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[AS502217]

Automating Overall Planning with Revit and Connected City Data Platform

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Learning Objectives

- Automatically creating 3D models using the predefined attribute information in Revit
- Collaboration and real-time testing and option development with clients.
- Creating a database for master plan projects with all buildings and plot information with automated plot sheets.
- Connecting design data to online platforms enhances client portfolio management and engagement.

Description

At InSite, we have spent years developing master planning solutions for large-scale master planning projects using connected data and automation in Revit, Civil 3D and online data platforms.
This session will talk about how automating the process has helped the team reduce manual errors and improve efficiency for cities and precinct design, show examples of leveraging data to drive decision-making through the design, and how we are using data-driven platforms to solve problems in urban analytics, resilience, sustainability, development feasibility, and strategic planning.
You will be shown real examples of this process and how it was achieved, along with data being linked to online data platforms diving financial city model, automation of design and how 3D and data visualisation is a powerful tool to drive informed decision-making on major projects. Design data, open data and web apps are combined to enable better outcomes throughout the development lifecycle.

Speaker(s)

As the Digital Lead, Chris is responsible for transforming how we design and advise to help clients become future-ready. Working with professionals across the business to enhance the way they design and implement integrated solutions across core digital competencies, including visualisation, data analytics, digital modelling, computational design, information management and solution development.

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Chris applies his years of experience with relevant industry and technical know-how to help clients fundamentally rethink their planning, strategy and business processes, create connected digital platforms and improve their analytics and collaboration. Chris leads the business in how we work, share knowledge, collaborate and communicate to improve whole-life performance on every project delivered to clients.

If you have any questions related to this topic, feel free to ping me on my LinkedIn profile or my social media accounts: @smeaton_chris

A Quick DCR Intro

Before we get started, it is good to understand that with every project, there are final deliverables which most of the time tend to be documentation-based, and Masterplanning is no different. We have a lot of reports and graphics to produce, but one of the critical deliverables is a document called **Development Control Regulations** (DCR).

Simply put, Development Control Regulations (DCR) is a document that shows planning regulations such as height, land use, area, setbacks and building lines for the full development and each plot in a subdivision plan.

The DCR sheets can vary from project to project depending on authority or planning requirements, so keeping flexibility is key and having the ability to update sheets quickly due to design changes or comments.

Introduction Project

This project workflow was initially created five years ago to generate DCR sheets quickly, but leave a model that could be updated easily and a framework for developing master planning information.

This workflow works best if you intend to utilise Revit for the whole project, as getting started is as easy as linking a DWG base information or sketches to creating plots using the **Room Category**. Rooms are a good tool for this as they cannot be allocated twice and will indicate if a boundary is not closed; using **Color Schemes** can help you quickly generate layouts for reports showing things such as LandUse, FAR and GFA.

Plus, with Dynamo's introduction, you can easily link Excel data to project parameters and drive the data and model.

Dynamo Graph

The graphs shown in this document were set up for one project and may not work when replicating this workflow without some adjustments or alterations. The below methodology and graphs are provided to demonstrate the thinking and techniques used when tackling this type of project.

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Project Example of Old Project

Setting up a Project

Setting up Color Scheme

This is one essential power of using Revit for master planning projects, **Color Schemes** used correctly are a powerful tool allowing you to create colour plans quickly or integrate the data within your plots in a visual way, from land use diagrams to building levels.

Project Parameters

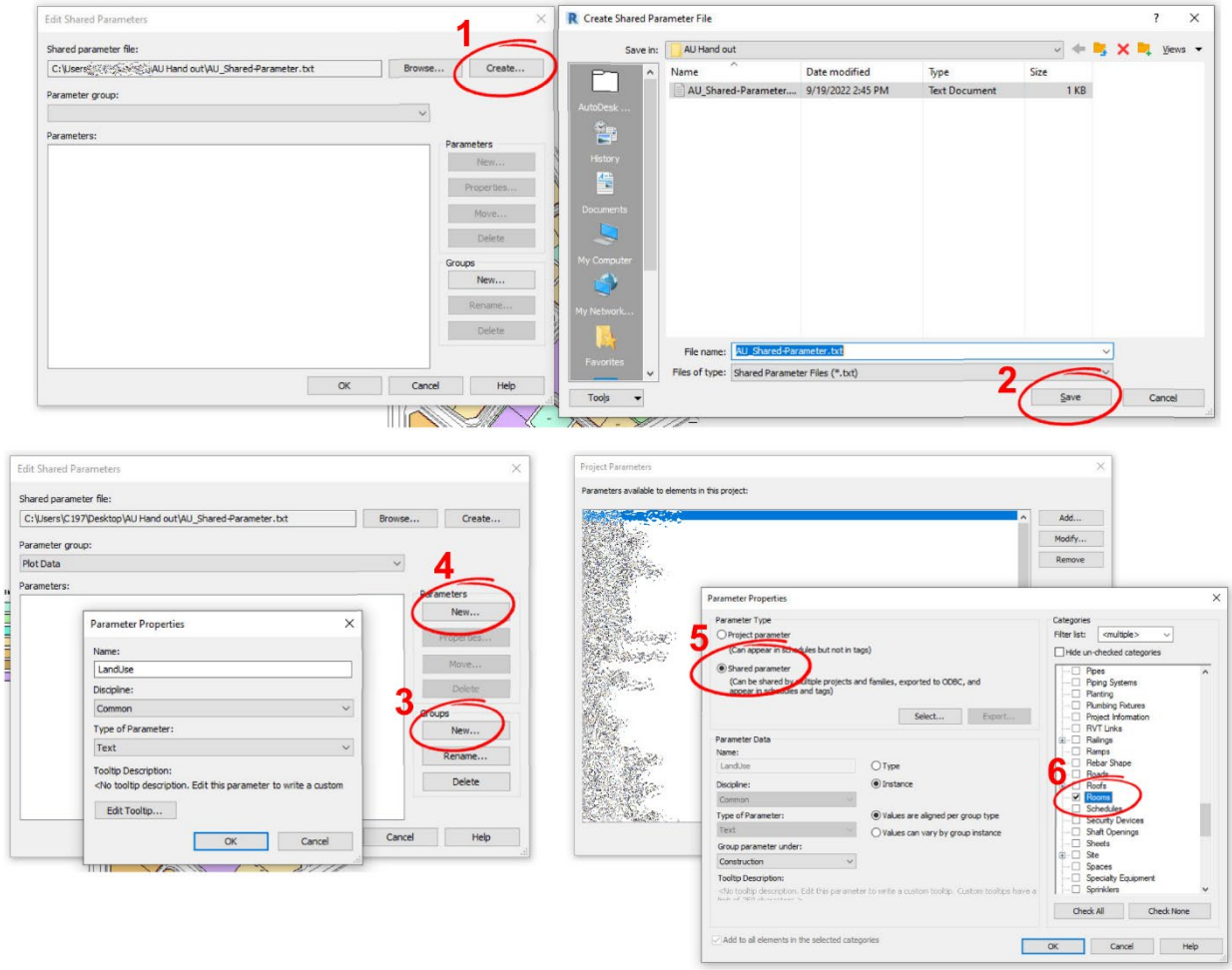
The first step is to create the project parameters that will be held within the rooms you will use to create colour schemes and other reporting within your project.

Example of parameters to create:

- Land Use
- FAR
- Land Use – Sub
- District Name
- District Code
- Block Code
- Zone Code
- Ground Parking
- Underground Parking

The above is a short list of options, but depending on the projects you work on, you may want to add a lot more data to maximise the reporting and using formulas - you can get creative.

Given that this process will be used over many projects, I would suggest creating a set of **Shared Parameters** to build flexibility and standards into your workflow and make adoption easier.

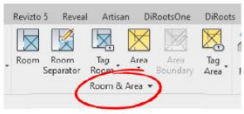


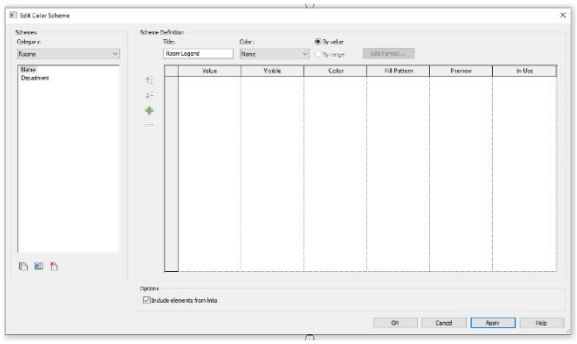
Steps:

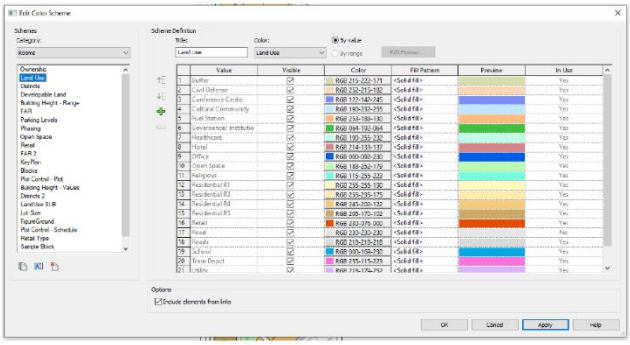
1. Select **Shared Parameters** from the **Manage** tab and create a new file,
2. Save this file in a central location that is easily accessible by your team with a descriptive naming standard, so it's easily understood.
3. Create a **New** group. For this example, I am creating a group called **Plot Data**. You could also create a group for parameters within massing.
4. Create the parameter names you want, such as **Land Use.** Once complete, save and open **Project Parameters** within the **Manage** tab.
5. Select **Shared Parameters** and press **Select**; this will bring up all the parameters you have just set up. Select which grouping you want the parameters to use. I have used **Construction**; select **Instance** type as you may like this to be different in every plot depending on the design.
6. Select the **Categories** you want the parameter to apply to, the main one is **Rooms,** but you may want to add it to others such as **Areas** and **Mass**.

Creating Color Scheme

Now you have all the parameters set within your rooms. You can now start to set up your **Color Scheme** to use within your plans.



