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Plan for Space Programming

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Learning Objectives

- Learn methods of using Revit and supporting tools for multibuilding space programming projects.
- Learn methods of using Revit and supporting tools for single-building space programming projects.
- Learn methods of using Revit and supporting tools for renovation of space programming projects.
- Learn strategies for managing data at varied scales of projects.

Description

Space programming isn't a one-size-fits-all approach for DLR Group. Each project brings a different set of challenges with a different set of solutions. This presentation will discuss the different approaches that DLR Group uses for space programming in Revit software from campus planning to small-scale, tenant-fit projects. We'll provide actual project examples and talk about the challenges of the projects and the approaches that we used. You'll see examples of custom software, paid subscriptions, and freely available resources as we talk about building, room, and FFE data.

Speaker(s)

William Carney is the Design Technology Leader at DLR Group where he sets the strategy for how DLR Group's Integrated Practice leverages technology to design buildings and leads the Design Technology Team. He is one of three R&D studio leaders where his role is to ensure the firm's integrated design teams are on the leading edge of design innovation and project delivery. The Design Technology team at DLR Group collaborates with design professionals to implement new design technologies, and transform data driven ideas into reality on projects. Outside of DLR Group William is a LinkedIn Learning content author, frequently speaks at conferences, is an adjunct professor at Washington University, and works with technology user groups to keep current with today's technology.

Ju-Hui Chia is the Design Technology Manager at DLR Group where she is responsible for developing custom Revit add-ins for architects, mechanical and structural engineers that reduce time spent on repetitive tasks and improve Revit workflows through automation. Ju-Hui is passionate about computational design and visual programming.

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Tech Stack

Software you can buy

With the intent of giving this presentation being to talk about the logic behind why DLR Group uses a type of tool or not. We do show software that we built or have internally. This isn't a comprehensive list of everything that's out there but the things we could think of at the time of writing this.

Blocking Software

- Egan Tools: Space Planning

<https://eganbimresources.com/space-planning.html>

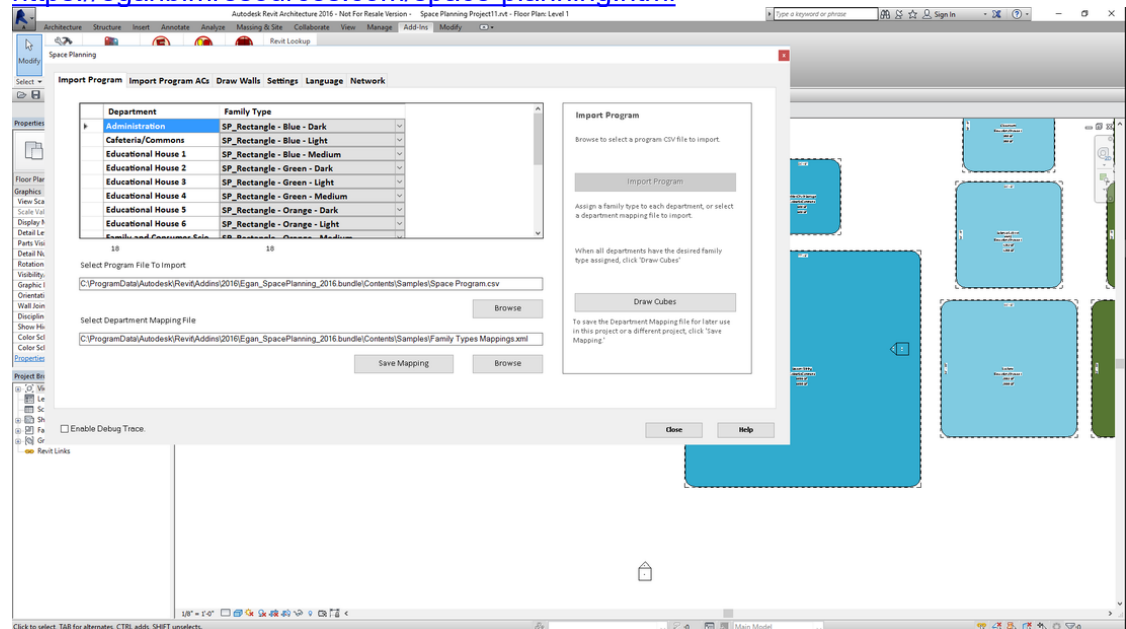


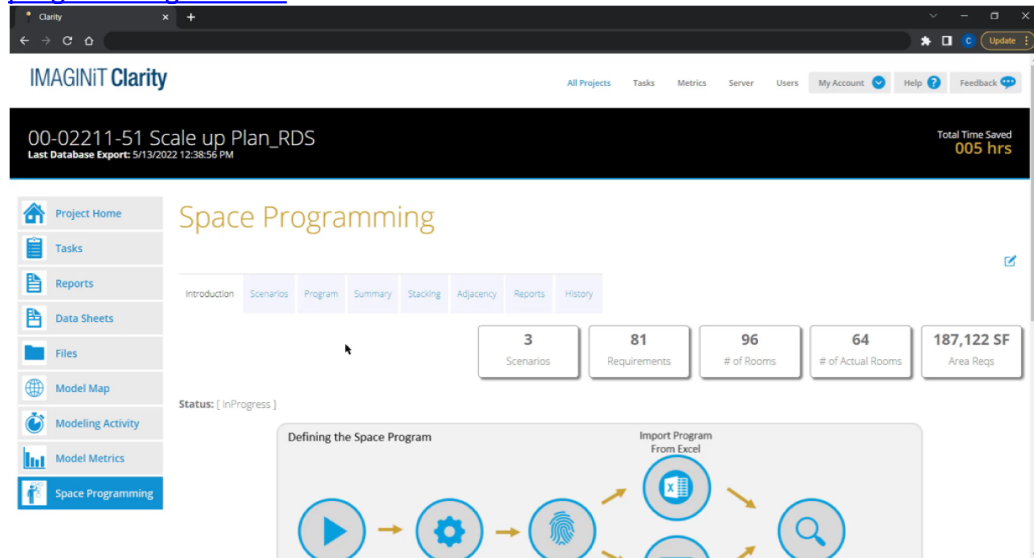
Image from eganbimresources.com website of tool

This tool is a common low-cost solution I have seen many firms using when looking for a space planning workflow. It's effective and easy to use but does not have the

database connection that is available with Clarity or dRofus. This addin does come with the Revit blocks similar to the blocks we showed in our presentation.

