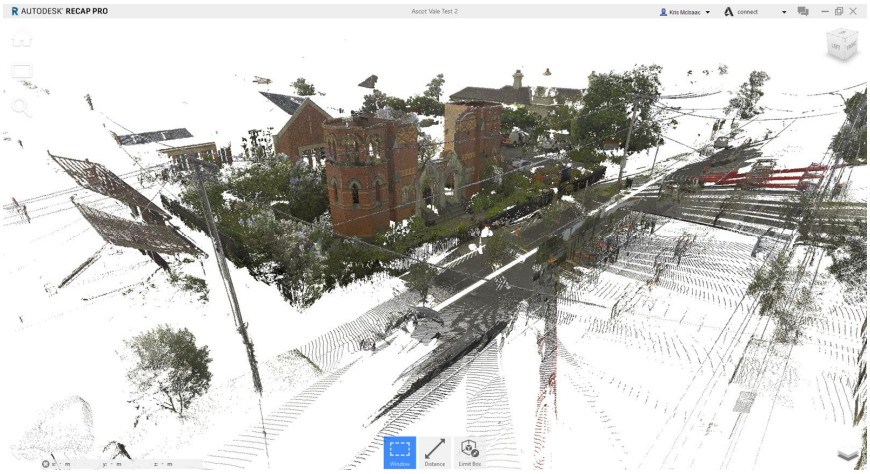
Figure 2- I have no affiliation to Leica or any other hardware brands. This was just a nice image from google (also no affiliation to them)

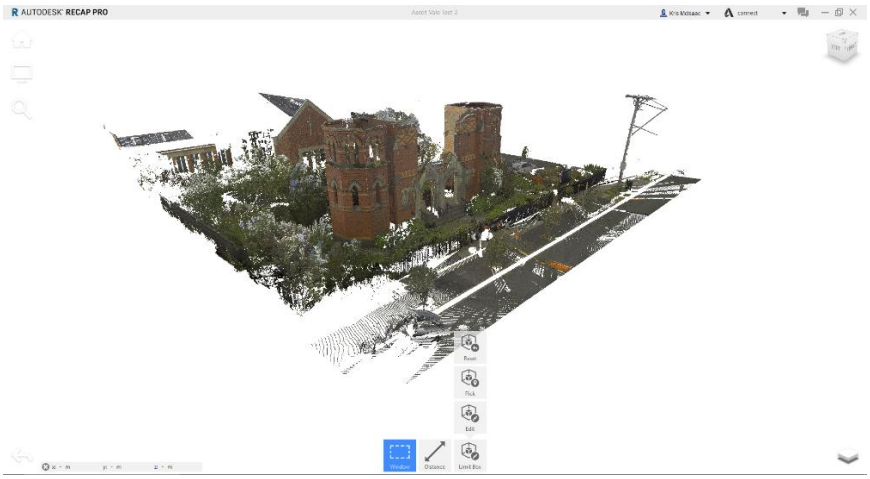
USING POINT CLOUDS IN REVIT

Revit has been able to natively link Point clouds since Version 2012. Autodesk has their own proprietary point cloud format (RCS / RCP). If not already in this format it will have to be converted. Revit 2018 and previous will do this conversion if you try to link any other point cloud format.



Since 2019 this functionality has been removed and the conversion to an Autodesk format needs to be done in Autodesk Recap. Recap can also be used to crop the point cloud





COORDINATES

Coordinates need to be considered. You can't acquire coordinates from a point cloud and it will not display correctly if a large distance from the origin. If coordinates have not already been established in your Revit model an accompanying CAD plan from the Surveyor can be used to set coordinates and then the point cloud can be linked directly using Shared coordinates.

If coordinates have been established before the point cloud survey the details of this coordinate system should be provided to the surveyor to allow them to align the point cloud to match. The point cloud should then link using shared coordinates

If coordinates have not been established and no CAD file is available, the point cloud can be linked to a temporary Revit model origin to origin. Create some geometry near the point cloud location (likely a long way from the origin and a bit jumpy). Save this file and link to your actual model using centre to centre. Manually position the link as desired and acquire the coordinates. Remove this link once coordinates are acquired and link the point cloud directly using shared coordinates

Ideally this should be discussed in the initial briefing with your surveyor however in some cases you may receive a previously completed point cloud or were not involved in the engagement process. In some cases, the point cloud is provided with an arbitrary datum point. This is typically near enough to 0,0,0 to link into Revit and align manually