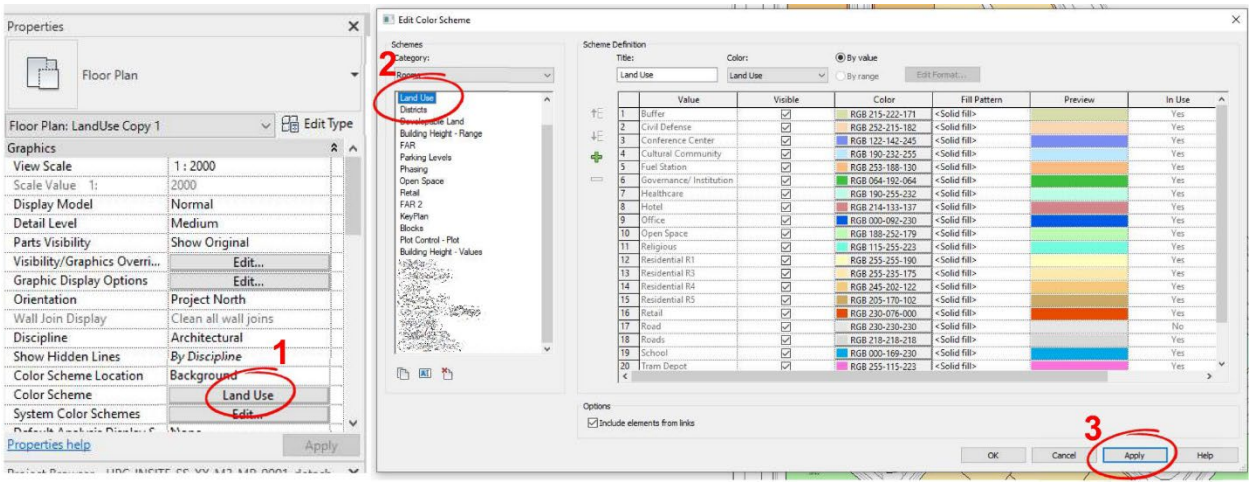




Steps:

1. Navigate to the **Architecture** tab, select the **Room & Area** dropdown and click **Color Scheme**.
2. Under the schemes category dropdown, select the **Rooms** scheme and **Duplicate** from the bottom left corner. Here you can set out all the schemes you want within the project.
3. On the right-hand side, you can now start adding the **Scheme Definitions** by selecting the **+** and selecting a value; for Land Use this may be Residential, Office or Open space plots. You can then set a colour and fill pattern type.

Setting the Color Scheme in the view is done within the **View Properties**; navigate to the graphics and set the **Color Scheme**.



Example schemes:

Massing with Dynamo

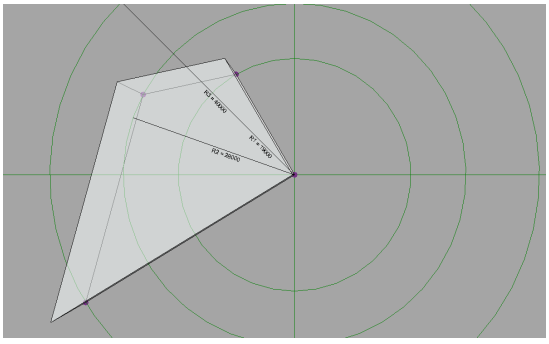
This section will cover how we created simple massing for the overall building envelope on the project on a large scale. This workflow is for DCR development, so the massing is basic to show maximum development.

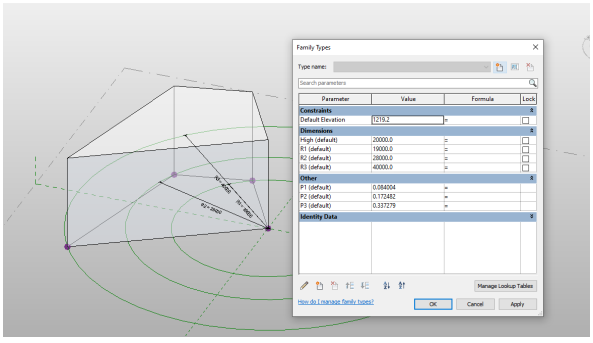
For the Dynamo script to work; you will need to download the following packages from the library:

Package	Version
LinkDWG	0.3.91
Spring Modes	210.1.1

Massing Family

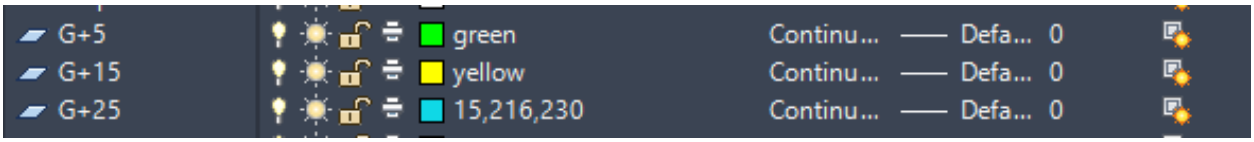
We created an adaptive component massing with 4 and 5 points for this example. If you need more points, you can add more to the family depending on the project's complexity. The example massing .RFA is available in the download files.

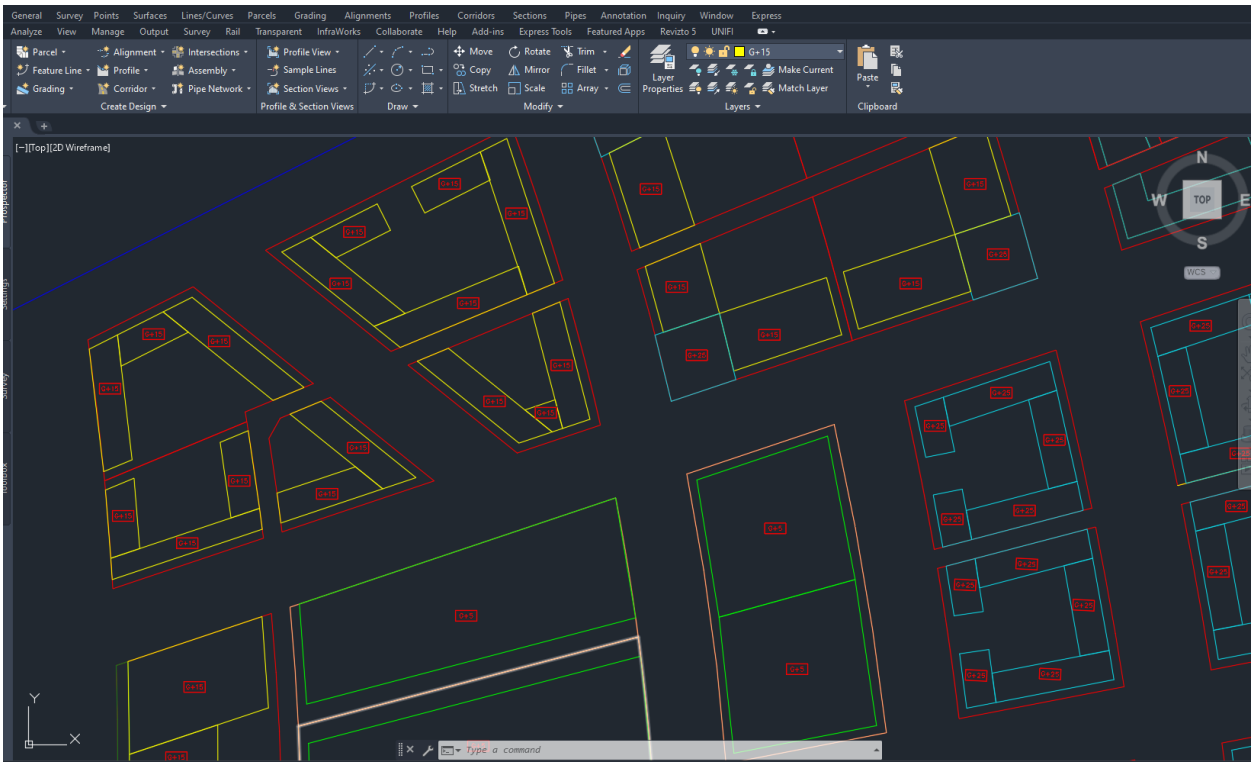




Autocad File

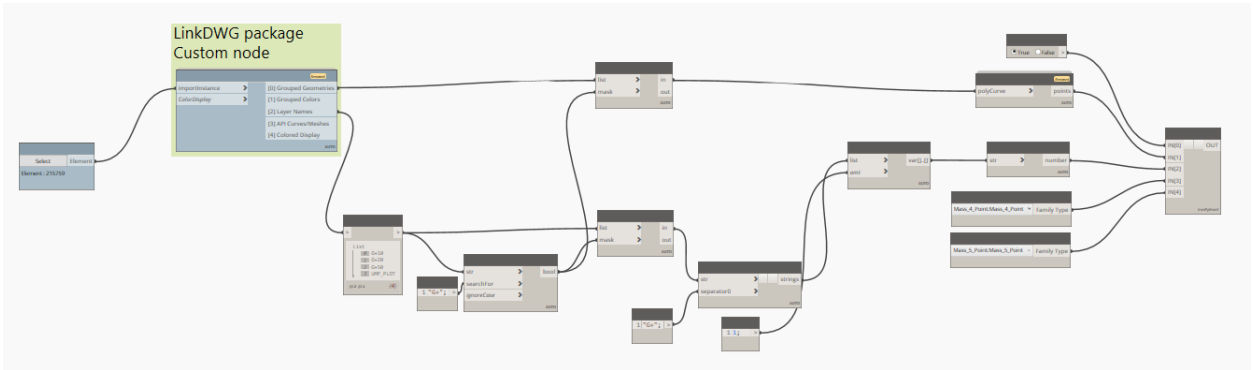
For the Dynamo script to work, the building footprint needs to be separated into individual layers defined by **G+** followed by the intended massing height in meters. The tags are not needed; they were just added for this example for information.