- **Imaginit Clarity Space Programming Module**

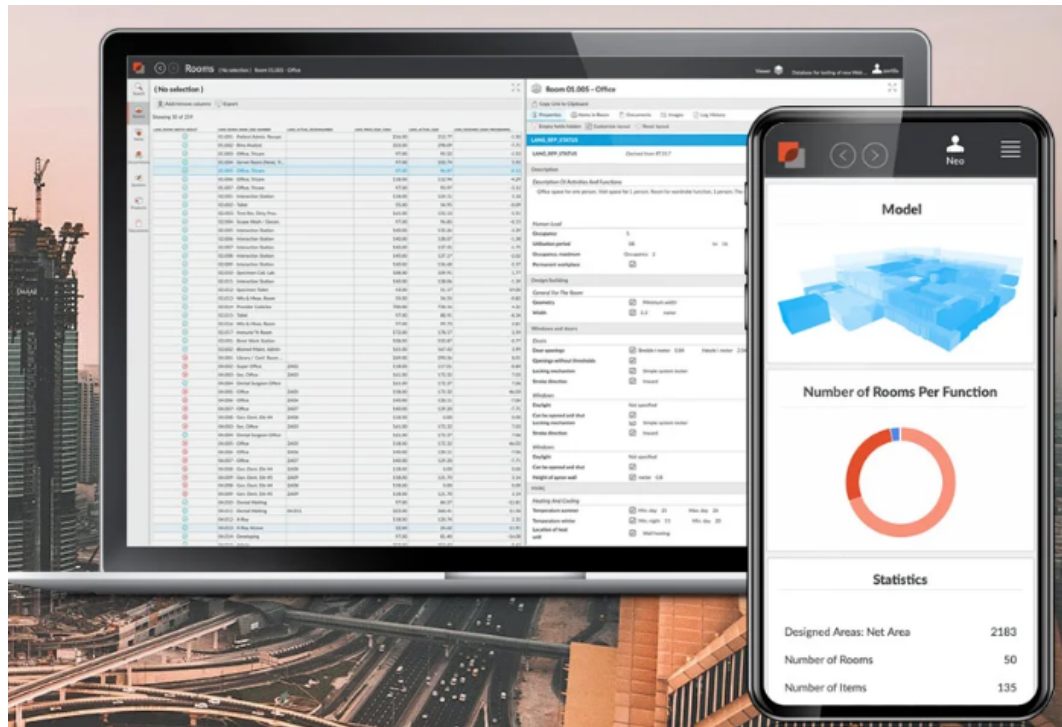
<https://www.imaginit.com/software/imaginit-utilities-other-products/clarity-space-programming-module>



This is the space programming tool we showed throughout our presentation. Clarity added a space programming module to it's existing platform that allows for web editing of a space program or upload of excel that is connected to Revit with an open API that allows for additional programming connections.

- **dRofus**

<https://www.drofus.com/>

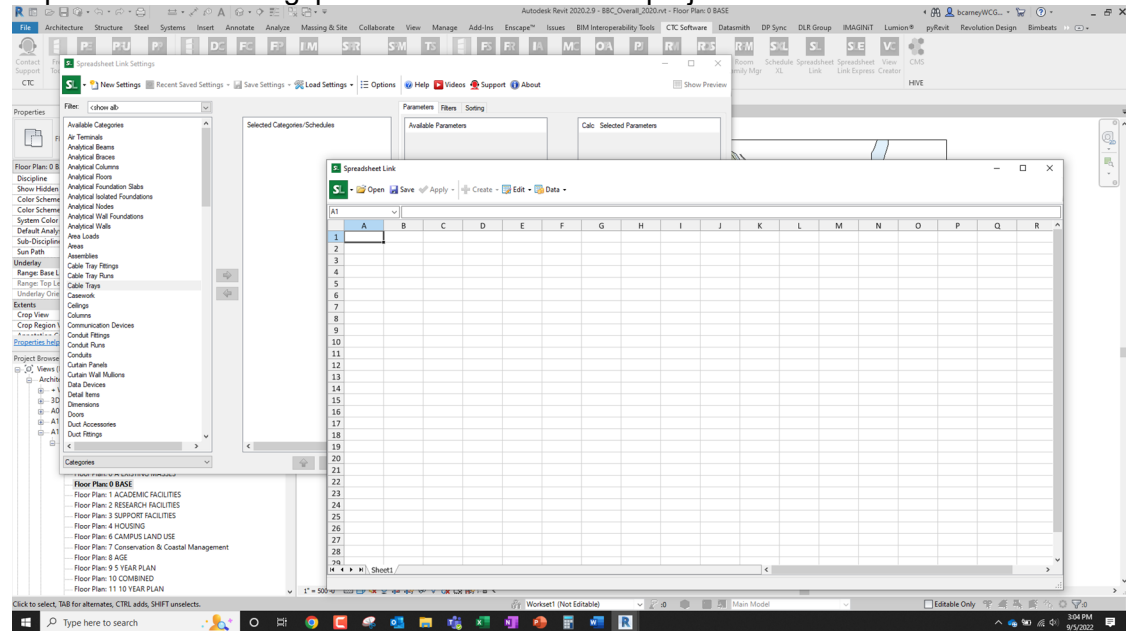


This might be the Cadillac of space programming tools. dRofus has a power Revit addin and web editing that can be leveraged by many stakeholders to develop the program requirements for projects.

Excel Connectors to Revit

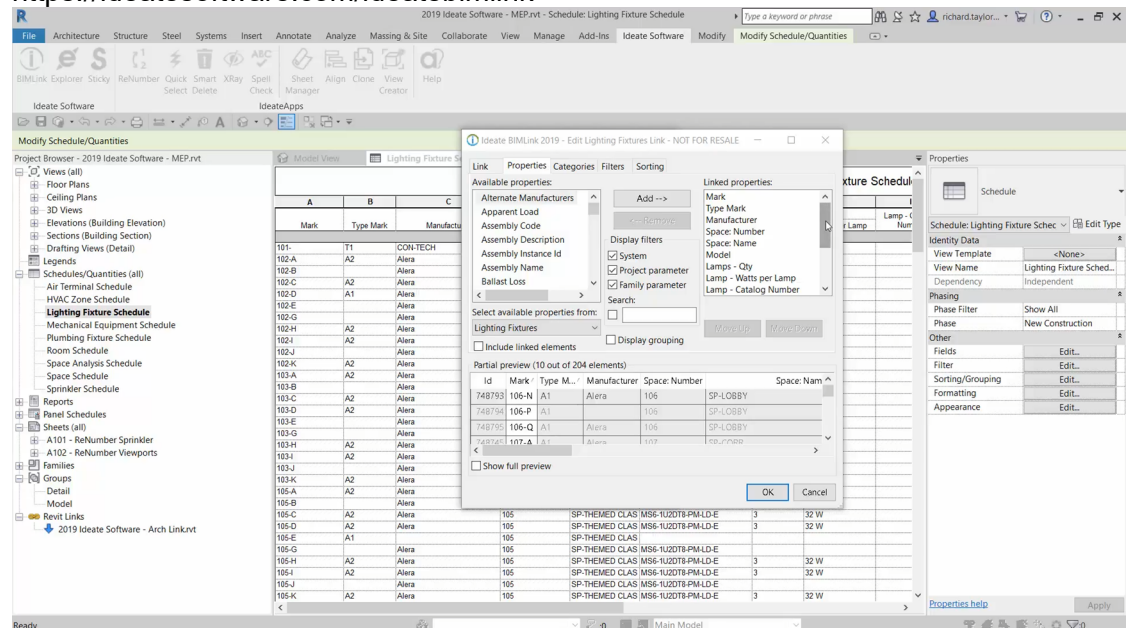
- **CTC Project Suite: Spreadsheet Link**

