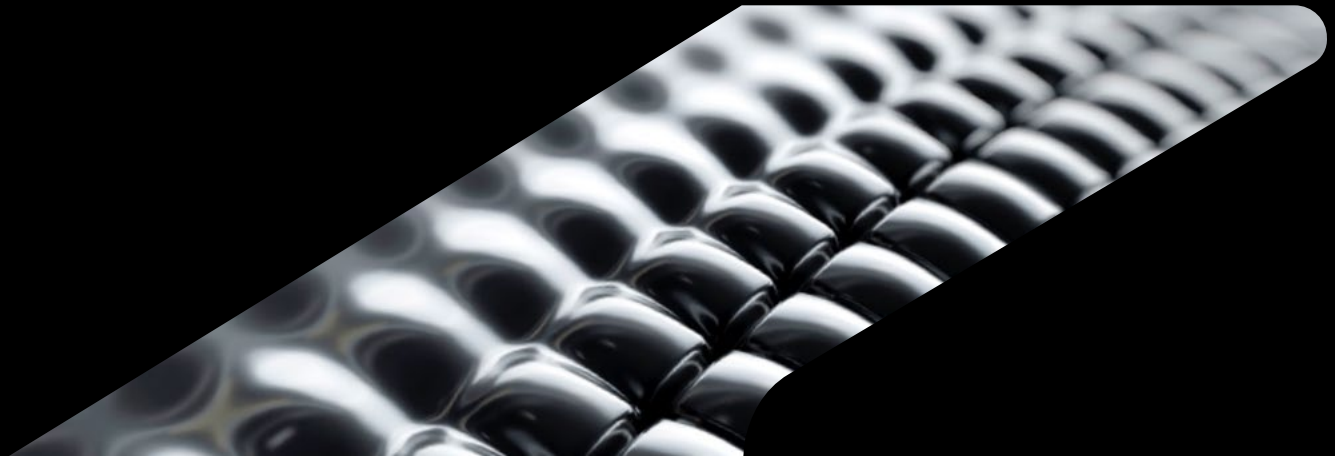
AUTODESK UNIVERSITY

Automating Overall Planning with Revit and Connected City Data Platform

AS502217

Christopher Smeaton
Digital Leader | @smeaton_chris



Talk about myself

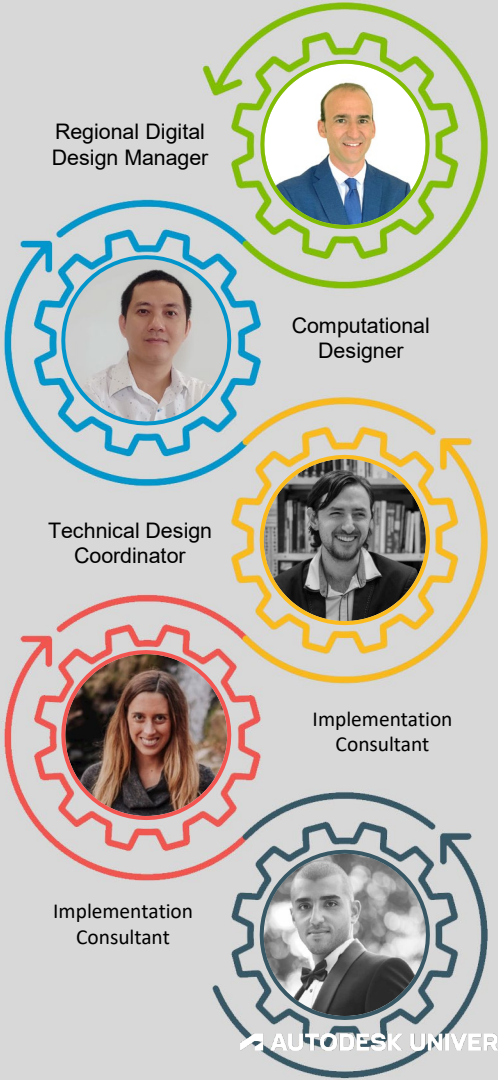
- Christopher Smeaton, Associate Principle
  - Digital Lead InSite Urban Planning / Landscape
  - 14 years of experience across UK, GCC and Asia
  - WIB Regional Lead UAE
- Experience:
  - Digital Advisory & Leadership
  - Smart City Advisor
  - Automation
  - Revit Content Author
  - Delivered multiple large-scale projects in Revit and other BIM authoring tools.

