

Back to the Future: Travel Back in Time and Create History Using Revit

Viraj Voditel

Techture

Learning Objectives

- Understand how to effectively use point clouds in Revit, Navisworks, and ReCap
- Get an exposure to unconventional modeling techniques of historical objects
- Understand the 3R (ReCap to ReCap Photo to Revit) workflow
- Learn the use of Revit Live to visualize historical structures

Description

The class will start with an introduction to a historical project created in Revit software using scan-to-Building Information Modeling (BIM) workflows. The completed model will be showcased and specific features of the model will be highlighted. You will then be introduced to various Autodesk software used to accomplish the model, viz. Revit, ReCap and Navisworks. Once you have a basic understanding of the proposed workflow, a hands-on instructional demonstration shall be given. The workflows you will learn include visualizing a point cloud in ReCap and Navisworks; importing the point cloud in Revit, and making sure it's at the right location; creating basic historical objects using the Revit family editor; modeling complex architectural features in Revit; and scanning through ReCap and Revit. Lastly, you will discover how the model can be exported to Revit Live and visualized in a 1:1 scale using virtual reality devices to truly go back in time using tools of the future.

About the Speaker

Viraj is the CEO and Founder of Techtur, a BIM consulting firm based in Nagpur, India. He started out as a Student Expert for Autodesk while pursuing his Civil Engineering degree and currently is an Autodesk Expert Elite and a Certified Professional for various software. He is a BIM evangelist and frequently talks about BIM at various platforms. He has delivered technical lectures at the national and international level and is actively involved in testing out newest technologies in the AEC space. At Techtur, he leads multidisciplinary teams on developing newer and more efficient workflows. He strives towards ensuring that they always keep up with the latest technologies and diversify into broader segments. Viraj has been able to amass a rich experience on BIM Implementation for various large-scale projects including hospitals, hotels, airports, hydropower projects and smart cities.

Class Content

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1. Introduction

Laser scanning is a relatively new technology which has impacted the traditional profession of surveying radically. 3D Laser Scanning is a non-contact, non-destructive technology that digitally captures the shape of physical objects using a line of laser light. 3D laser scanners create “point clouds” of data from the surface of an object.

The technology accomplishes all the aspects of outputs provided by the conventional surveys while at the same time providing much more value addition to what can be achieved by equivalent efforts in the same time. Laser scanning is becoming much more prevalent due the technology becoming more and more feasible and scanning devices becoming affordable.

Data capture can be done using the following methods:

- Terrestrial scanners
- UAV/Drones
- Photogrammetry
- Even more technologies

The scans are then registered and geo-coordinated, so that the data is further useful to anyone using it for modelling, coordination or appending it with other contextual models.

One of the major impacts this technology has had is on the capture of data of existing structures or buildings. More so, historical buildings which have been built decades and centuries ago. Capturing these historical structures using this technology provides variety of benefits:

- It helps in documenting these structures as they are quite old and there may not be enough documentation or drawings available
- In case of natural disasters, if there exist reality models or 3D models of these structures, then they may be restored with a significant source of data to rely on

Converting the laser scans to BIM models provides additional benefits:

- Models are lighter than point clouds and do not take up too much hard disk space
- Help to document materials and material properties
- Add metadata to points in the model, example cracks or deterioration
- Creation of 2D drawings is possible through a 3D Model
- Models can be a simplistic representation and used for gaming purposes
- Model can be used by governments to promote tourism

- Planning for emergency situations

The software needed for this class

- Autodesk ReCap Pro
- Autodesk ReCap Photo
- Autodesk ReCap 360
- Autodesk Revit
- Autodesk Navisworks
- Dynamo Add-in for Revit

Autodesk ReCap Pro

The main tool for reality visualization. Supports most formats for bringing the native point cloud files from a scanner to the computer. Can also be used for converting point clouds to mesh models.

Autodesk ReCap Photo

Earlier ReMake, ReCap Photo is useful for converting photographs (20+) to mesh models. Works on a cloud subscription.

Autodesk ReCap 360

Cloud service to share and view RealView of Point Cloud projects online as well as convert photos to mesh models. Converted meshes from ReCap Pro are also visible here.