<http://revitaddons.blogspot.com/2019/12/ctc-bim-project-suite-2020-v2003.html>



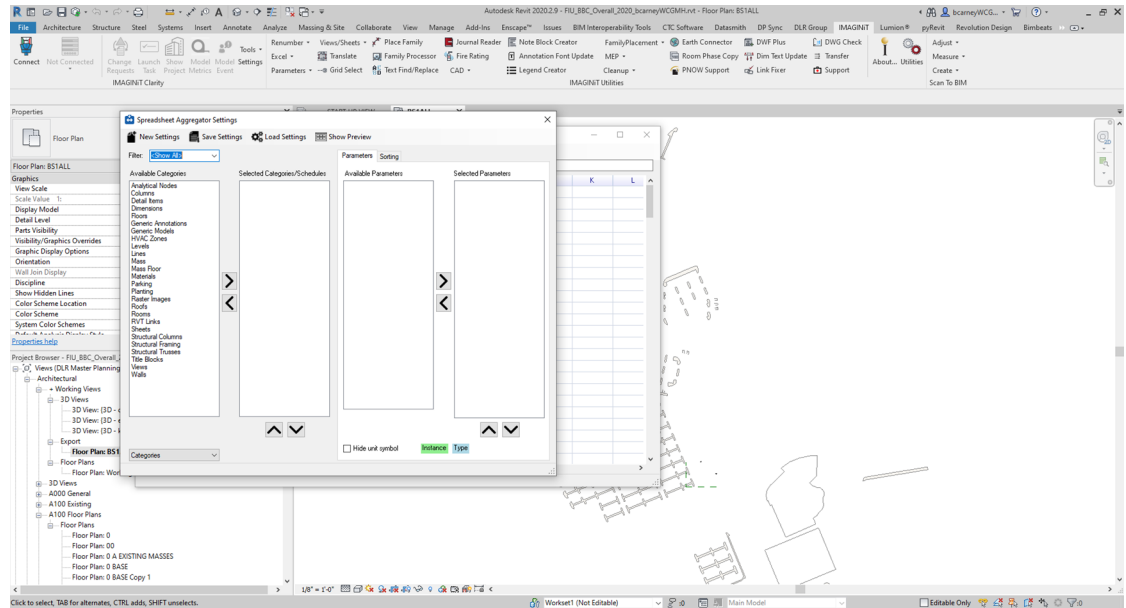
CTC's spreadsheet link has been my go-to excel connector for the last half-decade. It works well to edit information from Revit in excel and allows you to push the changes back to the file. The biggest limitation is that this uses the element id to preserve associate the changes. This can cause challenges in a workshared file if multiple people are working on the category of information you are editing. For a low-cost effective tool to apply information to Revit elements while in excel, this tool is as advertised.

- **Ideate: BIMLink**
<https://ideatesoftware.com/ideatebimlink>

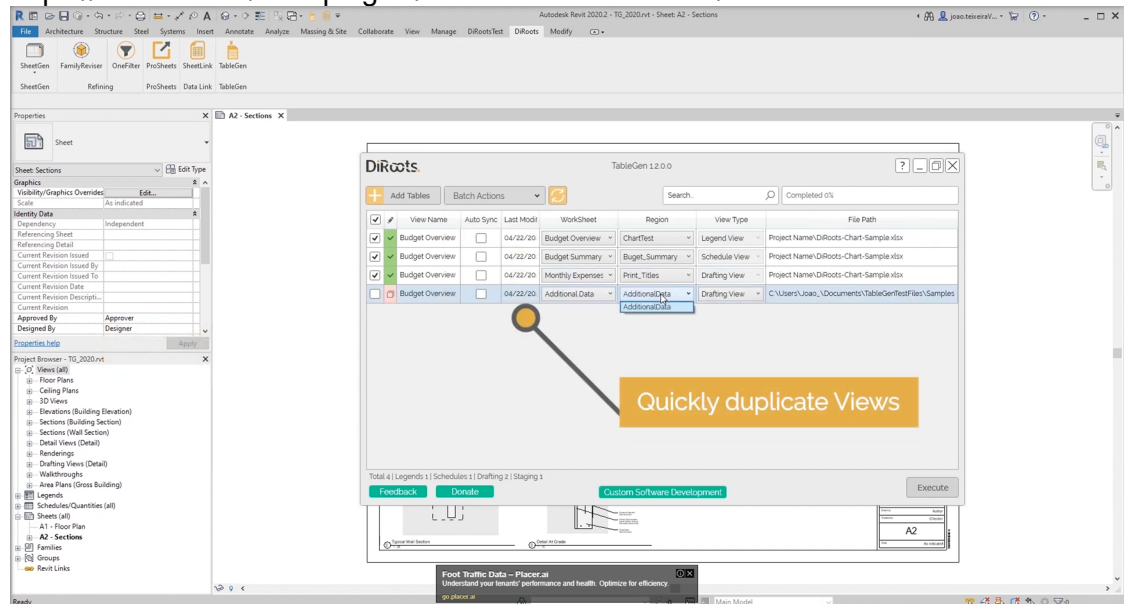


This is a tool that we don't have a ton of experience with but is a common tool in the industry for excel editing. It works really well but comes at a higher price tag than CTC's spreadsheet link. The UI seems easier to learn and it performs well so we wanted to include it in the options.