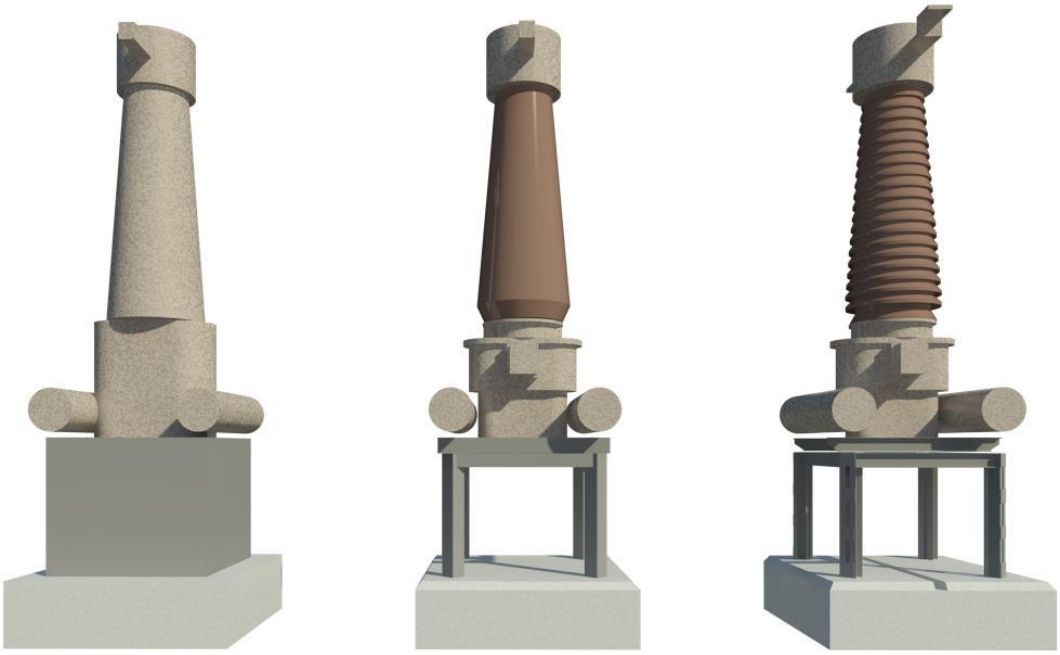
MODEL DETAIL AND ACCURACY

Traditional LOD definitions do not fit the point cloud to existing conditions model workflow. These describe data graphically and non-graphically that we cannot necessarily know from a point cloud such as the layers behind a wall finish, fire ratings or even the finish and material that is visible apart from the colour.

Instead look at the model in terms of detail and accuracy. Detail relates to the amount of geometry and intricacy of a model or component whereas accuracy relates to any deflection, skew or deformation of the model or component

Example: A row of timber windows in a turn of the century church. Detail may include the sash profiles, chamfers and hardware whereas accuracy will determine the tolerances before modelling sag and skew of the frames or any differences between each instance.

Project North / Scope boxes



Setting Project North for rectilinear projects can make modelling processes more efficient however the client may want the model to be handed over without a project North established. An alternative is to create scope boxes to rotate the views to align with the structre or asset.

As with traditional surveys you don't get nice straight lines. You need to find the longest straightest thing you can to establish Project North rotation or a scope box. Draw a few reference planes on straight bits of wall and see what looks good.

TIP:
Raise the bottom view range up from the floor to better help you see the wall face.

TIP:
Even once a North rotation or scope box has been established many parts of the model may not align perfectly. Depending on the agreed tolerances you may be required to model these deviations. Using the snap override “SO” will allow you to model items such as walls slightly off axis. Sometimes zooming right in to the object is required to see the best fit with the points

Levels

as above, things are not always straight or flat. Floors can sag, floor finishes can give you slightly different results depending on where you cut. A good idea on a multi-level building is to cut through a stair well or lift shaft and find the floor levels adjacent. Often floor to floor heights are consistent and round numbers (± a few millimeters)