It’s not all about me

Meet the team!

This workflow was possible due to many stakeholders across the company; each member brought a wide range of skills and experience here are some of the key players:

- KEO / InSite Team
  - Juan Tena Florez
  - Truong Hoang
  - Pierre Gordon Smit
- Autodesk Team
  - Raquel Báscones Recio
  - Mohamed Adel Ahmed



What are we going to cover

There is a lot to cover so hold onto your seats!

The Problem

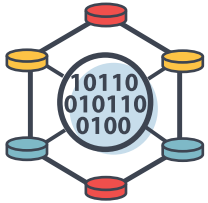
What are the challenges and what are we trying to solve?

Revit Solution

We will look at why we turned to Revit, how we set the files up to capture the data and Dynamo workflows to automate the processes.

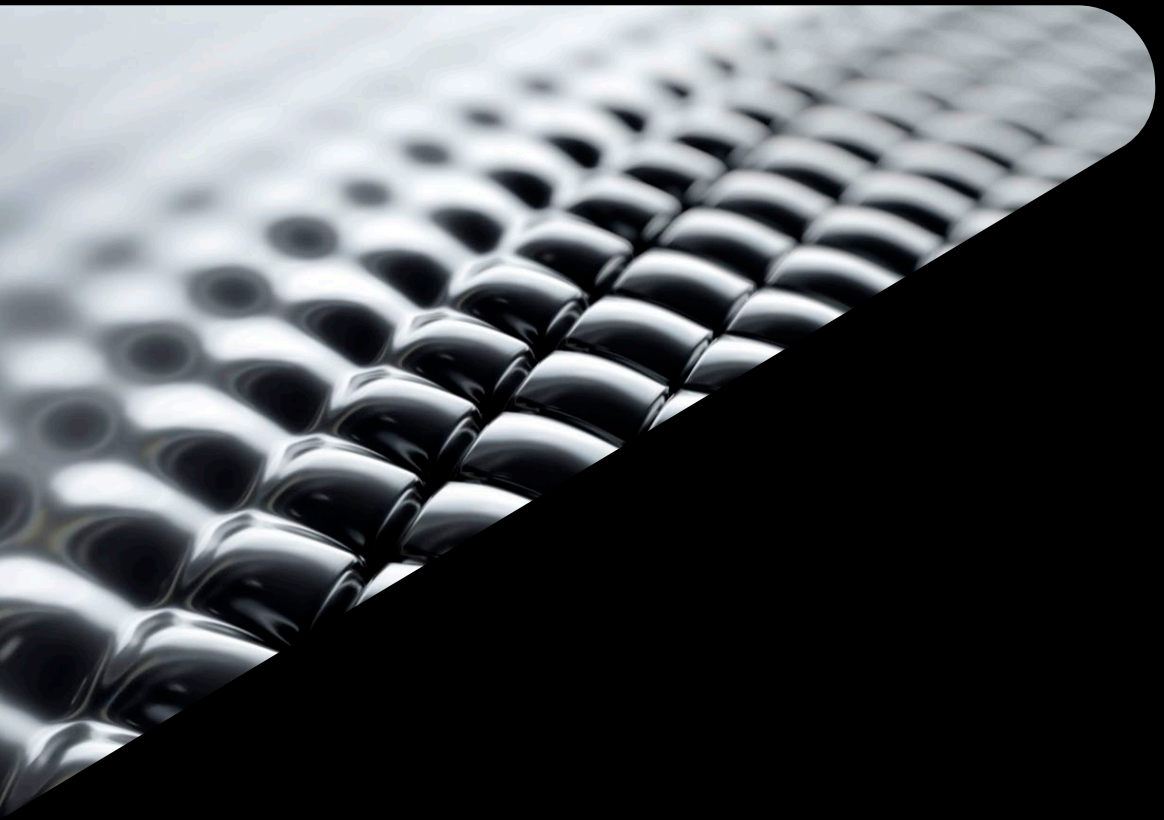
Civil3D Solution

Why do we use Civil3D, what is the process of setting up the project and the scripting and workflows to Automate planning outcomes?



Online Platform

This section will cover taking your master plan into an online planning tool. How to set up the files to automate the generation of your master plan and how this will help your engagement.