Autodesk Revit

Everyone's favorite model authoring software. In this class will be used for creating families and model elements based on point clouds

Autodesk Navisworks

Bringing multiple Revit models and Point Clouds together for visualization and model audits

Autodesk Revit Live

Cloud service which will convert a Revit model to a navigable 3D BIM Model in a gaming like environment and also supports Virtual Reality Devices

Dynamo Add-in for Revit

Visual Programming application used in this class for automating model checks and importing OBJ to Revit

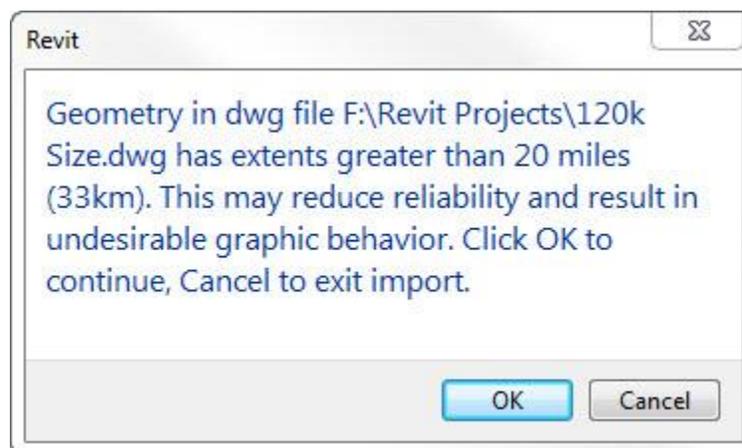
2. Creating Revit families using point clouds

Software to be used in this section:

- ReCap Pro
- Revit
- Dynamo

In any scan to BIM project, especially when modelling the architectural and structural features, you would be using the family modelling tools the most. This is natural, because most of the items that need to be captured are quite custom, especially when considering historical architecture.

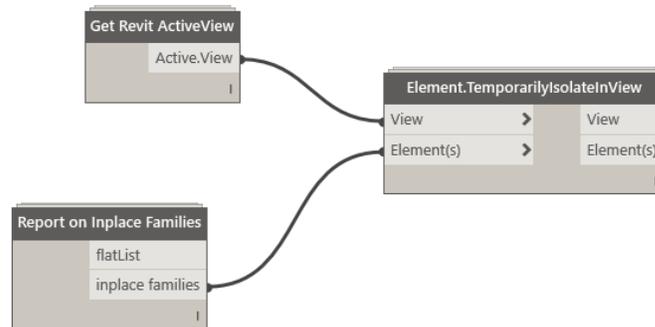
To start off, we would be looking at bringing a point cloud at the correct coordinates in Revit. It is of prime importance for better collaboration and correctness of the model, but Revit's limitation of 33km does cause some issues while doing that. We will take a look at what is the best practice for bringing in point cloud data when you get the following warning:



Since the family environment cannot be used to directly import point clouds, an equivalent workflow of using “Model In-Place” and then using the modelled geometry from that instance to create a loadable family should be followed. Use of Model In-Place should be restricted to a minimum. This is because they increase file size significantly and there will be issues quantifying them via schedules.

If you are working on a large model with multiple people working, you may prefer to use Dynamo to audit your model for any Model In-Place families that may be there in your project. The following script automatically checks the model for any such families and isolates them in the currently active view. It is recommended to use a 3D view with everything checked in the Visibility/Graphics dialogue.

It is a simplistic script with custom nodes from Bakery and Hot Gear, so make sure that you have added those packages before running the script.



The following cases will be discussed:

- Generic Model Template Families
- Face Based Families – Voids and Cutouts
- Profile families – Wall Sweeps and Reveals
- Line Based Families
- Adaptive Components

Uses of the above templates in context of point cloud data will be covered.

3. Creating Mesh Models using Photographs

Software to be used in this section:

- ReCap 360
- ReCap Photo
- Revit

In this section, we will be looking at how photographs can be used to capture historic monuments and converting them to mesh models which can also be then appended into the Revit models to aid in BIM documentation.

Something as simple as photographs taken from a smartphone or DSLR camera can be used to create mesh models. Earlier this could be done using ReMake Software but it has recently graduated to become ReCap Photo. (see links in helpful resources at the end of this document for more information)

This technique relies on Photogrammetry and the following strategies can be applied while taking photographs:

- 1) Camera Dome
- 2) Moving Camera
- 3) Flying Camera
- 4) Turntable
- 5) Moving Object

For architectural photogrammetry however, only points 2 and 3 are applicable. It is important to take as many photographs as possible to achieve better results.