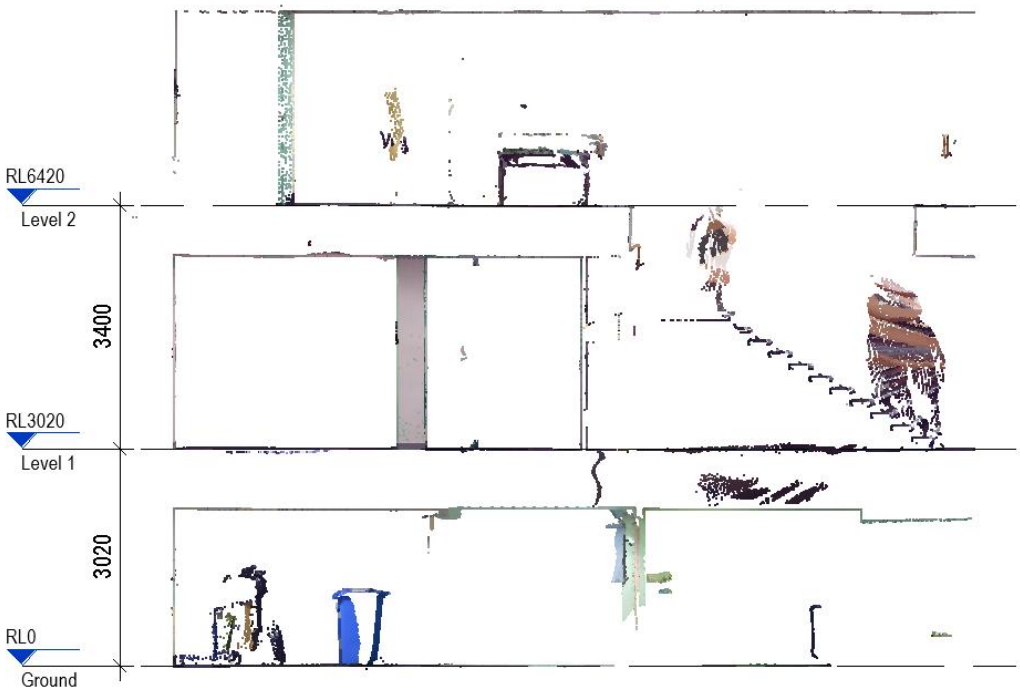


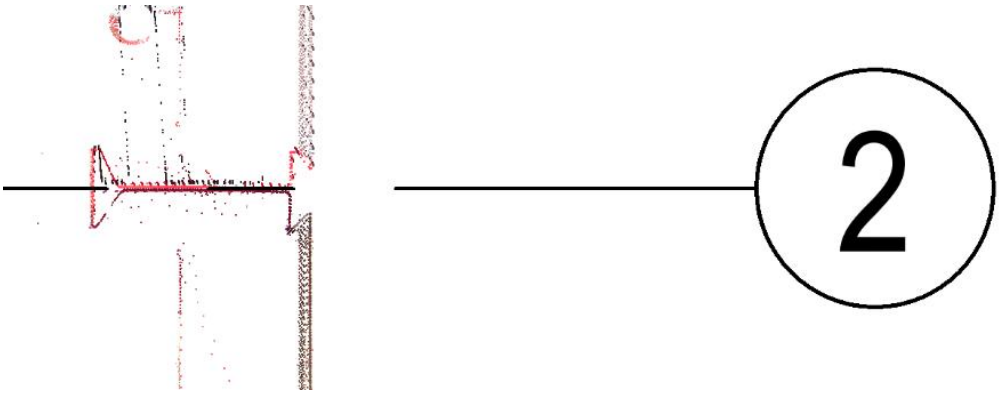
Figure 3 - floor to floor heights are often consistent on multi-level structures (except this one that I chose as an example)

Grids

No row of columns is every perfectly straight or square. This really is a best fit situation but like levels, grid to grid will often be consistent. Most of the time the grid spacing is a common and round number so you can lay the grids out, lock the dimensions and nudge them as needed to get a good fit.

Keep in mind that grids for existing structure can't really be used to measure from as they don't actually exist in the real world.

Make sure to model the columns as close as possible to the survey as these will likely be measured from. Also, think about grid linings, will this be stripped off during reno / demolition? That won't help your dimensions much.



Phasing

Your scan is typically an existing condition record. You can apply a phase to the point cloud link so put it on the existing phase. Set your views to existing and model on the existing phase. It is a good idea to audit phasing before handing over the model

Views

the one thing you need to do to model with point clouds is chop, chop, chop. Use lots of temporary section and plan views.
Don't bother with view templates, at least not ones that control view range. And use the section box a lot.

In plan raising the bottom clip up from the floor and above the majority of furniture to isolate just the walls or columns can help with wall layouts. Section range can be kept very small to see the exact alignment of an item that is being cut such as steel profiles

When modelling large flat surfaces like walls or ceilings place them as best as I can in plan but always view them in 3D and nudge them back and forward to get a good mix of geometry and dots. It can also be a good way to identify deflection

If your model needs to be handed over with some specific views use a filter in the browser to turn them off while modelling. It just makes it easier to bounce around your working views