The Problem

What are we trying achieve

The planning team

Trying to create one vision with unconnected data

Urban Planner

Planning statistics come from the client

Urban Designer

Have fun sketching and drinking coffee

Drafting Team

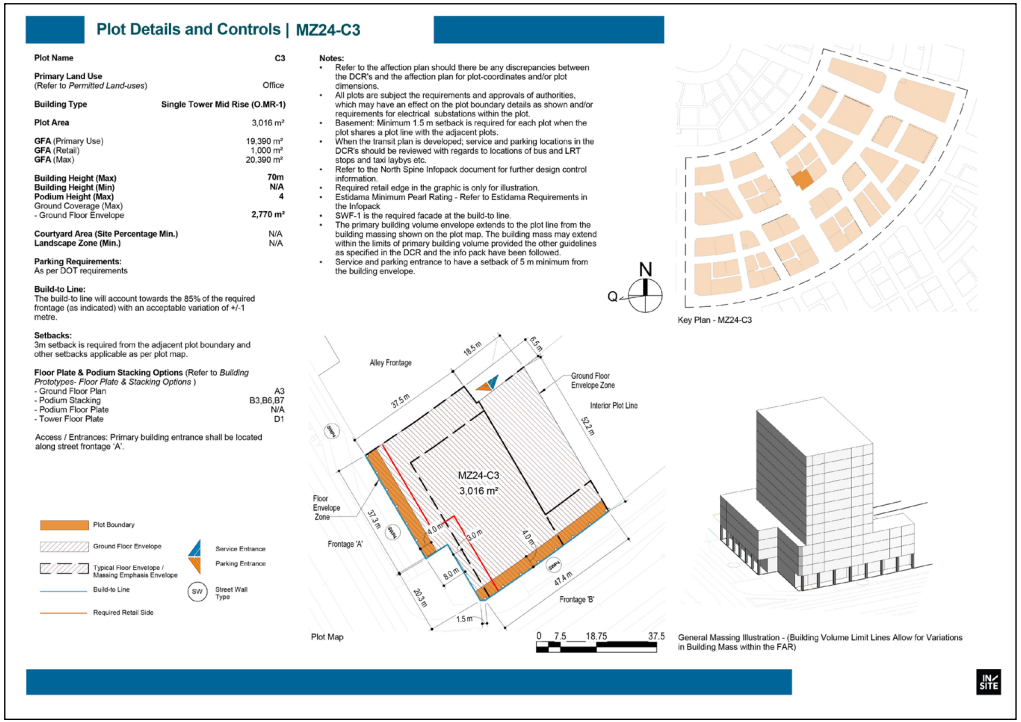
Turning sketches into workable CAD plans

Visualization Team

Creating the dream

Final Delivery

- **Development Control Regulations** (DCR)



Example from a typical project:

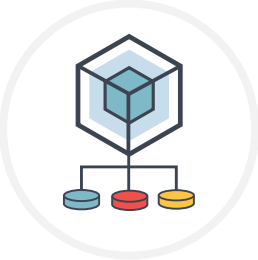
- Project size 450,000 sq kilometres
- 2500 individual DCR sheets
- 8 week turnaround
- Estimated 417 hours manually
  - 17 weeks to create DCRs
  - Plus, design updates
  - QAQC

Revit

- Why is this a good choice?

Data

Revit is great for data collection, and able to produce both 2D & 3D data



Design options

You are able to save multiple design options within Revit and switch between them