As a simple example for this class, this model in the below pictures was created using only 6 photos. This was possible in ReMake and ReCap 360 but in ReCap Photo a minimum of 20 photos would be required. As mentioned in the Helpful resources at the end of this document, only ReCap Photo is going to be available for this process after December 1, 2017.



EXAMPLE PHOTOGRAPH. MULTIPLE PHOTOS NEED TO BE TAKEN TO ENSURE A PROPER 3D MODEL IS CREATED.



3D MESH MODEL (LEFT) AND CORRESPONDING WIREFRAME VIEW OF IT (RIGHT) CREATED

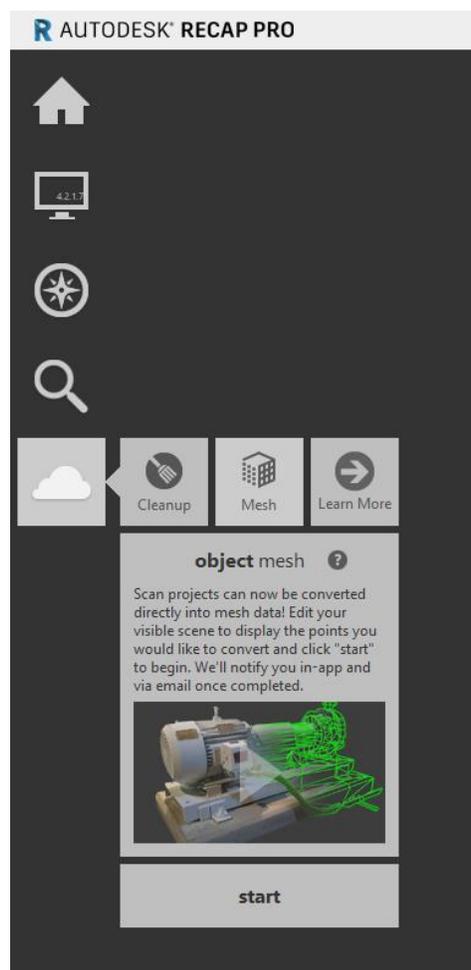
4. Creating Mesh Models using Point Clouds and bringing the models in Revit

Software to be used in this section:

- ReCap Pro
- Dynamo
- Revit

Point cloud data can even be used to automatically create models. For example, in large scale mapping in civil engineering workflows, you can use a point cloud generated from a UAV scan to achieve a pretty accurate terrain model using Autodesk Civil 3D. While this workflow has existed from a long time, using a similar workflow for architectural modelling is relatively new.

The software and tools available today make this possible. You need a subscription to ReCap Pro and cloud credits to achieve this. The model creation takes place in the cloud and you can download the model in multiple formats. None of them, however, are compatible with Revit directly.



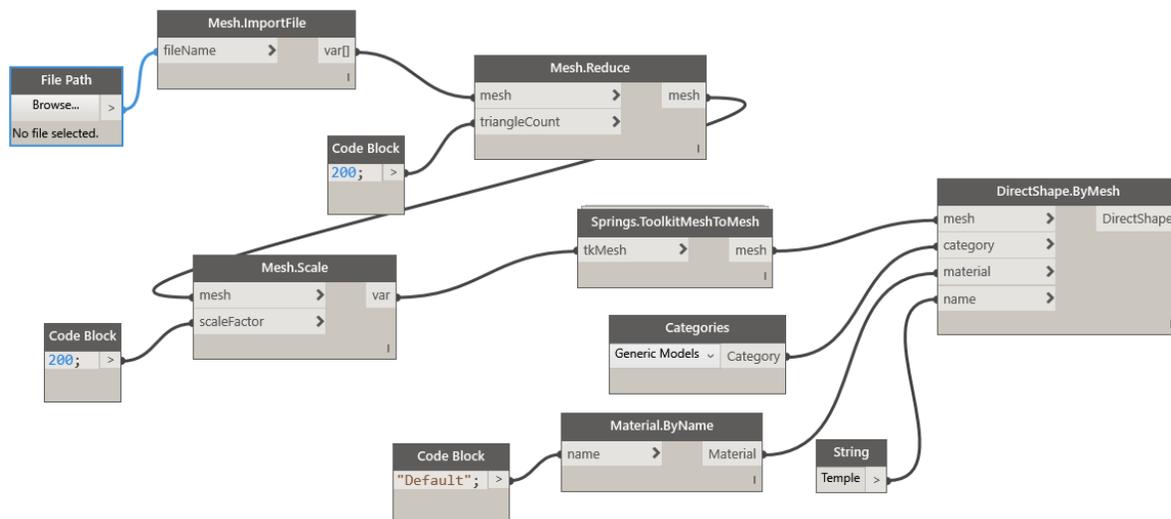
Converting the mesh models generated in the above step and bringing them into Revit is another challenge, since they do not exist in native formats that Revit supports for import. The below workflows can be followed for bringing into Revit:

- 1) OBJ > DWG (Via 3DS Max) > Revit Family > Revit Project
- 2) OBJ > FormIt > Revit
- 3) OBJ > NWC > Revit Project (Just visualization)
- 4) OBJ > Dynamo > Revit Project

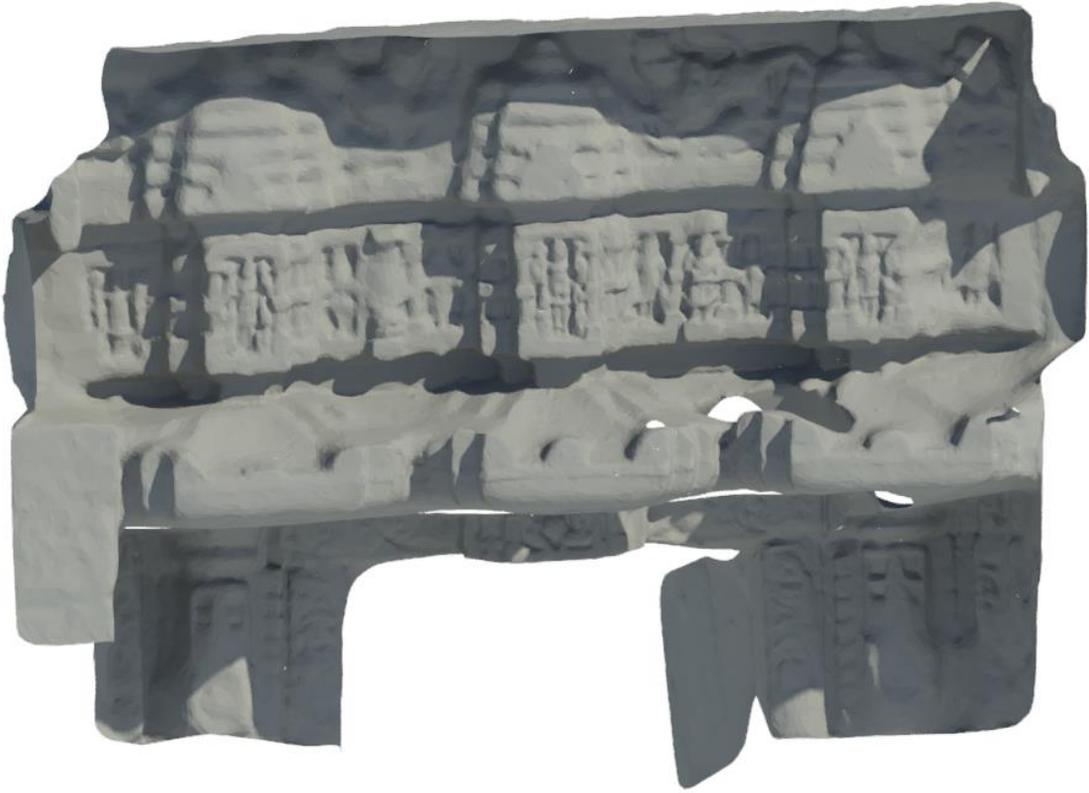
The script for bringing an OBJ to Revit is shown below, but be careful, as with all things Dynamo, it may not work with larger models for multiple reasons. It is a good idea to break your OBJ into parts and then import it.