Revit Families

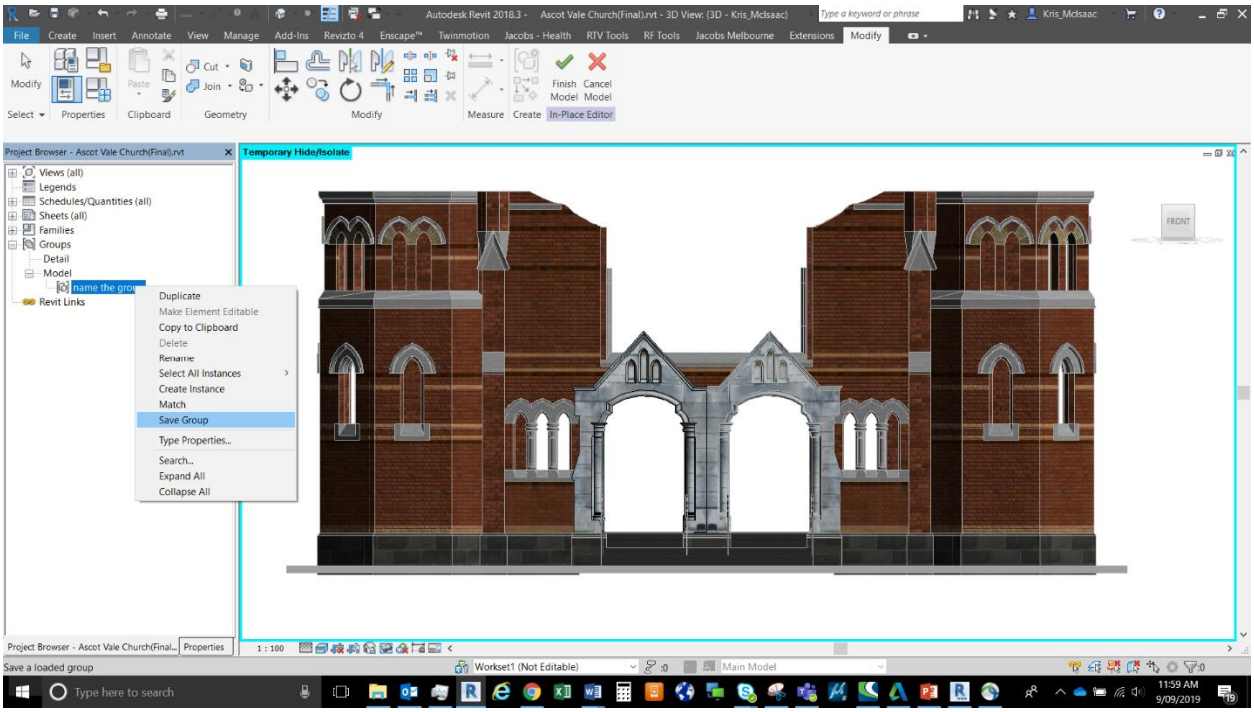
Natively you can't link point clouds into the family editor. As such, modelling component families for use with point clouds is more difficult. Some 3rd party software may be able to help.

Another option is to use in-place families, especially with more decorative buildings. Like with conventional Revit, if it is a one off it will likely be ok. Just make sure it is on the correct category and properly named

Even with one off items you can convert the in-place family to a component for reuse. Some people will try to copy and paste the geometry from the project to the family but that doesn't always go as planned. The better method is to save the family out from the in-place editor

In-place to Component workflow:

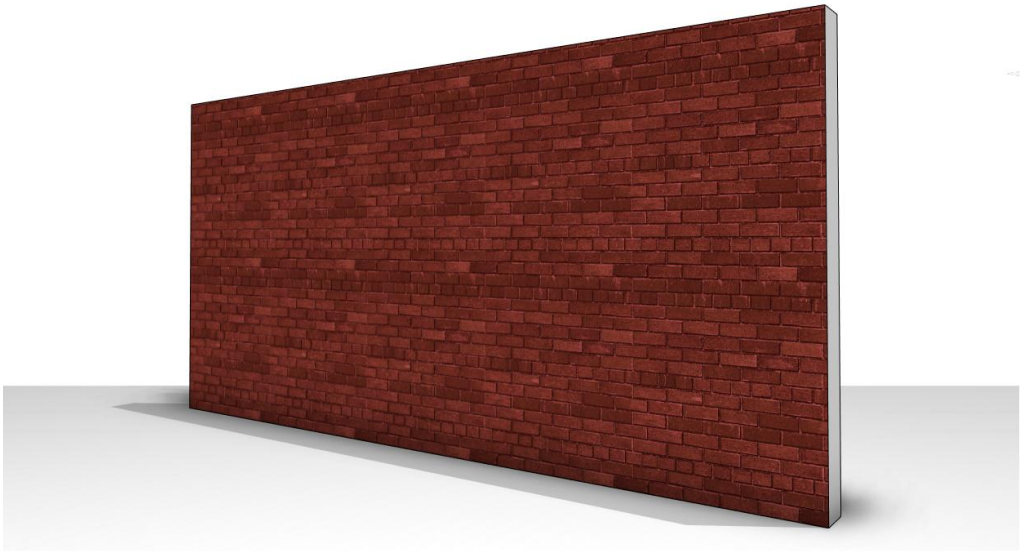
- First, model the in-place family using the point cloud as a reference.
- While still in the family editor mode select all the geometry and group it (gp).
- Before finishing the family and exiting the family editor find the group in the browser and right click save as RFA.
- Now finish or cancel the family.
- This has converted the in-place family to a component.
- Before loading the new family into your project open the newly created rfa in the family editor.
- You will find that the geometry is at the same elevation as the project so it may need to be moved back down (or up) to the base level.
- You can now update the family as desired with additional geometry, parameters, detail linework or even parametric controls and load into your project