Rooms / Areas

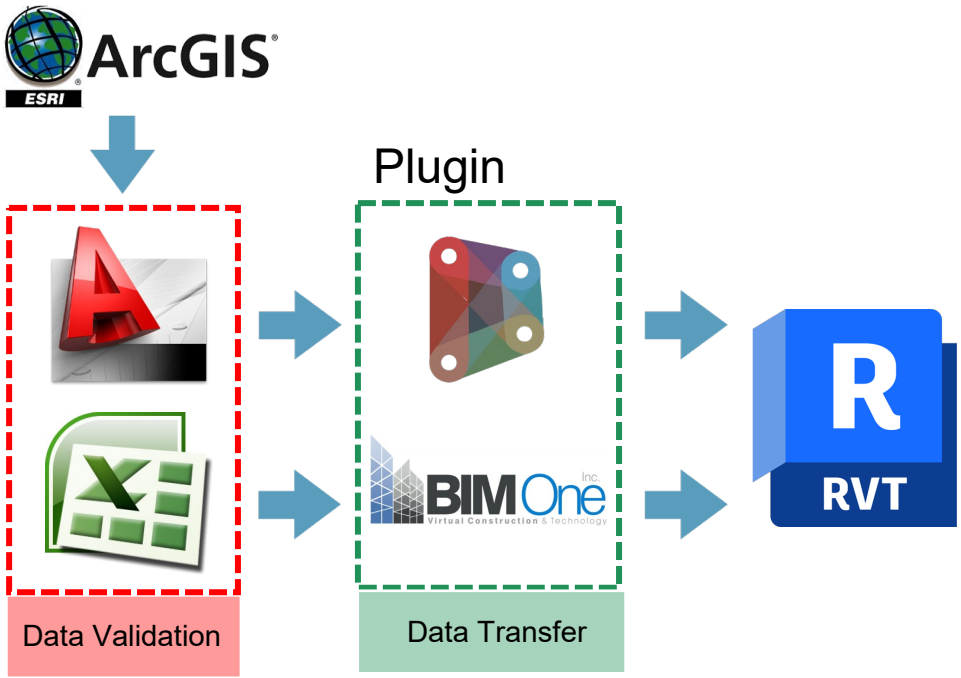
Rooms can be treated like plots allowing you to store area, heights and other data. Also, you cannot allocate the same space

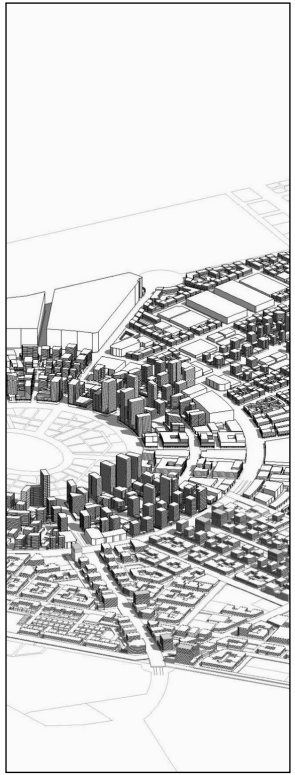
Dynamo

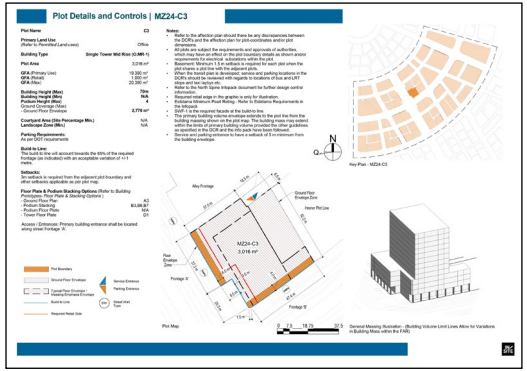
Gives us the flexibility for the scripting and ease of deployment

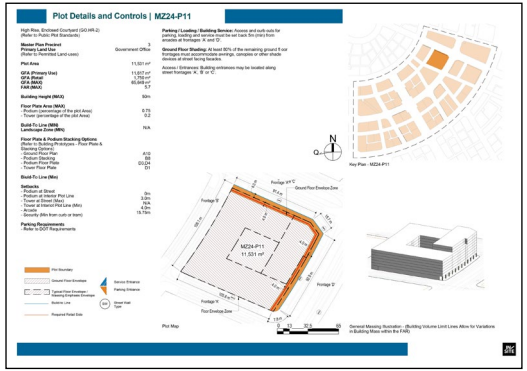
Final Delivery

- **Development Control Regulations** (DCR)





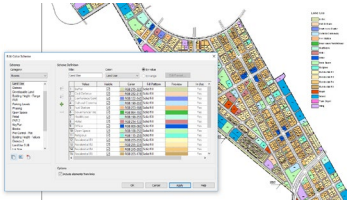




4-step Template Set Up

You will need to set up Color Schemes and Room tags (full workflow in handout)

Step - 1 → Step - 2 → Step - 3 → Step - 4

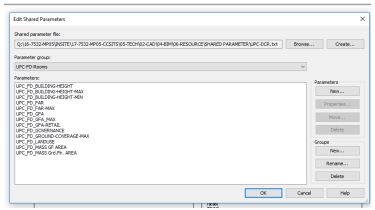


Color Scheme

Within Color Scheme, use “Room” category and create new “Schema” this is to cover plan you may want to create such as “Land Use” “KeyPlan”