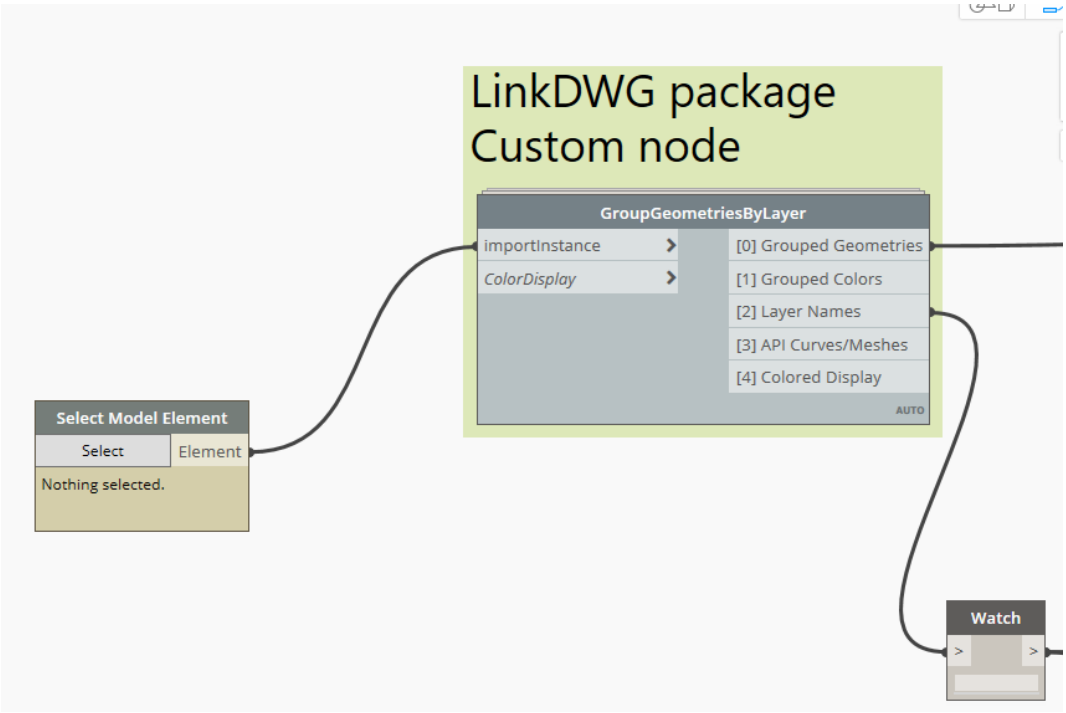


Massing_Create_FamilyParameter

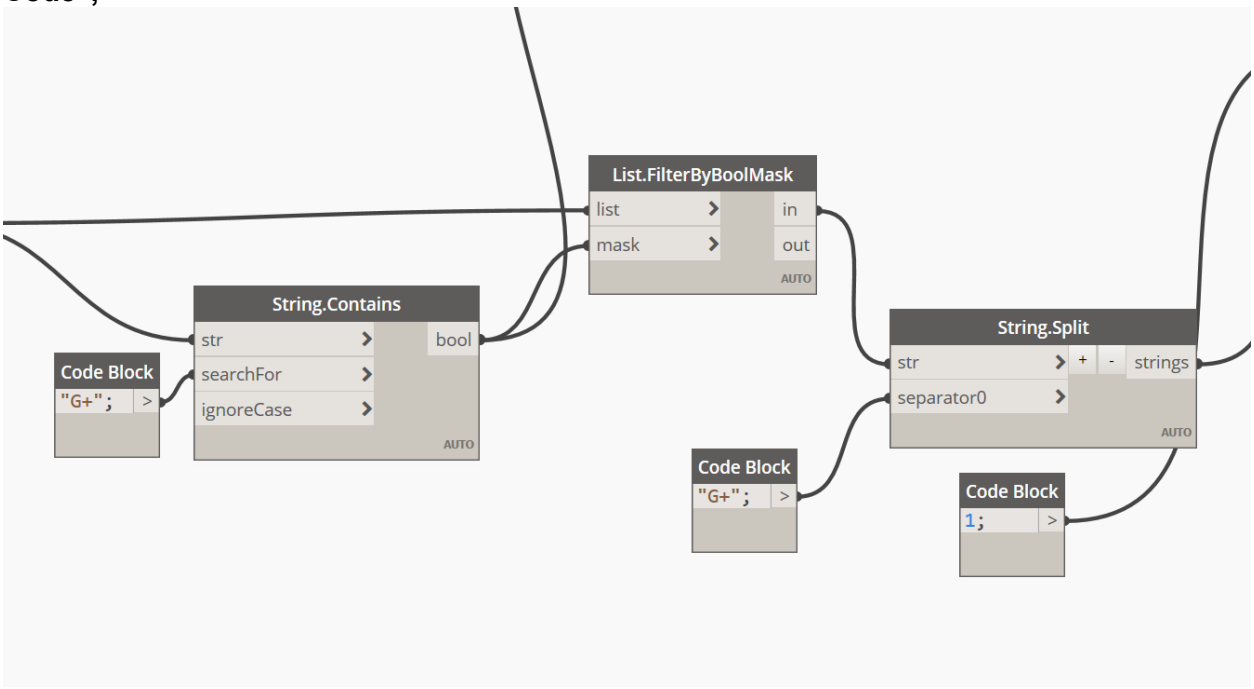
Below is the Dynamo graph used to create massing; link the Autocad file into Revit and open Dynamo.



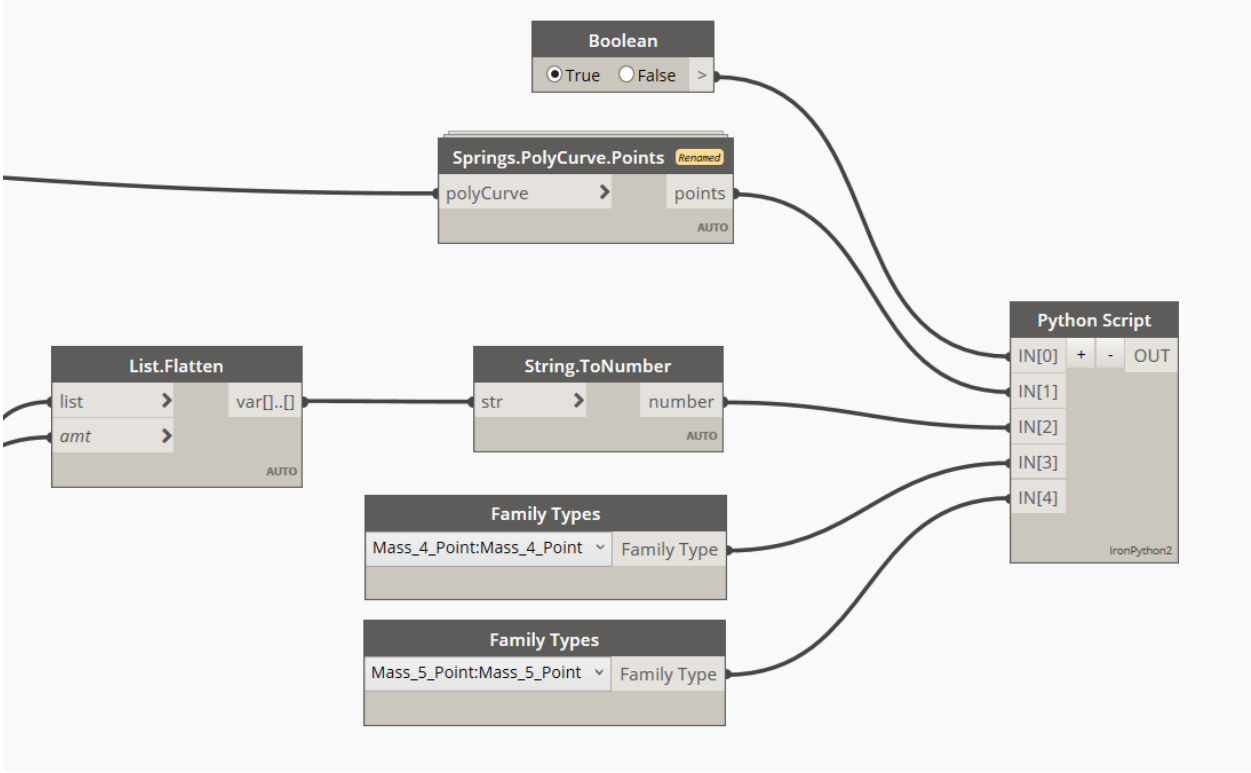
Use the **Select Model Element** node and select the linked Autocad file in Revit.

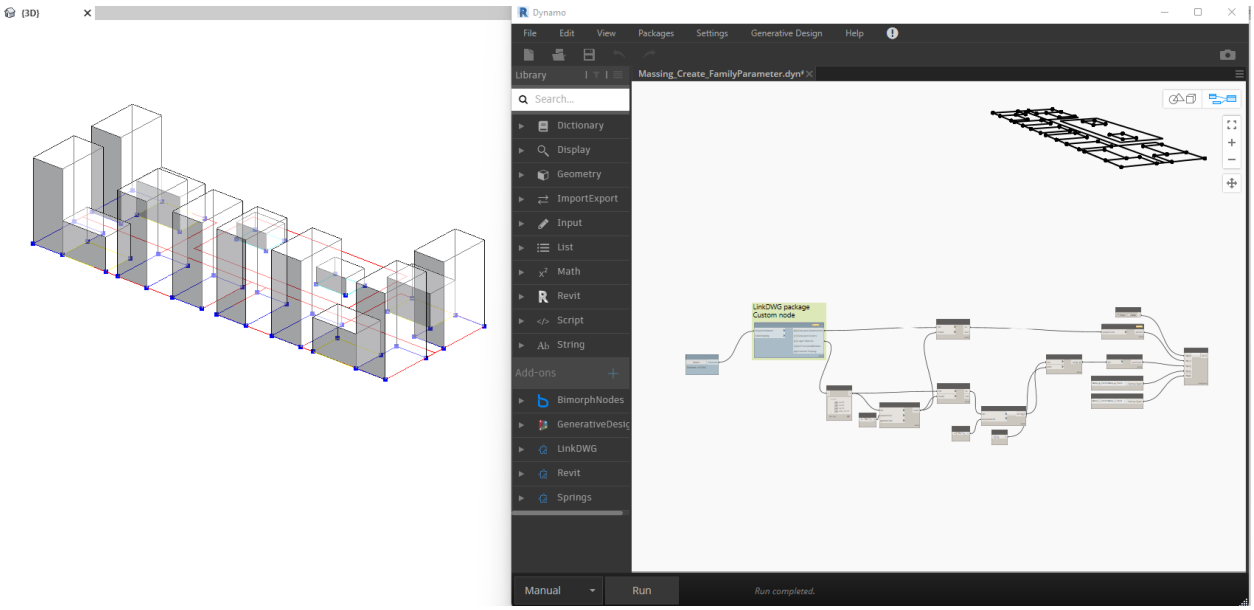


For this example, the layers are identified by **G+**, so within the **Code Block,** you need to make sure you type **"G+"**; you can update this to anything you like; just make sure the layers start with whatever you use and are typed into the code block for example: **"Your Code";**

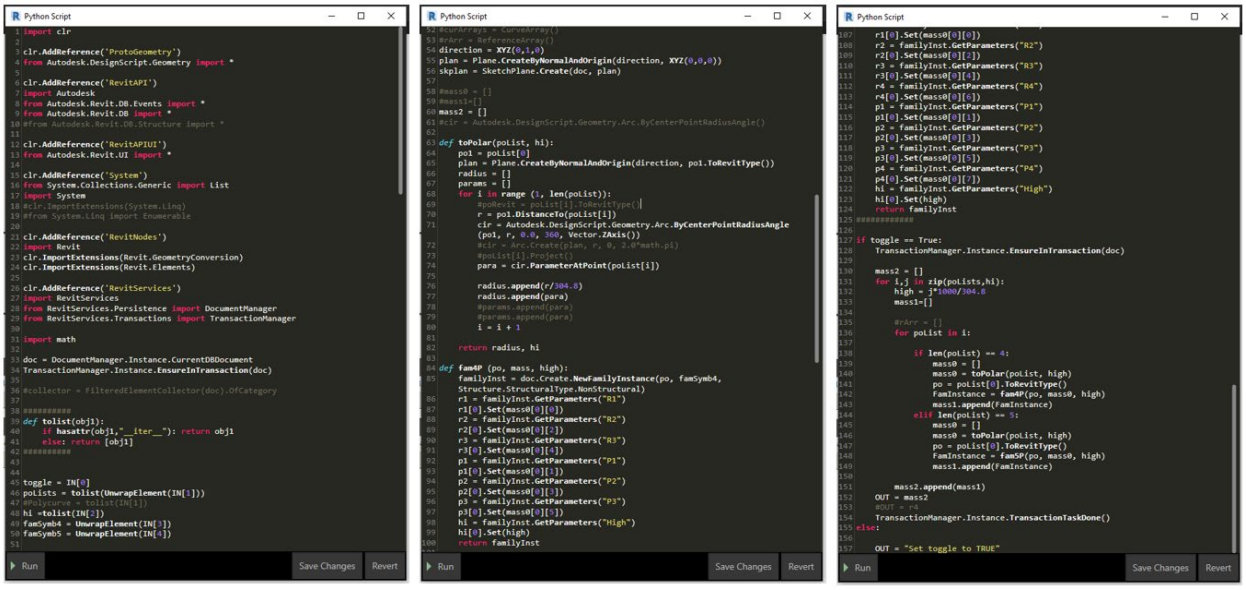


This script contains a Python node that is in the download files. You need to make sure you have the massing families loaded into your project and select them from the dropdown in the **Family Types** node for inputs 3 and 4.