- **Imaginit Utilities: Spreadsheet Agrigator**
<https://www.imaginit.com/software/imaginit-utilities-other-products/utilities-for-revit>



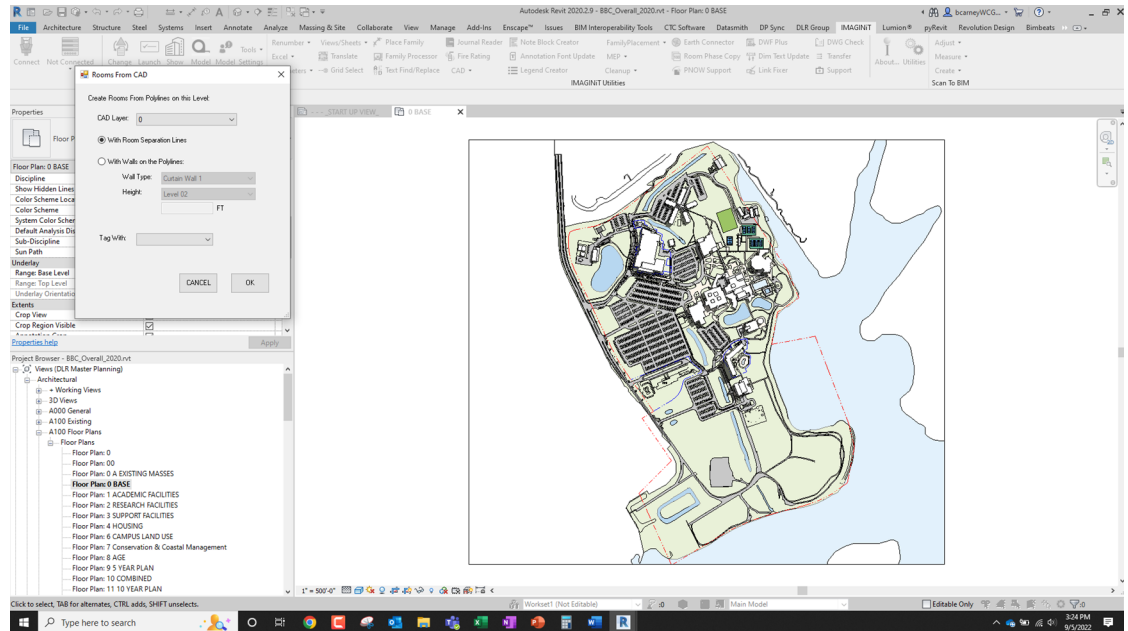
- **DiRootsOne: SheetLink**
<https://diroots.com/revit-plugins/revit-to-excel-sheetlink/>



DiRootsOne is a suite of **free** tools that contains SheetLink which will quickly connect excel and Revit. Because it's free and works really well. It's worth exploring as an option for your tech stack.

CAD to Revit stuff

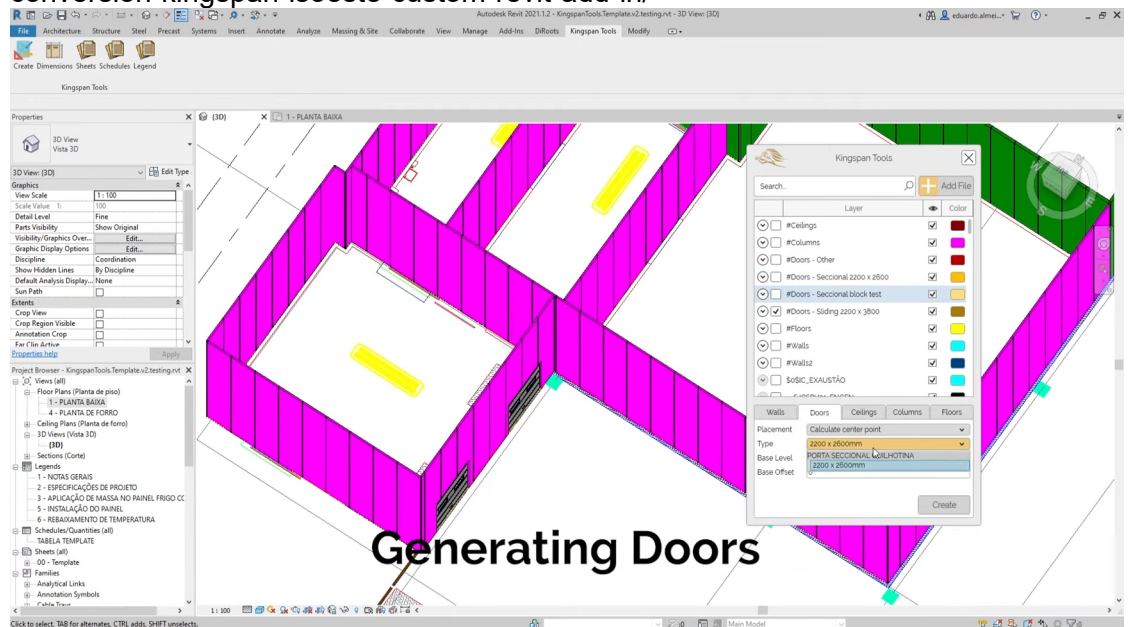
- **Imaginit Utilities: Rooms From CAD**
<https://www.imaginit.com/software/imaginit-utilities-other-products/utilities-for-revit>



We built our own version of this before we found out it existed and already had our Dynamo Script. I have found times that when one doesn't work, this one might so we like that we have it. When working with CAD things, don't seem to be consistent so I do prefer the ability to pre-setup a script for a person to run with Dynamo but the performance of a stable Revit addin is hard to beat when working with an external CAD file.

- **DiRoots**

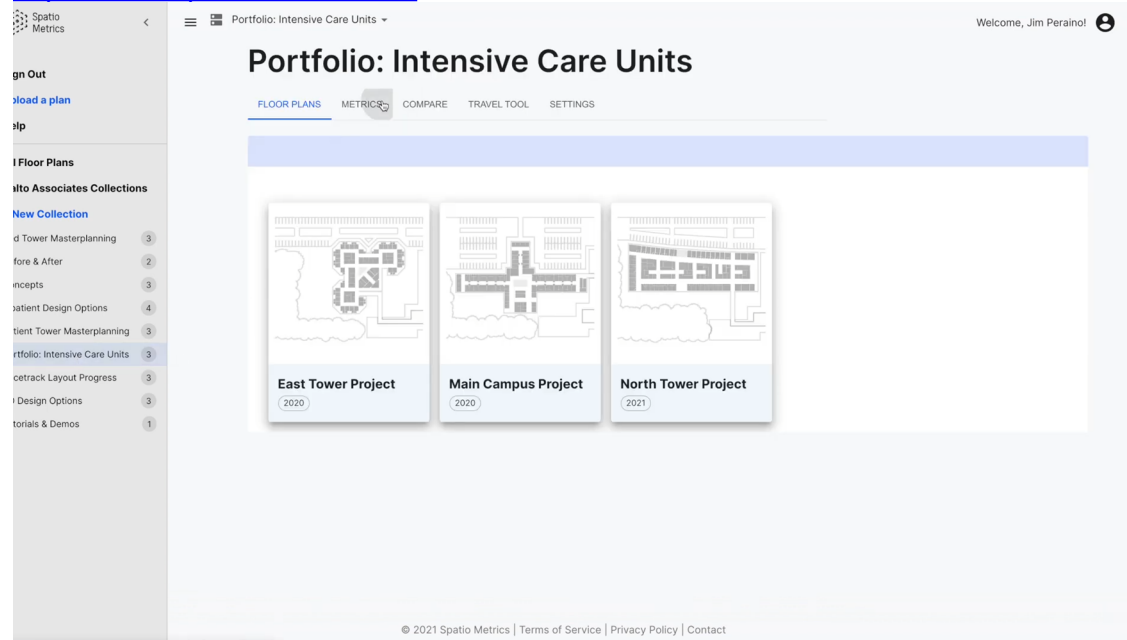
<https://dirroots.com/custom-software-development/case-studies/auto-dwg-to-revit-conversion-kingspan-isoeste-custom-revit-add-in/>