Within your Schema you can set definitions such as, “Open Space” “Office” “Healthcare” “Residential”

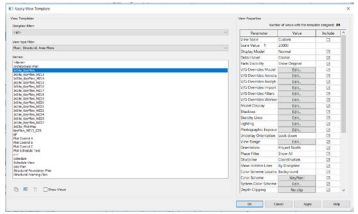
This will be used within View Templates to set the colors



Shared parameters

There will need to be a shared parameter file containing parameters that will be contained within the rooms. This will be connected to the planning statistics such as:

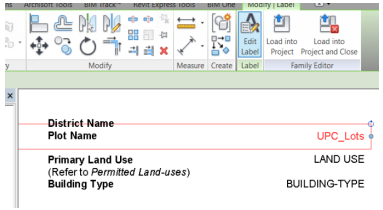
“GFA” “LandUse” “FAR”



View templates

View templates will set the view on the sheets, you will need to create four views called “PlotMap”, “KeyPlan”, “3DView” and “ScheduleView” and set the corresponding template to control what you want to see.

The schedule view will only show the room tag and this will be used for the plot data notes

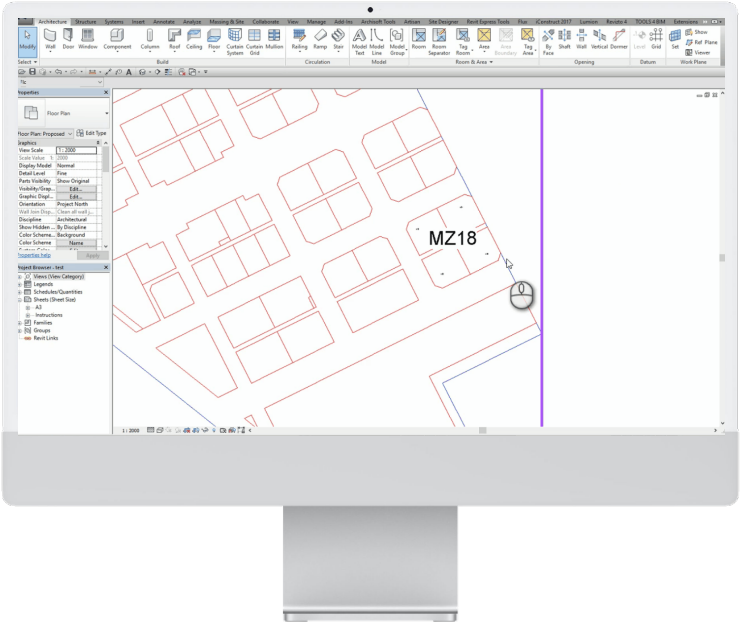


Room tags

Create a room tag with the shared parameters so that you pull out the data from the rooms as this will be different for every plot

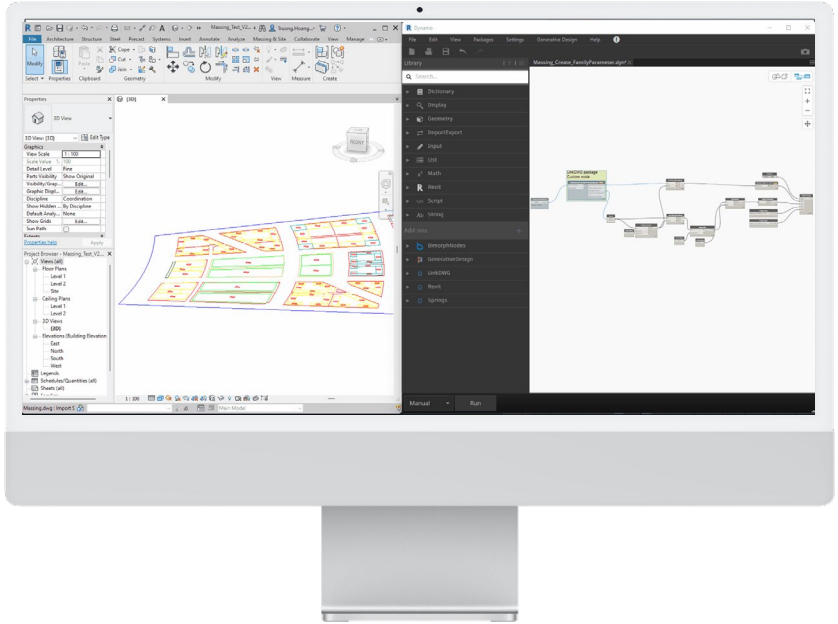
Dynamo Scripts

- They are in your hand out (don’t panic)