The Python script is available but below is the code. NB. The Python was developed some time ago, and for this specific task - there is likely a more streamlined way to achieve the same result!



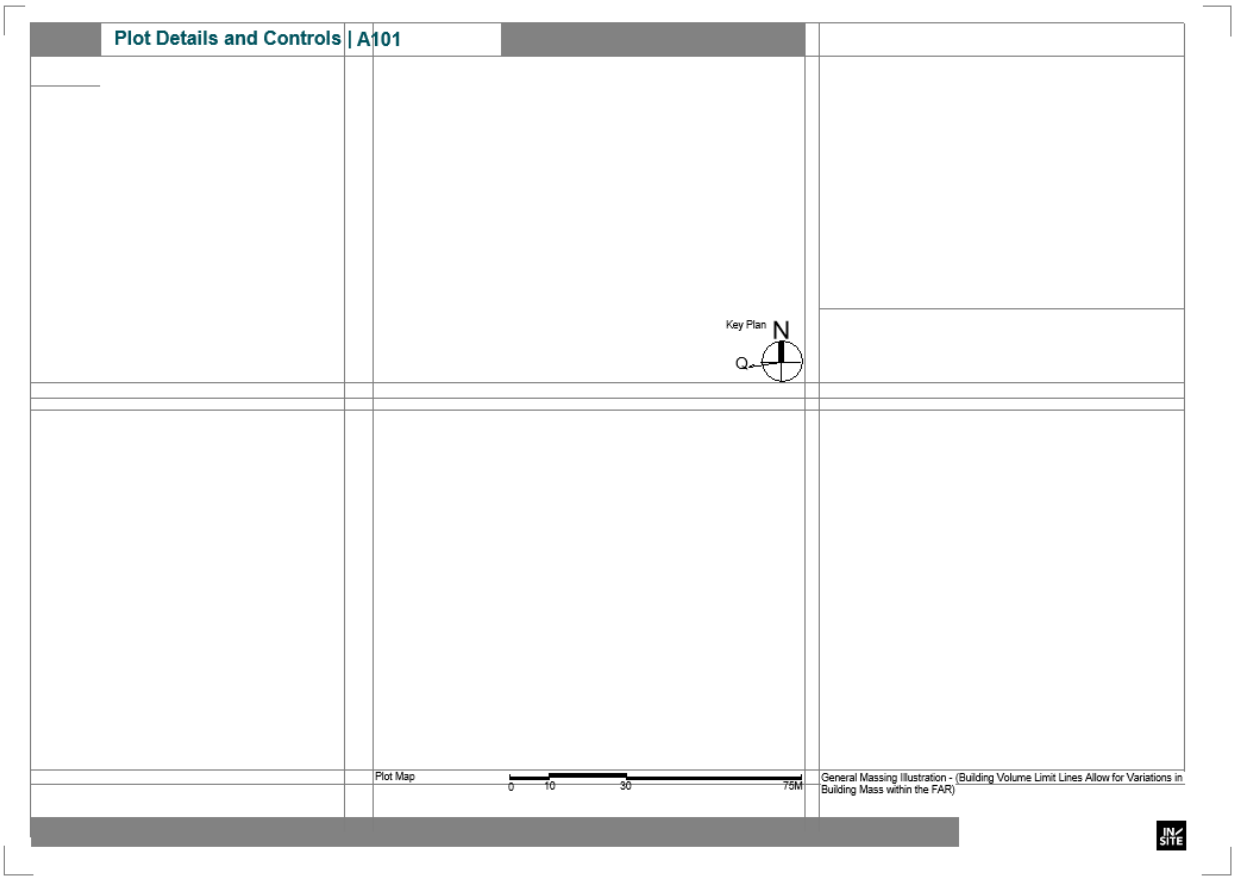
Revit Template

Within your Revit file to get the sheet and view creation working when you run the Dynamo graph, there are a few things you will need to add, such as:

- Sheet Title Block Template – to set out DCR layout look and views to be placed
- Views – there is a set of standard views that Dynamo will use as a template
- View Templates – this will make sure all your views look the same
- Legend – this will be placed on every sheet

Revit Sheet Template

Within this example, I have marked out the position of the views and information using invisible **Detail Lines**; this helped me set out and tweak the position of the views in the Dynamo graph while not showing on the finished sheets.

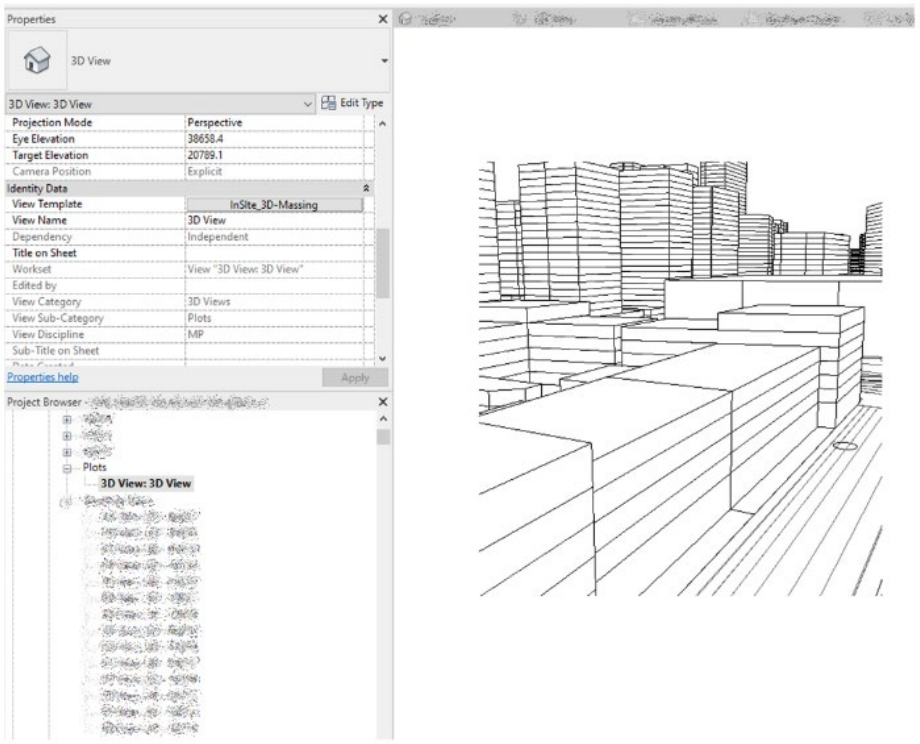


Template Views

These are the views that Dynamo will replicate for each plot and place on the sheet.

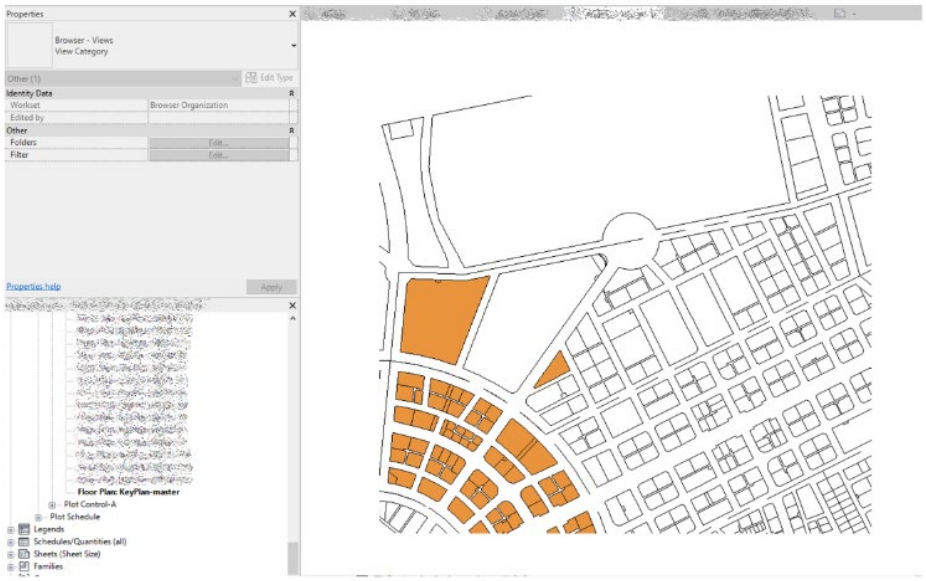
3D View Template

Set up a 3D view showing one plot, use the crop region to size the view to the dimensions used within the **Title Block** and set a **View Template** to make sure all the views are the same and so that all views can be easily changed later on mass.

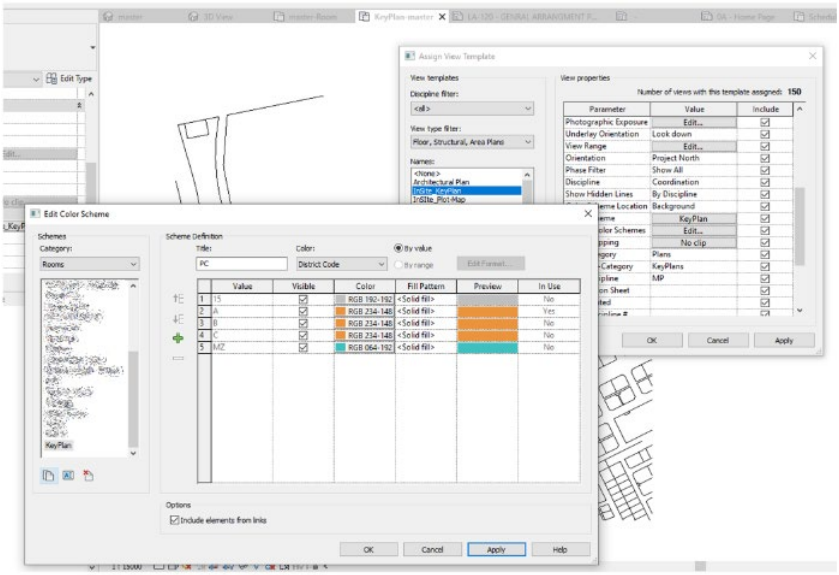


Key Plan Template

Set up a plan view showing the area or segment you will be creating, use the crop region to size the view to the dimensions used within the **Title Block** and set a **View Template** to make sure all the views are the same and so all views can be easily changed later on mass.