Generating Doors

Data Analysis

- Spatio Metrics
<https://www.spatiometrics.com/>



We haven't found another tool quite like this one. That doesn't mean it's not out there. Spatio Metrics works well in Rhino or uses a Revit addin to apply some annotative elements that it will run analysis on to compare room types, sizes, relationships, views, and similar information to let you compare multiple design configurations with metric comparison to make data informed decisions.

- Proving Ground's Tracer
<https://apps.provingground.io/tracer/>

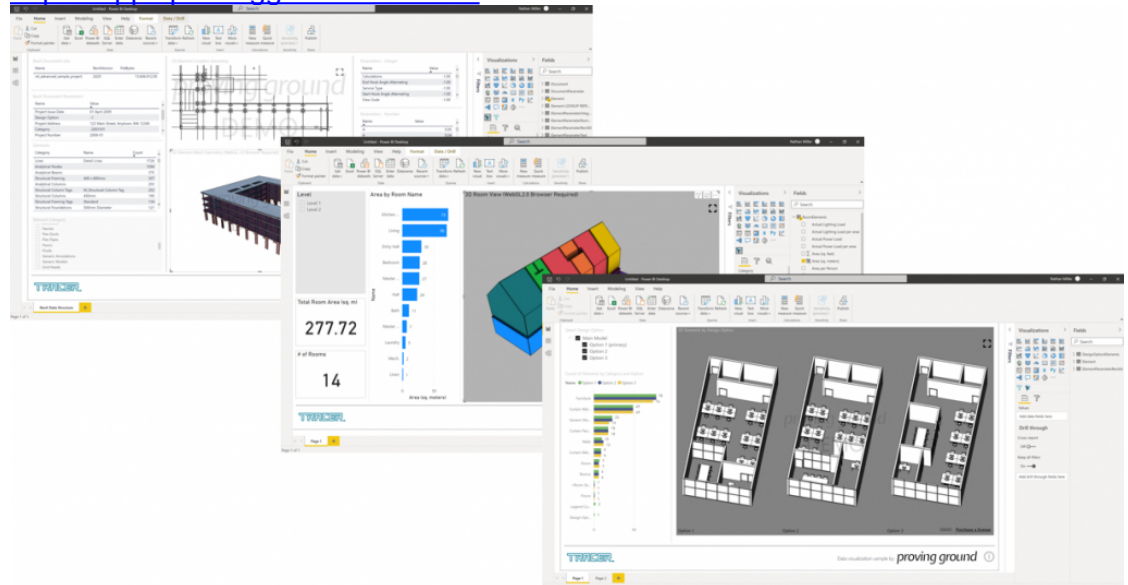
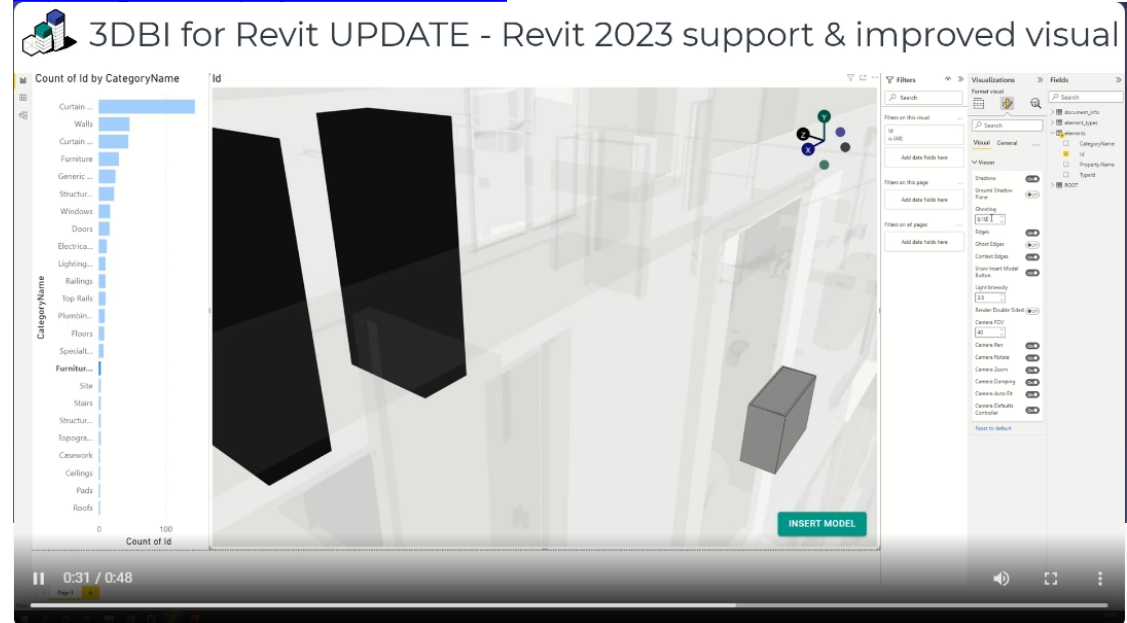


Image from Tracer Website

Tracer seems like a very powerful solution. To-date, we don't use it but is one that if I did not have the other tools already in use at DLR Group would consider so we wanted to include it. Tracer isn't quite like Spatio metrics but does allow you to display your data in Power BI which if you run your analysis with Rhino Inside or Dynamo you could apply the value back to a parameter or export to excel and graphically create an interactive display similar to Spatiometrics.