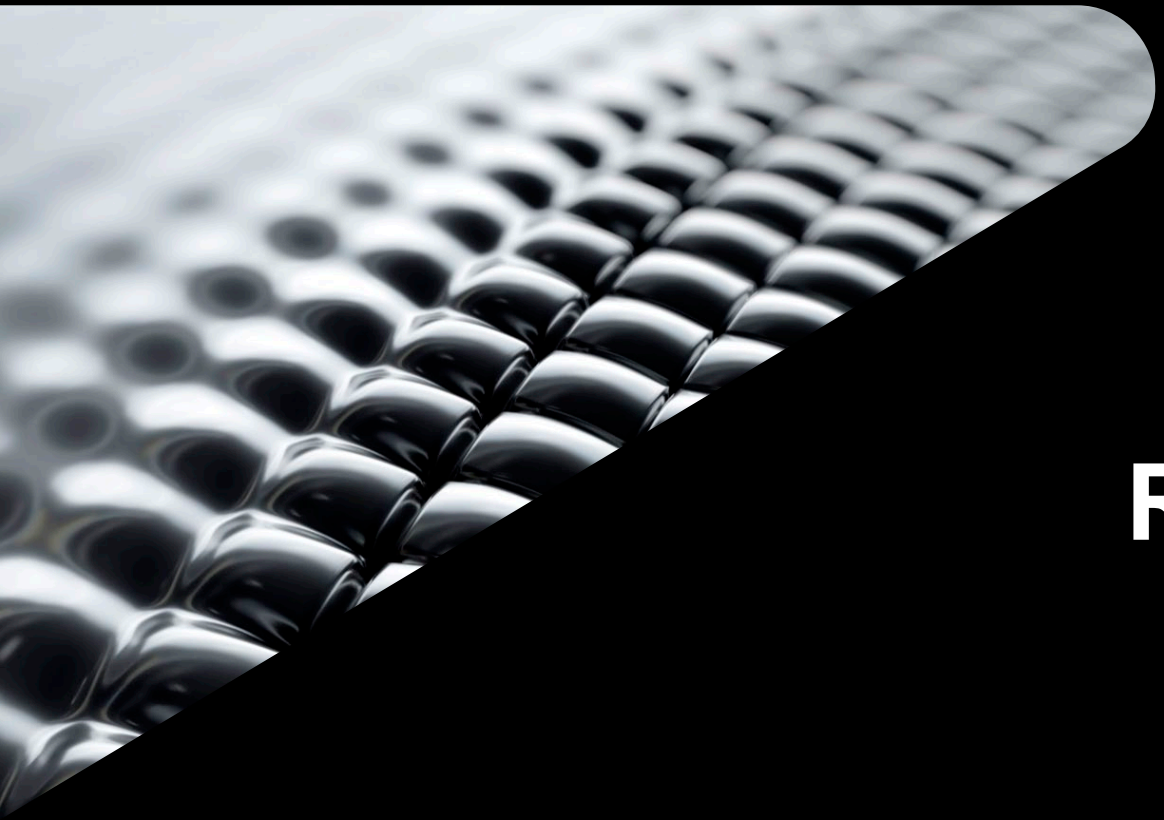
DCR Sheets

1) Create Rooms from CAD
2) Create Views & Sheets



Massing

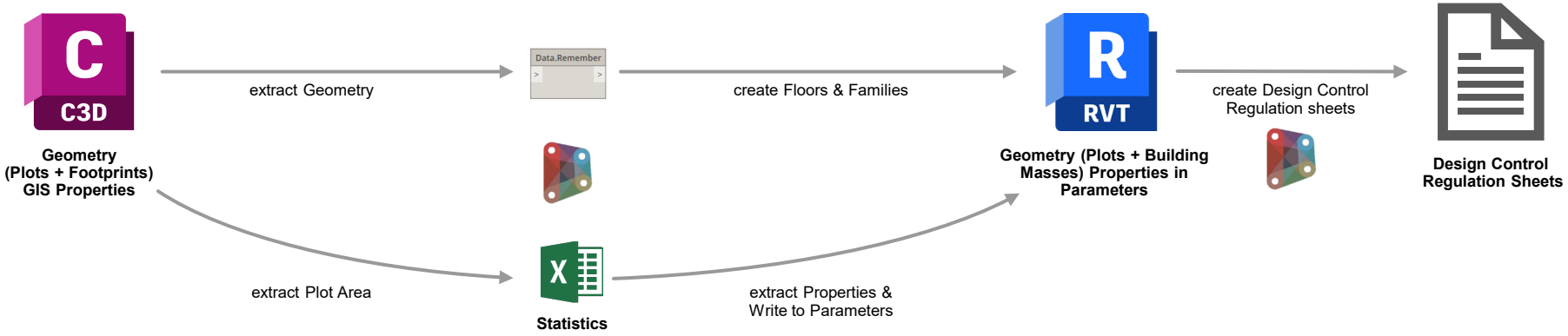
1) Create Massing from CAD



Revit Solution

What did we develop

Strategy



Process

- Creation of Development Control Regulation sheets
- Revit elements from Civil 3D and GIS data
- Population of Revit parameters with Excel/GIS data

Technology

- Civil 3D Toolkit
- Dynamo for Revit
- Dynamo for Civil 3D

Data

- Geometry (Plots & Footprints)
- Statistics
- GIS Properties

The Setup

Preparation – Civil3D

Coordinates

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

Generate Parcels

1. Select all closed polylines to be converted to parcels
2. Click Home tab >> Create Design panel >> Parcel drop-down >> Create Parcel From Objects
3. In the Create Parcels dialog box, you can edit default settings before creating any parcels

Export SDF