The following packages need to be installed before running this script:

- MeshToolKit
- Spring Nodes



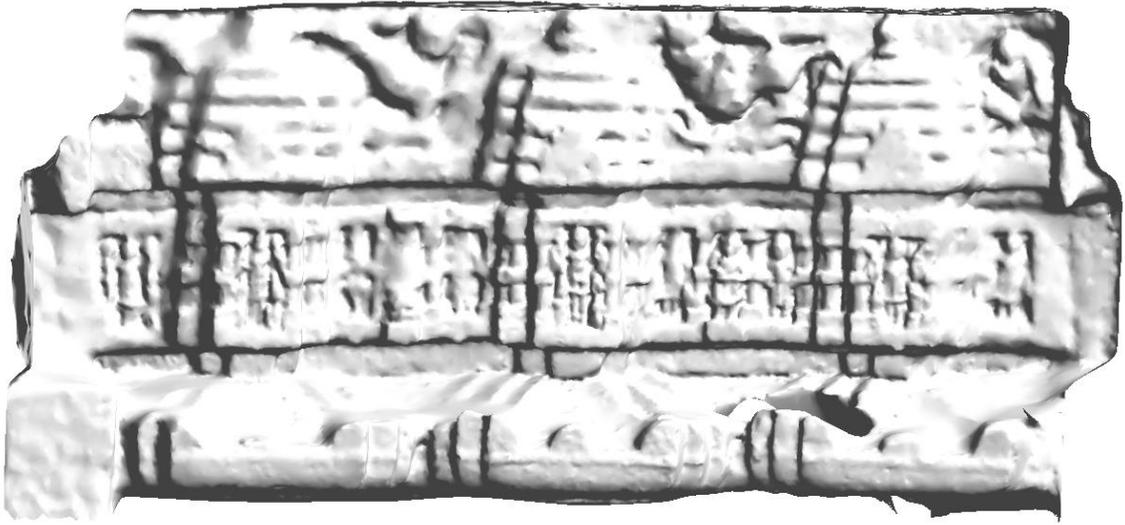
THIS DYNAMO SCRIPT SHOULD BE RUN IN A FAMILY ENVIRONMENT AND YOU CAN TWEAK THE TRIANGLE COUNT AND THE SCALE FACTORS FOR ACHIEVING THE DESIRED RESULTS.



THIS IS THE OBJ INSIDE REVIT IN RAY TRACE VIEW MODE



THIS IS THE OBJ IN REVIT IN REALISTIC VIEW MODE



MODEL REFERENCED AS NWC FROM NAVISWORKS IN REVIT

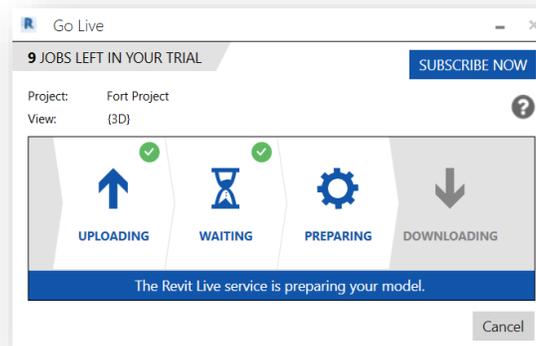
5. Exporting and Viewing the Models

Software to be used in this section:

- Revit Live
- Navisworks
- A360 Viewer

Model authoring tools like Revit are also great for viewing the 3D BIM Models that have been prepared but it may be of prime importance to export the models from Revit to another application for a variety of reasons.

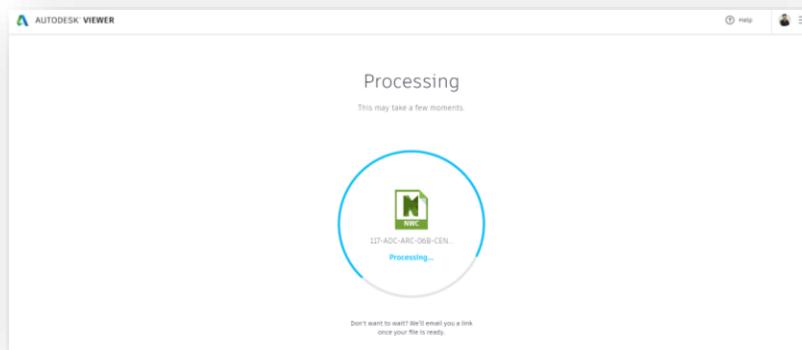
- Exporting to Navisworks Freedom can be useful in case the client does not have a license of Revit
- Export to A360/A360 Viewer/Revit Live will solve the above problem and also without a need to download any software
- To do more with your model, you may want to export it to a gaming engine or a visualization software like Revit Live, in which you can navigate around the model