- 3DBI

<https://kq-dev.be/project/3dbi-for-revit/>



3DBI is a newer program for us. We don't use it but have tried it out and it does work well. Is similar to Tracer in that it offers an easy way to go from your design software to a tool that will allow you to interact with data outside of Revit in an impactful way.

Revit & Dynamo

Everything we've built in Revit or Dynamo had a starting point that we've learned from someone sharing. These building blocks are tremendously helpful in developing your own workflows or tools. This section is intended to leave some of the cookie crumbs to the workflows we've developed for you to develop your own.

Revit Space Planning Blocks

What it does: There are two methods of space programming that I really like with Dynamo. One is more traditional and well documented from Kyle Martin. This was an evolution of what I had seen previously with Grasshopper and one of the early great uses of Dynamo. It takes a list of rooms and size requirements and makes a lot of blocks in Revit for you to move around.

The other method, uses the Dynashapes package. In theory it looks amazing. This also takes a list of rooms and size requirements but adds in adjacencies and tries to fit them into a boundary in a bubble diagram sort of way.

How it works: Method one, it uses math to divide the square footage requirement to get the dimensions of the block. Using a spacer dimension, it creates a list of points in rows to place each block without overlapping each other and set parameters of the blocks. <https://dynamobim.org/space-planning-data-cycle/>

Method two, is complicated... Dynashapes has some great features to analyze structure and allows for manual interaction in Dynamo. Similar to method one takes a list of spaces uses math to decide the size of bubbles, but then allows you to adjust bubbles that are informed which bubbles should stay close to each other to assist in the planning process. <https://dynamobim.org/space-planning-in-dynamo-with-dynaspace/>

When to use it: If you don't have an addin, you can find the space programming dyn in a few spots by googling it. It works great, allows you to add a few specific requirements that the purchased options don't because you can customize the script to do exactly what you need it to do. We use it to parse the excel file if we have a client specific project and fill in information that may not be filled out in excel.

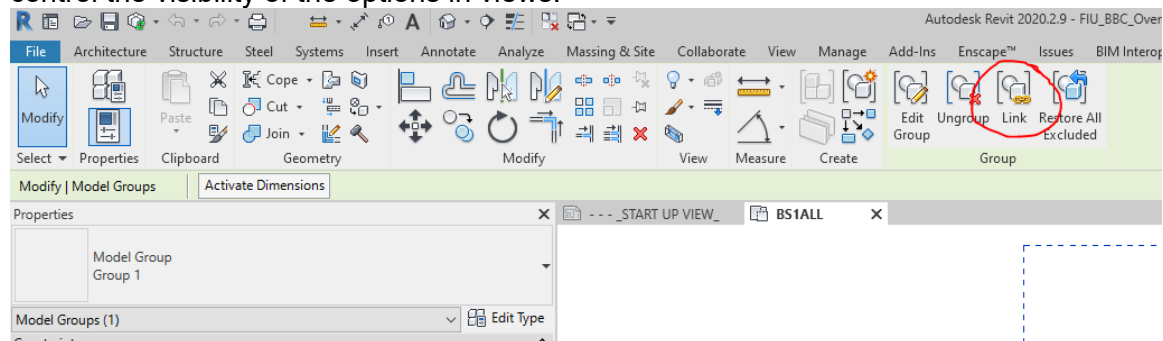
Revit Design Options

What it does:

Revit design options are great if you use them correctly. You can use a design option in portions of the model to display different options and then bind the file back together when you've picked an option. They have their limitations. The design option feature of Revit is limited to a single person editing at one time. It's geared toward options on an element or a small space. When multi-person editing is needed, so are workarounds. You can use a Revit Link.

How it works:

When you need to work on a portion of the building that is large enough to require more than one person working in it, you can make the area you need to work on a model group and then convert the model group to a link by selecting the model group and clicking link. This new link can be added to a design option in your current model to control the visibility of the options in views.



Here's a video link from the LinkedIn Learning video course Managing and presenting design options <https://www.linkedin.com/learning-login/share?forceAccount=false&redirect=https%3A%2F%2Fwww.linkedin.com%2Flearning%2Frevit-presenting-and-managing-design-options%2Fmanage-li>

[nks%3Ftrk%3Dshare_video_url%26shareId%3DA%252BS9of8FQ4GitKTo%252FLUAIQ%253D%253D](https://www.dropbox.com/s/nt3kr58lp1juz9e/SVG%20Exporter.dyn?dl=0)

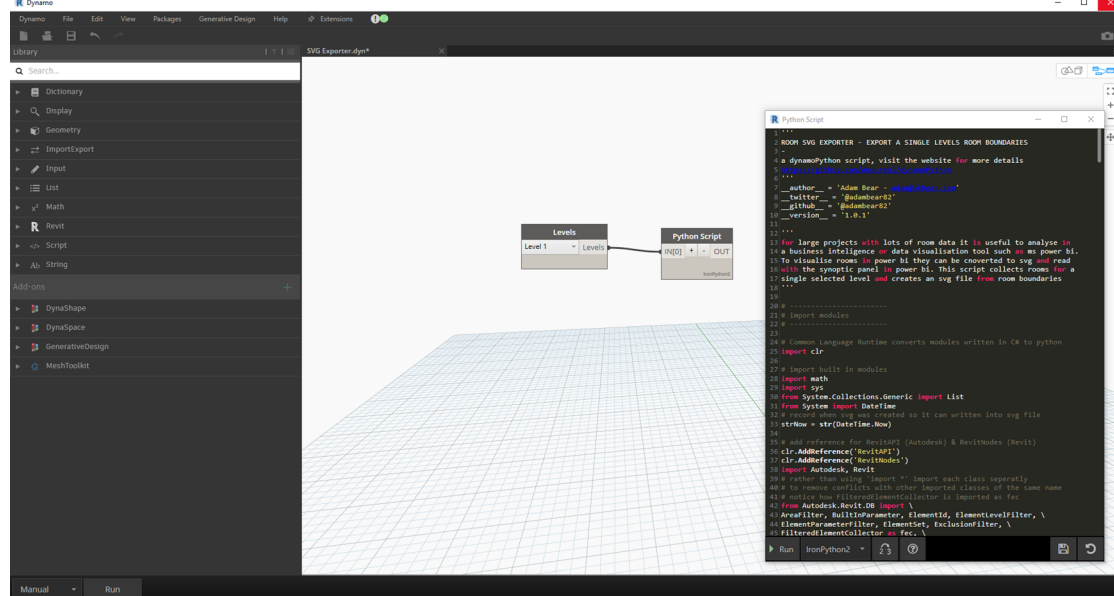
When to use it:

Any area that is of a size that would need multiple designers working at the same time should use this approach for design options. You can copy the entire file and re-name it to create new design options once the link is made and then bind it back into your model once an option is chosen.