System Families

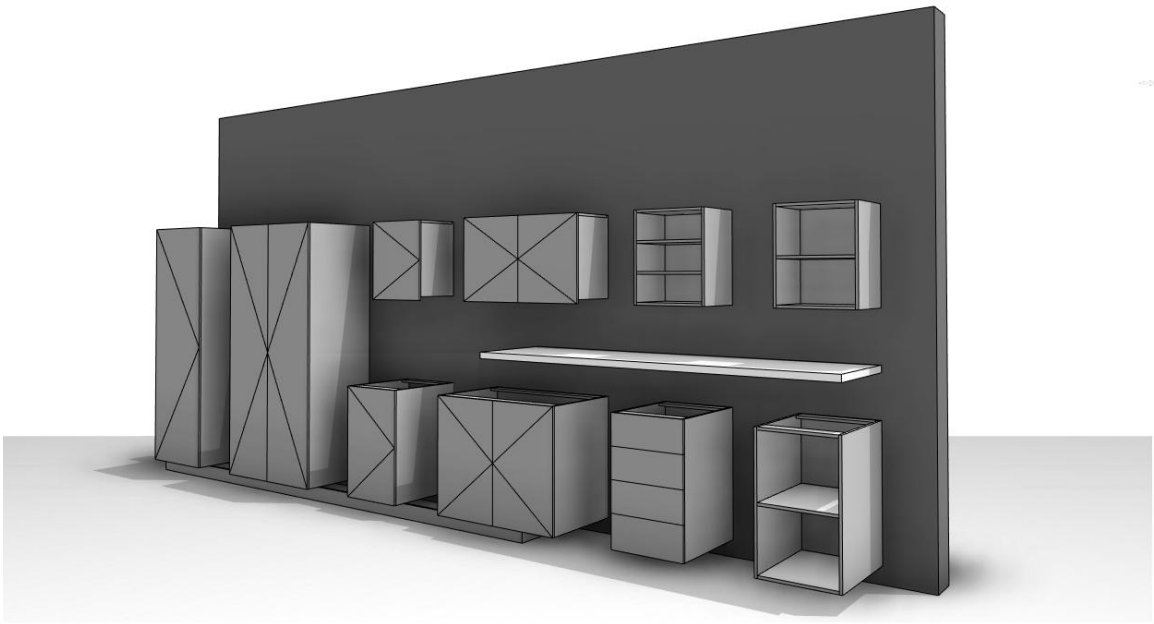
As with modelling in-place families you also need to consider the detail and accuracy required from system families. Generally, there is no way of knowing what is under the visible surface so generic single layer families of various thicknesses can be used. In some cases, a paint finish can be applied or if visible from both sides and obviously a monolithic structure a specific family type can be used.

Due to Revit's preference for straight and flat surfaces modelling deviations and skew can be a little harder. In many cases a small amount of deviation is acceptable, but it is important to identify what items, categories or locations may have specific acceptable tolerances



Component families

Again, detail and accuracy requirements should be discussed and documented before modelling commences. This will determine how much of your existing library can easily fit into an existing conditions workflow. Are your current doors flexible enough to satisfy the end user of the model for example? Consider instance Vs type for parametrically adjustable items. It is often easier to use grips and stretch to fit however many families are type based.



Summary

The key to producing fit for purpose existing conditions models using point clouds is to understand the client or end users' requirements for these models and ensure this information is communicated to the surveyors and modelers.

Being specific about what areas or items to focus on will ensure the surveyors maximise their time on site and provide a point cloud with all the necessary data to easily convert to a 3D model.

Those same requirements along with detail and accuracy requirements will inform the modelers on what needs to be produced and can be used to audit the deliverables prior to hand over.