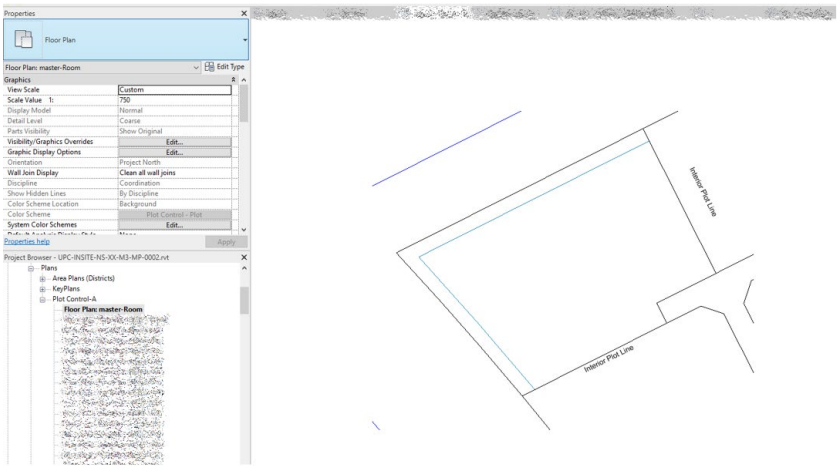


For this view, we used a **Color Scheme** within the View Template to control the demarkation of the plot on the sheets.



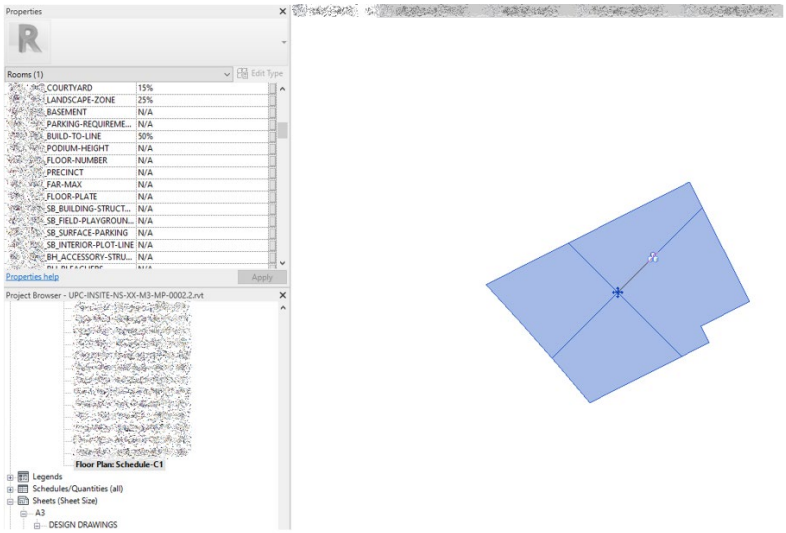
Floor Plan Template

Set up a plan view showing the area or segment you will be creating, use the crop region to size the view to the dimensions used within the **Title Block** and set a **View Template** to make sure all the views are the same and so all views can be easily changed later on mass.

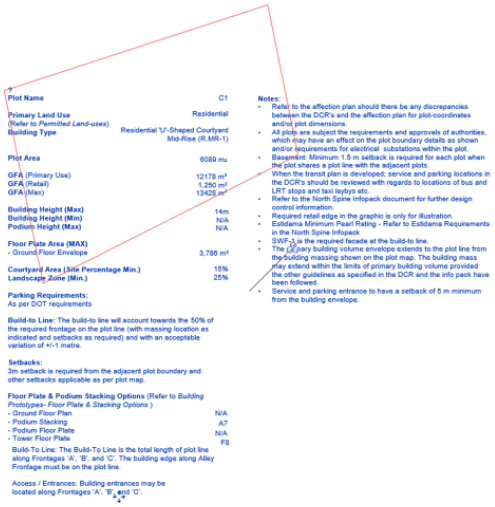


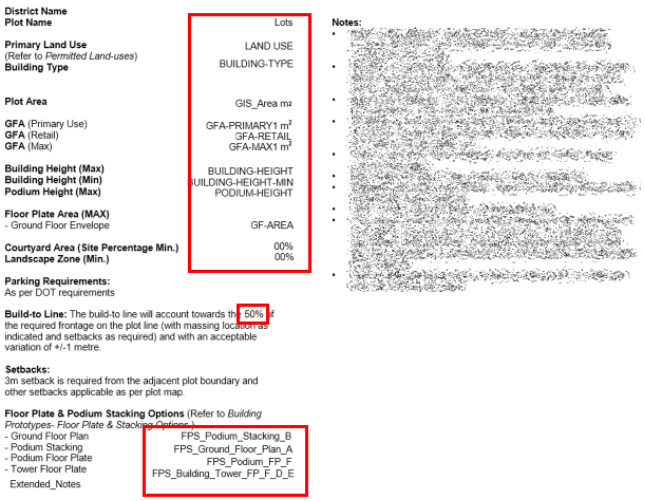
Floor Plan Label Template

This view is different from the rest; it is for all the standard text on the DCR sheet. It is a floor plan of the rooms with everything hidden using a **View Template**. Once placed on a sheet, the room is tagged using a **Room Tag**. This tag contains all the generic text with **Custom Labels** and **Shared Parameters** so that only the plot-specific data is updated.



The **Room Tag** utilises the **Shared Parameters** we set up in the project at the beginning, so if you want more information shown - add it to your shared parameter file and then add it to the room category. The text in RED is the text that is driven by the parameters of the rooms.



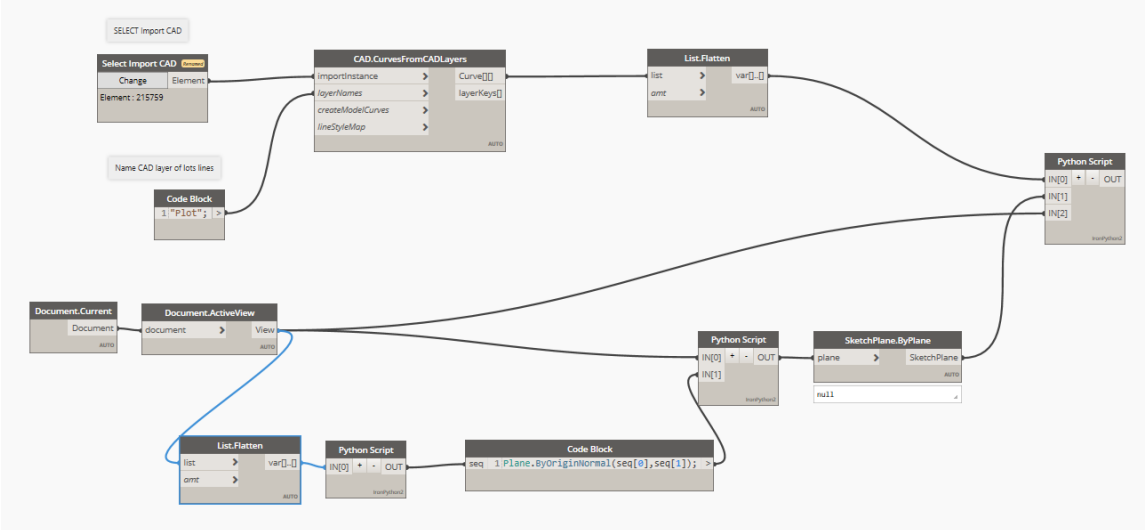


Create room boundaries from CAD

The project I am using for this example was originally in Autocad, so to get all the plots into Revit, we would need to trace the CAD outlines using **Room Boundaries**; the below graph completes this using Dynamo.

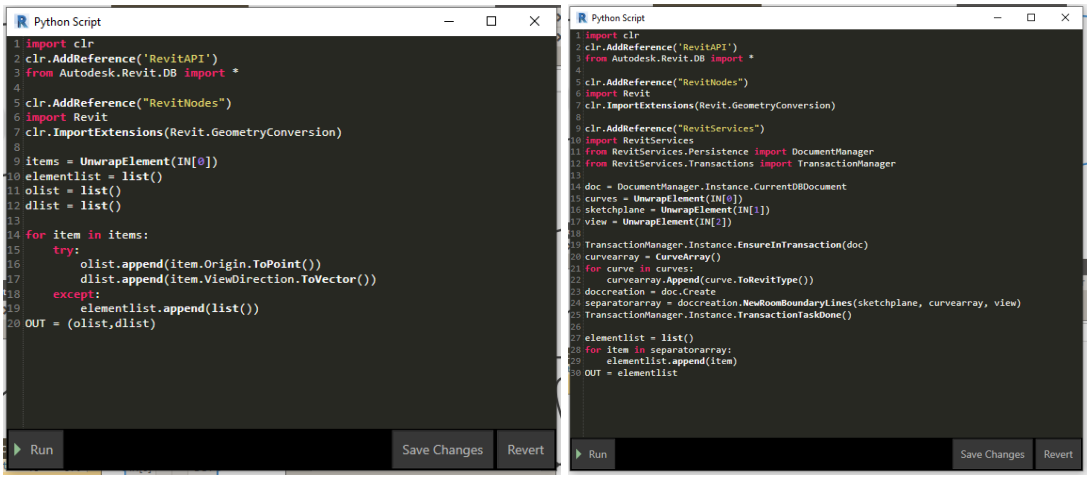
Create rooms

Once you link in your CAD base to Revit, you can convert the lines into room boundaries; first select the linked CAD file. Within the **Code Block** make sure you type the layer name you're wanting to use; in this case, it's Plot.