Revit to Power BI

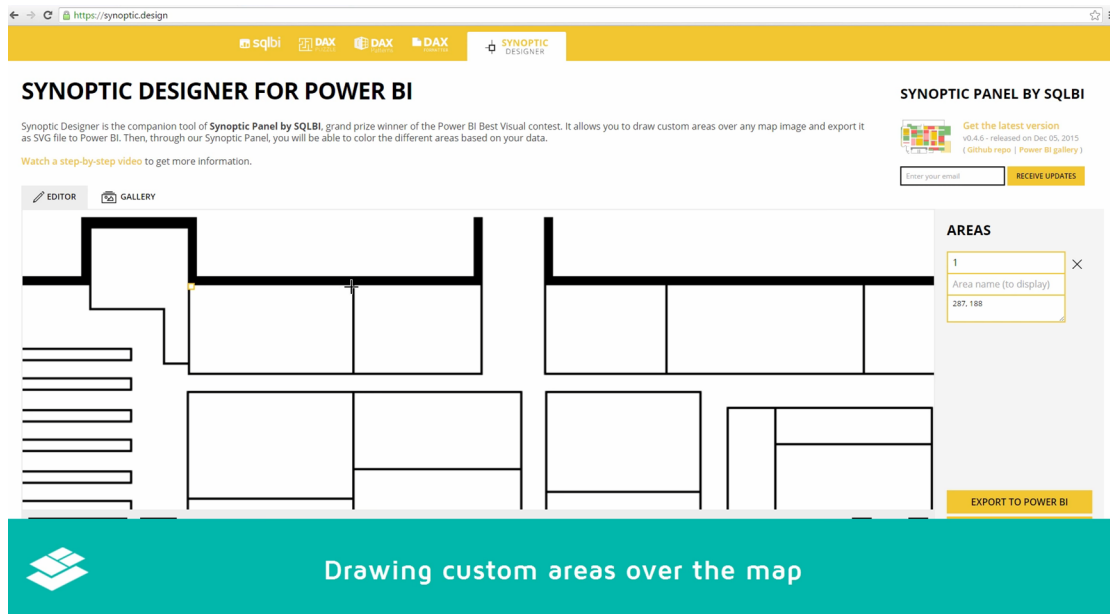
What it does: You can export a Revit schedule to csv and use Power BI to read the information. If you need to create a floor plan and don't have a tool like Imaginit's Clarity to generate the shape file, Dynamo can do that. Here's the script I have for this.

<https://www.dropbox.com/s/nt3kr58lp1juz9e/SVG%20Exporter.dyn?dl=0>



You can use the Synoptic Panel to connect the svg file to a visual in Power BI.

<https://okviz.com/synoptic-panel/>



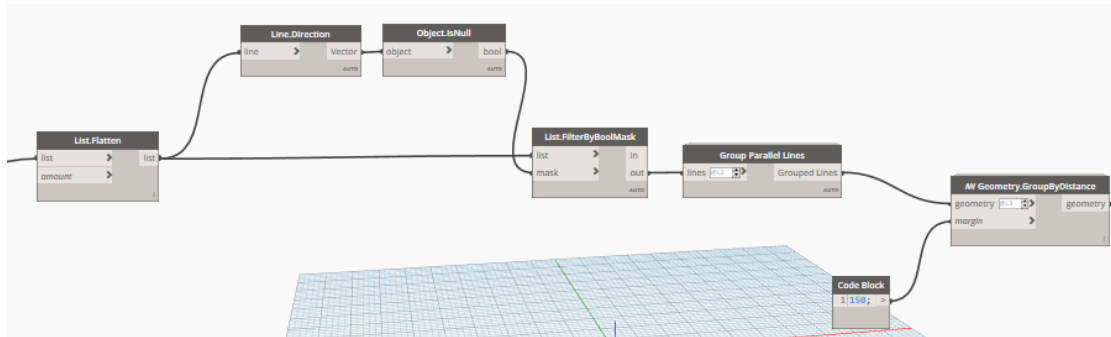
How it works: <https://forum.dynamobim.com/t/export-boundaries-of-revit-rooms-to-svg-and-use-them-in-powerbi/21776>

The power of a forum... This script came from a post we found on the Dynamo Forum for creating the svg image. Other users were having issues, if you read far enough down in the thread, you can find the python code that exports a list of boundaries and text to an SVG.

When to use it: This is a great method for quickly getting what you need. The limitation though is that it really only works well for a single floor of a building or campus so you may have scale issues. But you can make it work for what you need. It's free and offers a little flexibility in connecting outside data to your rooms because you control what the svg keys are where other tools will use Revit Element ID or other pre-set keys.

Dynamo for CAD Stuff

What it does: Yes, there is a dyn on the Dynamo Forum that converts CAD lines to Revit. We're not sure why this isn't being screamed from the mountain tops... Working with this script is how we worked out the logic for the tools that we developed to convert CAD to Revit. <https://forum.dynamobim.com/t/create-walls-from-cad-link-lines/25396/6>



How it works: If you have parallel lines, you can group them together by a distance. Something to note is the script looks for walls at a single distance. If you grouped them by known dimensions of wall thicknesses you could get a little more refined and place walls of multiple thicknesses.

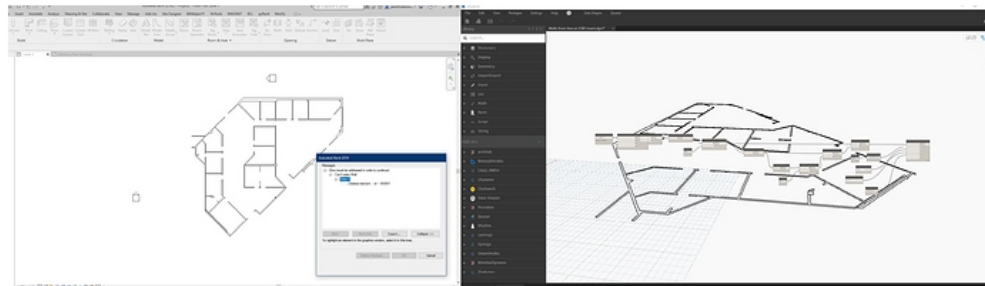
2 MONTHS LATER



jarod.tulanowski

Feb '20

I was all excited about using this, and this works great as long as your walls are all the same thickness. has anyone made something that can choose generic walls by the distance between two parallel lines. my example has many different thicknesses.