1. Determine what geometry type is going to be used; for a land use - a typical choice would be a surface
2. Define attributes for land use
3. Create SDF in AutoCAD/Civil 3D
4. Specify the file location and coordinate system
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

Preparation – Revit

Coordinates

The best workflow as follows:

- Draw a circle in the DWG file where the PBP will be located in Revit
- Copy that circle to a new blank DWG file with the command PASTEORIG
- Save the new DWG file
- Link the new DWG file in Revit with the option Origin to Origin
- 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.

Shared parameters:

Building Type, Coverage, Landuse, Plot area, Plot ID

Project Parameter: Print

Revit Families

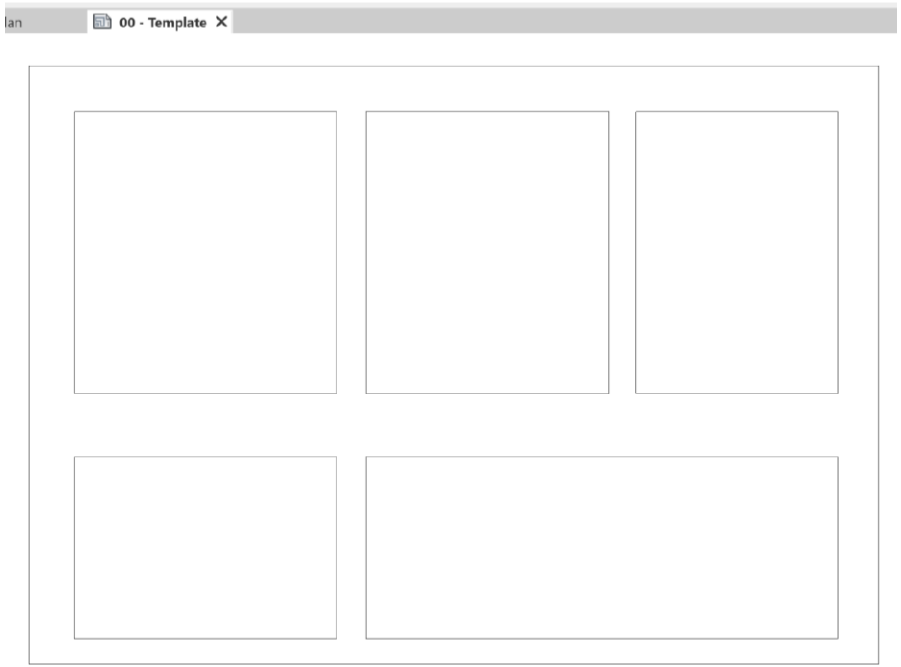
Prior to run the graph to create plots (floors) and place the helper frontage family, sheets template with the layout.