Python Nodes

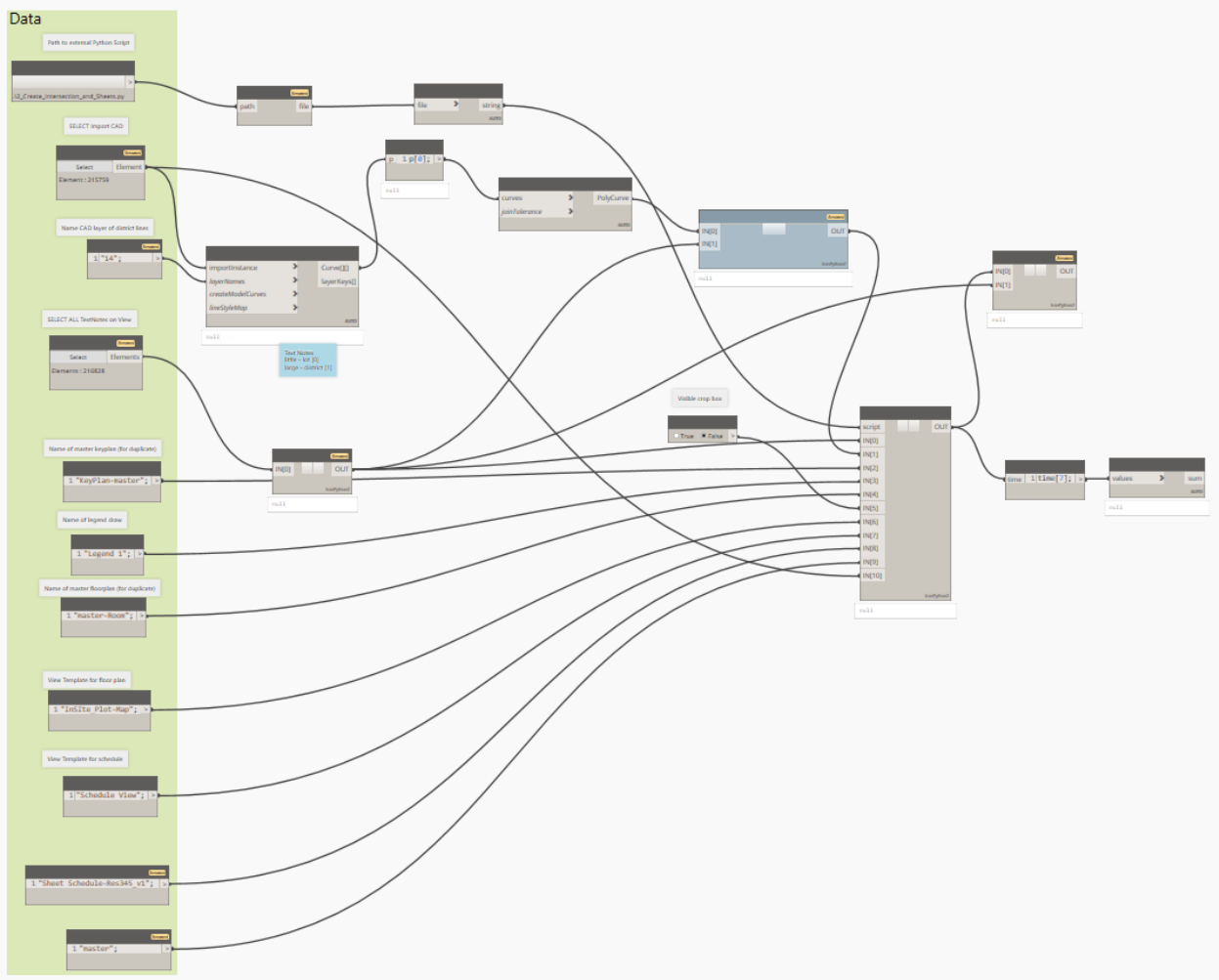
This graph contains Python node. As mentioned before, this was done a few years ago, and now you may be able to replace the Python without the box Dynamo nodes.



Create Sheets

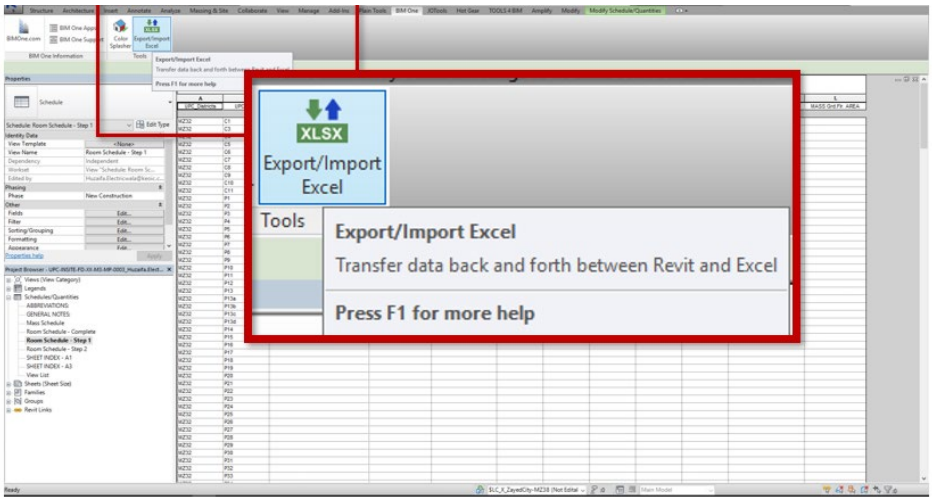
This is the graph that creates all the views from your templates and creates all the sheets based on the rooms. Once again, this graph and Python were created some time ago, and you may run into some issues with versions, so slight updates may be needed.

This graph is available in the download; I will not go into too much detail as the input nodes are labelled; the main thing to remember with this node is the external Python you need to load in the first node and update all the template names with the view you created within your file.



Data Input

This project had over 85,000 unique data inputs given the number of plots we had, I tried to use Dynamo lined up with Excel to populate all this data but had issues with the system crashing. So my workaround was to use the BIMone XLSX Export/Import app https://bimone.com/en/Apps



I created a **Room Schedule** in Revit and then used this app to export it to Excel. Once in Excel, I populated the fields from my Masterplan Statistics Excel and used BIMone app to load back in. This worked very well and was stable.

Revit Solution From Class

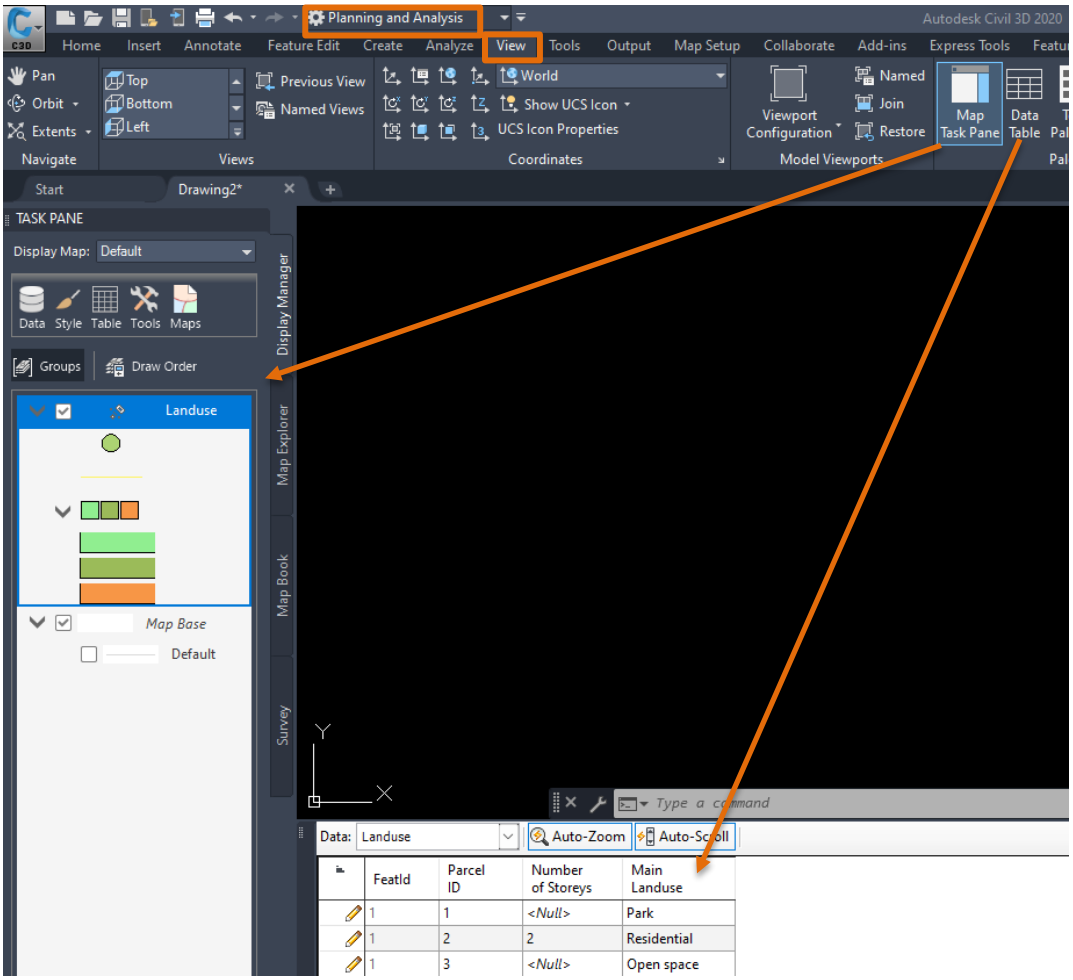
This section of the handout will cover how to set the files up to extract the data and prepare the files to work with the Dynamo scripting. This workflow was created in partnership with Autodesk.

Note: as the same as the workflow above, the examples show data from projects. This means that some of the workflow or data will need to be adapted to work on your project or workflow.

Preparation

Civil 3D workspace

First, you will need to make sure to switch Civil 3D workspace to **Planning and Analysis** and go to View tab to open Map Task Pane and Data Table.



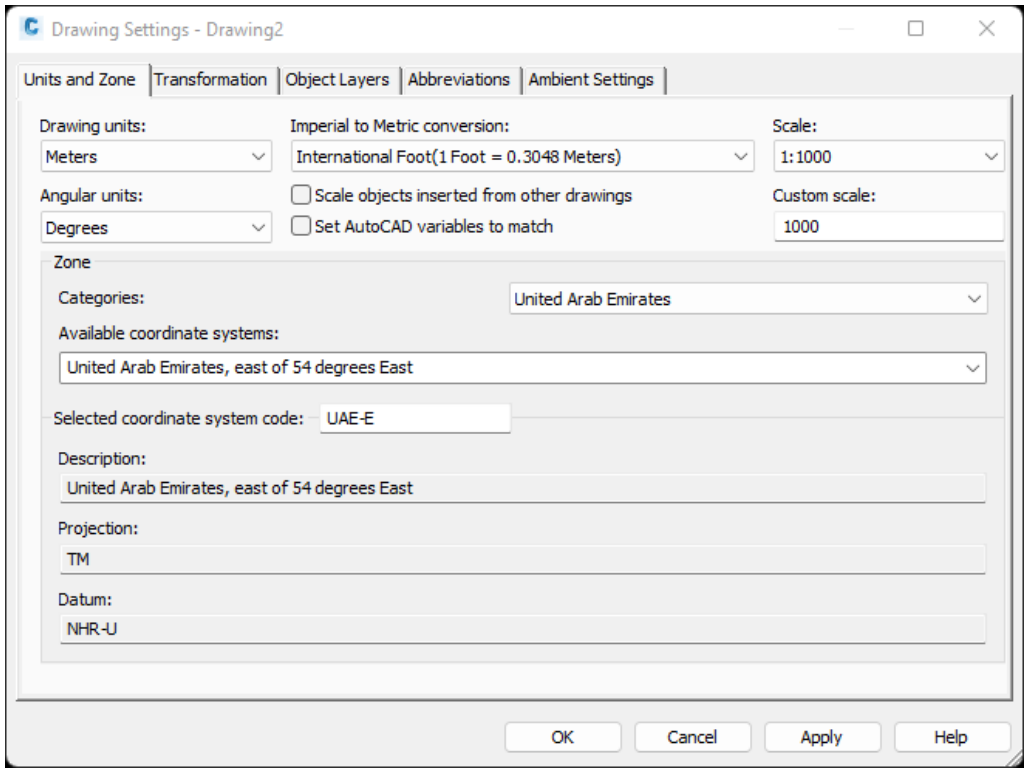
Coordinate system

Inserting geographic location information into a drawing file allows points within the drawing to correspond to geographic locations on the surface of the Earth.