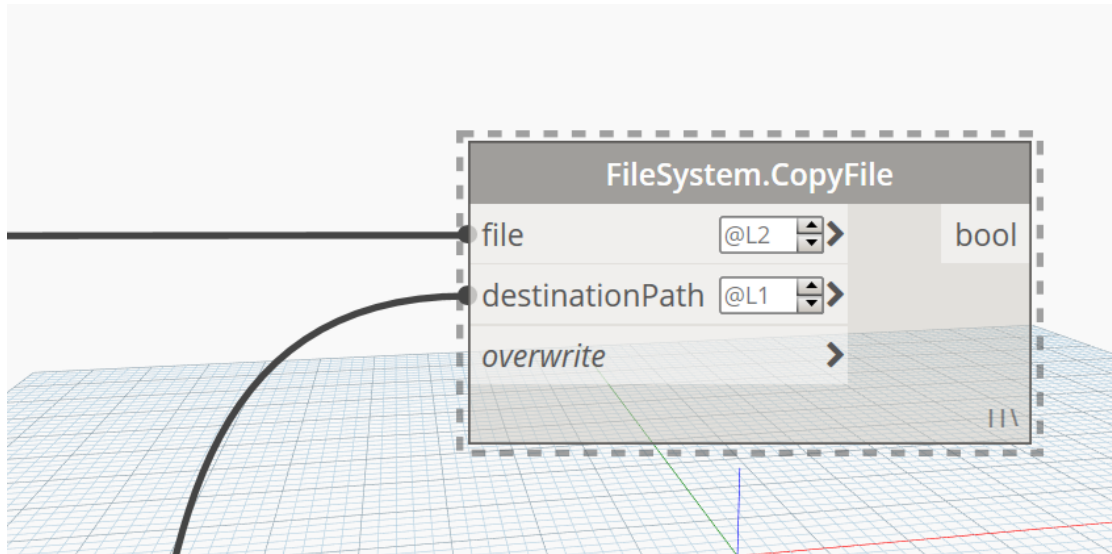
Another way to make this a little more powerful would be work with the circle of door swing to extend the line to enclose the room and actually draw the entire rooms. If the Cad file has text room names in it, you could read the text and place a room at it's location and name the room with the text.

When to use it: Any time you have a CAD file and it needs to be Revit... We're really excited about this being an option and will continue to improve our addin for it.

Dynamo File Setup

What it does: In the project example we showed we used Dynamo to copy our template, rename it, create levels, and link CAD to those levels before we converted the CAD to Revit rooms.

How it works:



The OOTB Dynamo Library has a node for copying files. With a list of excel file names and folder locations, you can easily script in to copy a file and set it's name. The next tricks to this are to run scripts on many files and link CAD files. The Rhythm package has a node `Document.BackgroundOpen` that will open a revit file and then do stuff to it. The BIMorphNodes has a node to link a CAD file. Here's a link from my good friend Dalton Goodwin who posted a great video on his youtube channel of how to work with Revit Links after working on this script while at DLR Group https://youtu.be/tQ4-8yJ_Gkc

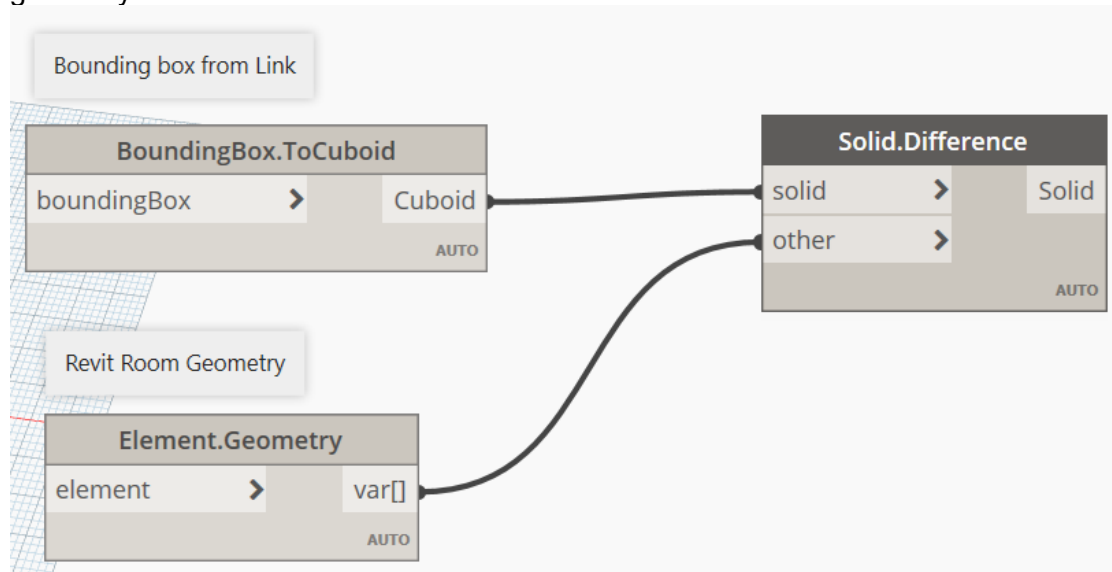
When to use it: We use a rule of 10X if the time it takes for you to script something is 1/10 the time it would take to manually do it, it's worth the risk of trying to script. When you need to setup several hundred Revit files and name them then do scriptable work to the files is when this is the time to write a script to do the tedious work.

Dynamo Revit Link Shrink Wrap

What it does: Draws a room boundary around the linked file and place a room inside of the room boundary. Then takes the geometry of the room and finds the inverse geometry which is the simplified geometry of the Revit model.

How it works: The 3 tricks to this, make the link room bounding, place your room slightly off the corner of the boudnign box to avoid placing it in the link, and use the

geometry difference node.



What this workflow did for us was to select a link and get the bounding box. Then offset the bounding box and take the bottom face's outline and place a room separation boundary. Then find a point inside the boundary and place a room at the point. With the link set to room bounding, the room should “shrink wrap” around the link. Then you can take the bounding box geometry and room geometry and the difference of the two solids to get the simplified geometry of the Revit Link. Then push that into a Revit family.

When to use it: This felt like a rare use case for us with a lot of effort to write a script. But it was effective to create a simple stacked mass that our teams could use to work the same way they were used to working.

Conclusions

We have a lot to explore and continue to do so in Machine Learning and computational design to build upon our tech stack. Our direction is to use computation to put the power behind the pen wherever possible and grow with our designers. Technology can do seemingly anything now but without the designer actually using a tool, it is just a tool. DLR Group's Design technology team has worked to integrate itself into our integrated practice by developing deep partnerships with discipline and sector innovators that innovate with us and are able to balance a lot of change across different groups while it seems like a manageable change to each of the groups as an individual.