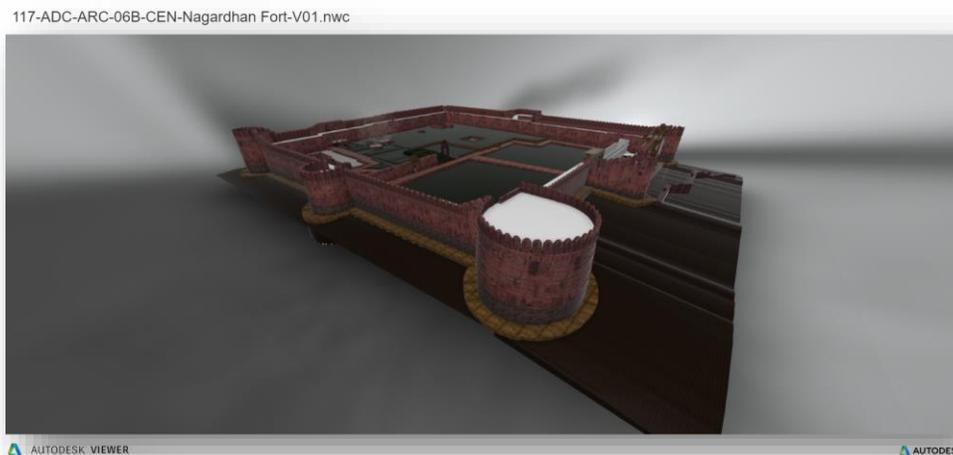
UPLOADING THE MODEL TO REVIT LIVE REQUIRES CLOUD CREDITS AND SIGNIFICANT WAIT TIME IF THE MODEL SIZE IS VERY HIGH



THE MODEL, WHEN EXPORTED TO REVIT LIVE. IT CAN BE FURTHER EXPORTED AS A STANDALONE APP.



THE MODEL CAN BE UPLOADED TO A360 VIEWER OR BIM 360 PLATFORMS FOR CLOUD BASED VIEWING



THE MODEL AS SEEN IN THE A360 VIEWER

Conclusion

From this class you have understood:

- How to crop & clean up point clouds to bring them to other software using ReCap
- Bringing the point cloud in the correct location in Revit and Navisworks
- Using the point cloud to model a family
- Creating generic, face based and linear families
- Best practices of creating families in a Scan to BIM project
- Workflow for creating a mesh model using photographs
- Workflow for creating a mesh model using point clouds
- Workflows for bringing mesh model to Revit
- Exporting the model to Navisworks and having it at the correction location
- Exporting the model to visualization software like Revit Live

Helpful Resources

ReCap Photos Limit Discussion

- <https://forums.autodesk.com/t5/recap-forum/recap-photo-lt-20-photos-limit/td-p/7393895>

ReMake is now ReCap Photo

- <https://forums.autodesk.com/t5/remake-forum/remake-is-moving-to-autodesk-recap-photo/td-p/7382079>
- <http://blogs.autodesk.com/recap/introducing-recap-photo/>

ReCap Photo FAQ

- <https://knowledge.autodesk.com/support/recap/troubleshooting/caas/sfdcarticles/sfdcarticles/ReCap-Photo-Frequently-Asked-Questions.html>

OBJ to Revit Other Workflows

- <https://forums.autodesk.com/t5/revit-architecture-forum/obj-file-to-revit/td-p/7394940>

Paul Aubin's Course - Project Soane: Recover a Lost Monument with BIM

- <https://www.lynda.com/Revit-tutorials/Project-Soane-Recover-Lost-Monument-BIM/422095-2.html>

Mesh import from OBJ Files: Revit Add-in

- <https://apps.autodesk.com/RVT/en/Detail/Index?id=7847254631022872970&appLang=en&>

Autodesk Revit Live Best Practices Guide

- <https://pages.autodesk.com/revit-live-best-practices-guide?mktvar004=707230&internalc=true>