Geographic location information in a drawing file is built around an entity known as the geographic marker. The geographic marker points to a reference point in the model space that corresponds to a location on the surface of the Earth of known latitude and longitude. The program also captures the direction of the north at this location. Based on this information, the program can derive the geographic coordinates of all other points in the drawing file.

Assigning coordinate system:

1. Click on Civil 3D file icon
2. Navigate to Drawing Utilities
3. Click on Drawing Settings Tools
4. Navigate to Units and Zone tab
5. Choose coordinate system category (country, region etc.)
6. Choose from available coordinate systems for a specific category
7.



Create an SDF file & Schema

SDF is one of the formats which AutoCAD Civil 3D uses to store GIS features (ex: land uses, buildings, right of ways …etc.).

In order to create an SDF file, a user needs to understand how to define a schema for the SDF, which includes feature lines, geometry types, properties …etc.

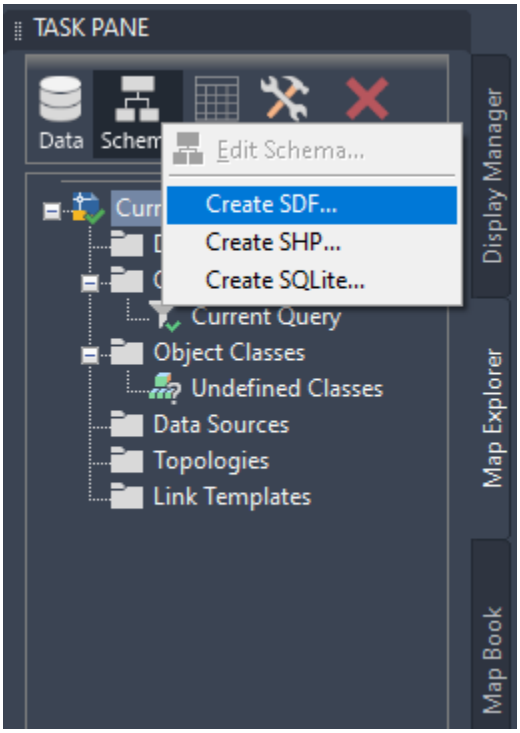
Below are the steps to create a sample SDF file for land use:

1. Determine what geometry type will be used; for land use, a typical choice would be a surface, as it is the equivalent to an AutoCAD polygon.
2. Define attributes for land use, examples below:

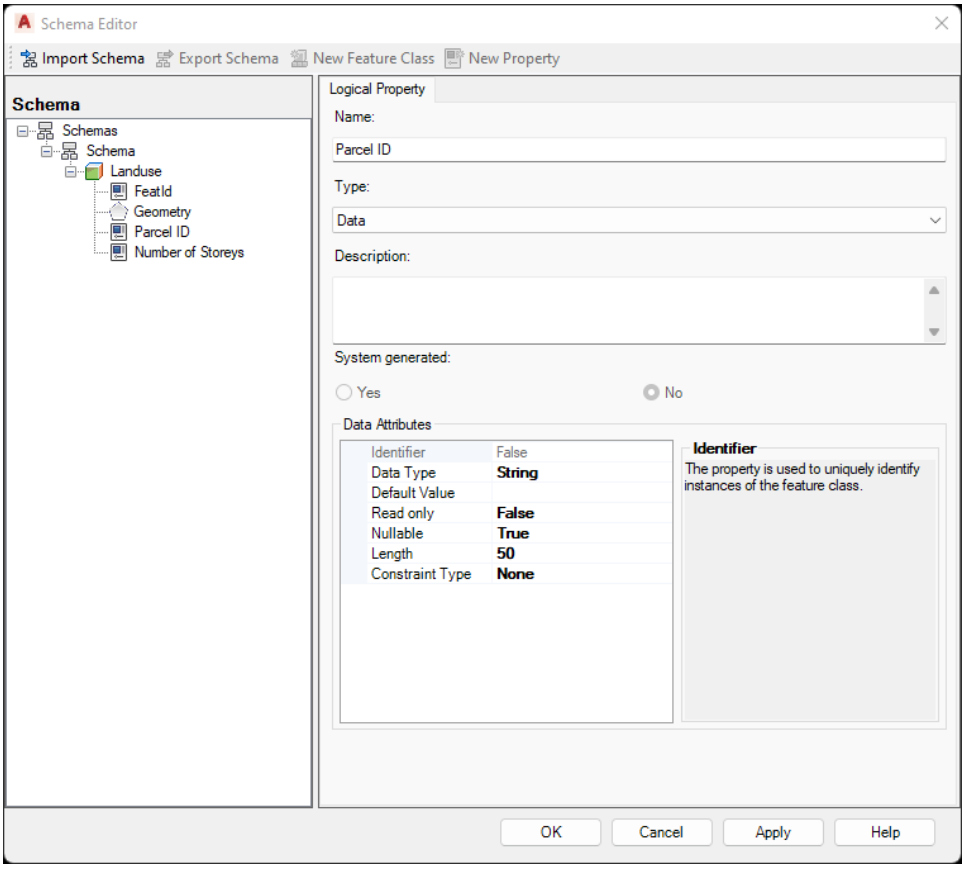
Attribute name	Description	Type	Example values	Constrain Type
Main Land Use Category	Used to store main land use type	String	Residential Commercial Industrial	List
Sub Land Use Category	Used to store secondary land use category	String	Employee housing Household living	List
Plot ID	Unique Plot ID	String	RES-HHL-01 INF-TRA-03	None

Create SDF in AutoCAD Civil 3D

1. Open Task pane using MAPWSPACE command.
2. Click on Map Explorer tab and then on Schema.
3. Select **'Create SDF'**.



4. Specify the file location and coordinate system.
5. In the **Schema Editor**, expand the schema tree and rename FeatureClass1 to the required type, such as land use.
6. To create a property, select the parent feature class in the Schema tree and click **New Property** on the Schema Editor toolbar.
7. Create separate SDF files with attributes for different feature classes using the above process.



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Revit

Shared Coordinates

To ensure the model elements created from geometry imported from Civil 3D lie within the Revit extension (33 km), it is necessary to acquire coordinates for the **Project Base Point** (PBP) close to the global coordinates where the geometry exists.

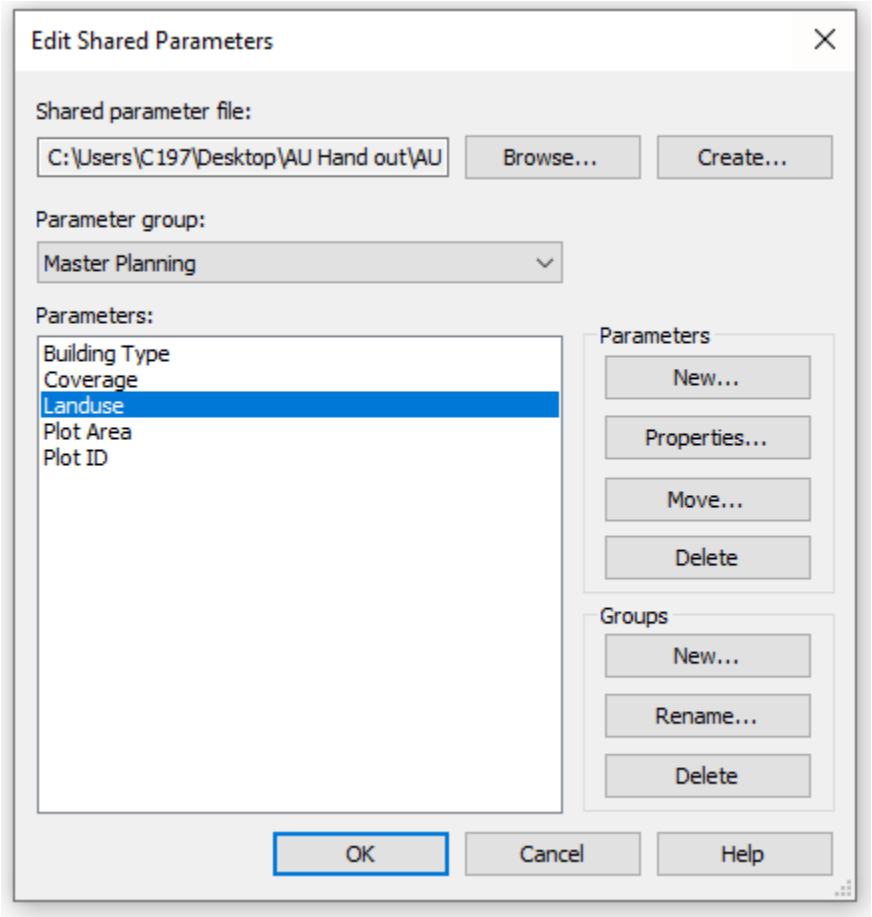
The best workflow to ensure this is as follows:

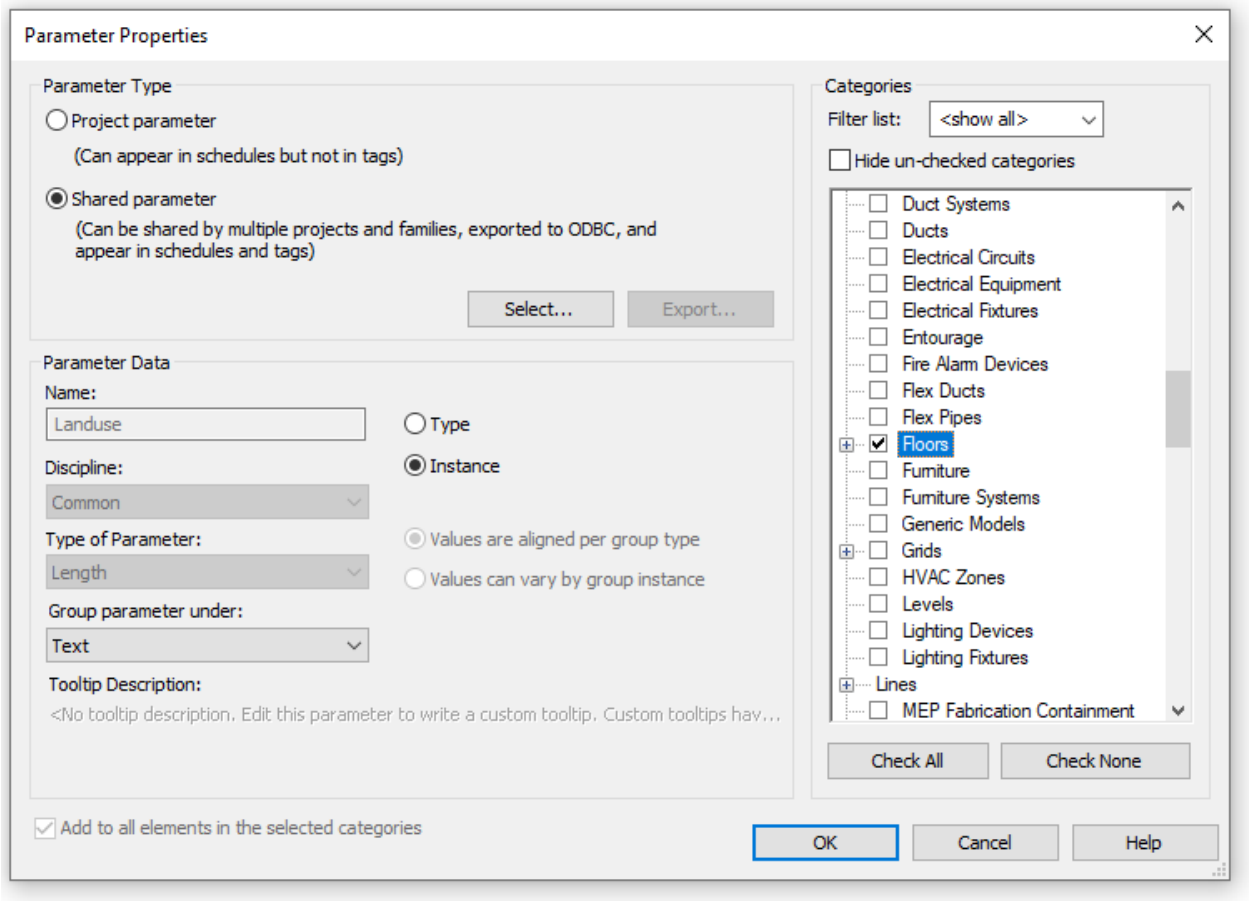
1. **Draw** a circle in the DWG file where the PBP will be located in Revit
2. Copy that circle to a new blank DWG file with the command **PASTEORIG**

3. Save the new DWG file
4. Link the new DWG file in Revit with the option Origin to Origin
5. Acquire coordinates from the newly linked DWG

Shared Parameters

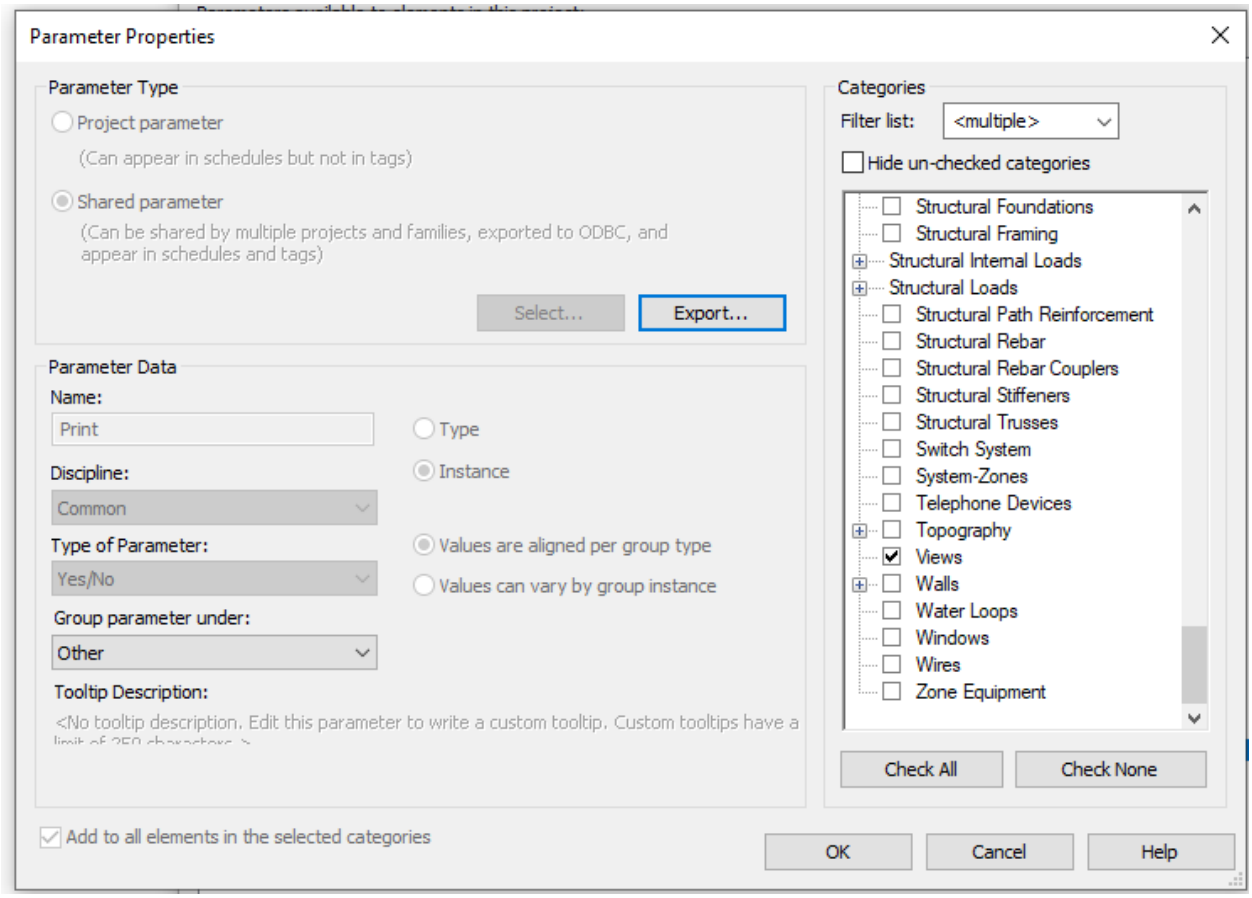
To write information to Revit model elements in specific parameters, these parameters must be created. First, as **Shared Parameters** and then included in the **Project Parameters** in the required categories. When creating these **Shared Parameters**, it is important to decide whether this information is type or instance-specific.
In the dataset files, there are some sample shared parameters created:





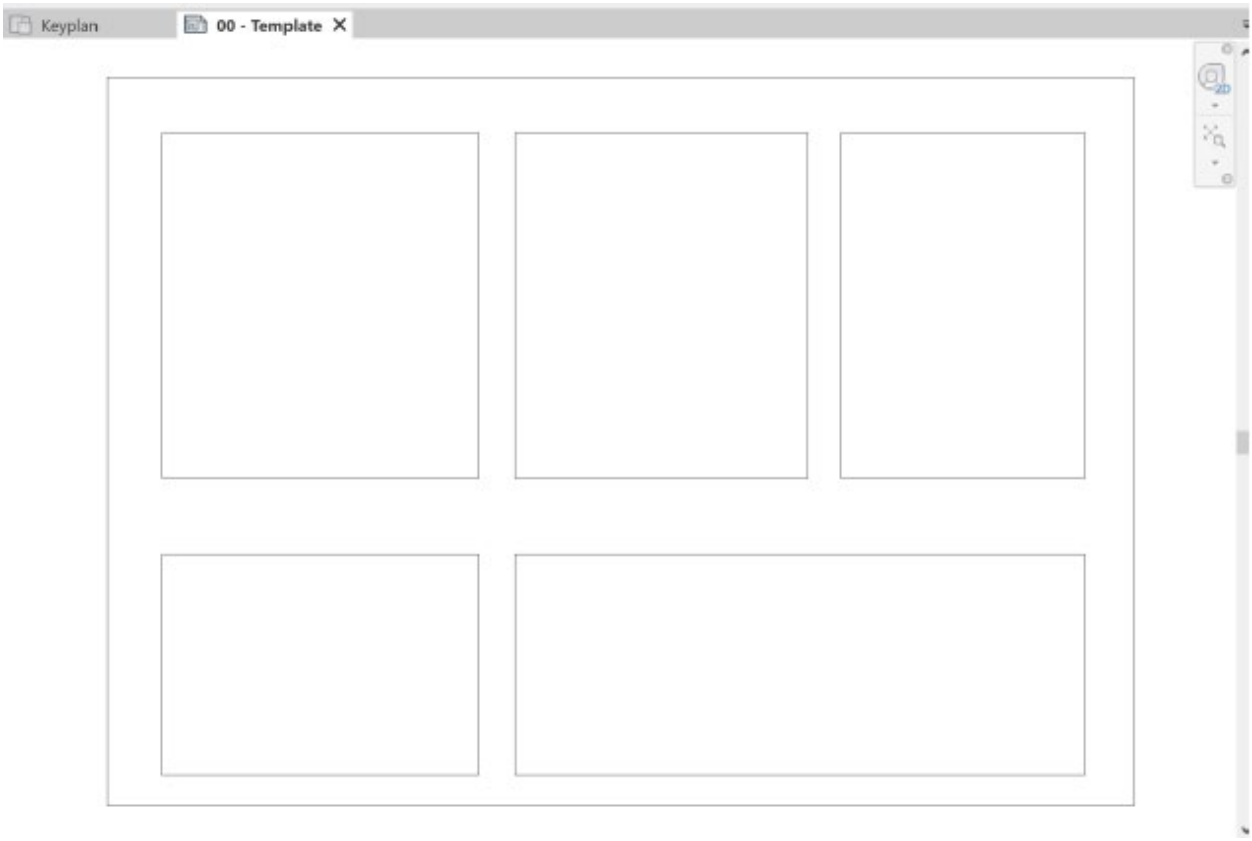
Project Parameters

Besides the **Shared Parameters** mentioned in the previous section, the dataset uses a **Project Parameter** called **"Print"** to mark those views that are ready to be placed in sheets. This parameter is key for the DCR sheet generation.



Sheet Template

To give flexibility and scale, the use of the workflow for different types of projects and the placement of views on the sheets will be based on a sheet template in the Revit model. The sheet template is a blank sheet with boxes made with detailed lines to designate the areas where the different view types will be placed. The template can be linked from a CAD file and then traced to generate the detail lines.



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