Preparation – Revit

- Sheet Template

To give flexibility and scale, the use of the workflow for different types of projects, 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 over to generate the detail lines.



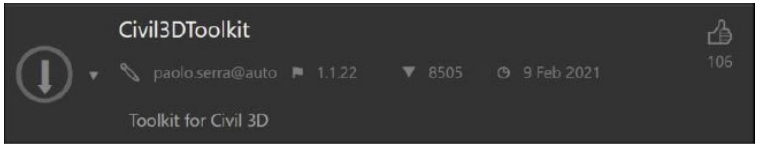
Dynamo Packages

- These need to be installed

Civil3D

Civil3D Toolkit

Version 1.1.22, developed by Autodesk Consulting. It is required to extract the Map Features and their geometry and properties.



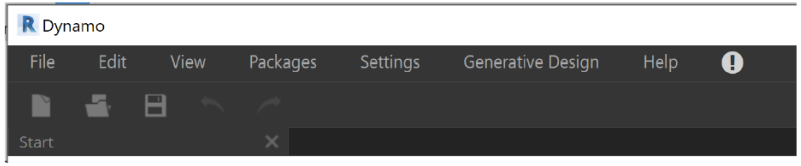
Generative Design View Extension

Generative Design is a View Extension that enables the export of Dynamo graphs for Generative Design for Revit. It is installed out-of-the-box in Revit 2021+ versions, but it must be installed manually in Dynamo for Civil 3D. Besides the export functionality, it includes a set of custom nodes that we will leverage in this demo to serialize data.

Revit

Generative Design

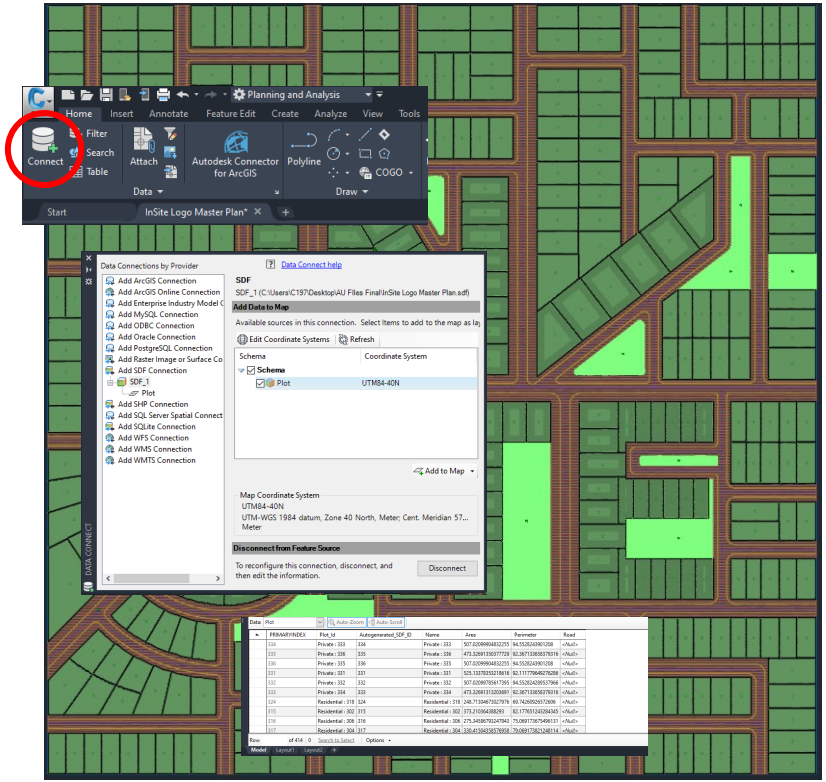
Generative Design for Revit must be installed so Dynamo for Revit can run the Data. Remember node - this tool is installed as part of Revit 2021+ installation, but it can also be downloaded and installed from Autodesk Desktop App and the user's Autodesk Account.



Let’s Get STARTED!

InSite Masterplan Template

- A demo project for this demonstration



Why SDF?

Well, it is one of the formats that AutoCAD/Civil 3D uses to store GIS features (ex: land uses, buildings, right of way and so on.)

Determine what geometry type is used for land use, a typical choice would be a surface as it is the equivalent to an AutoCAD polygon.

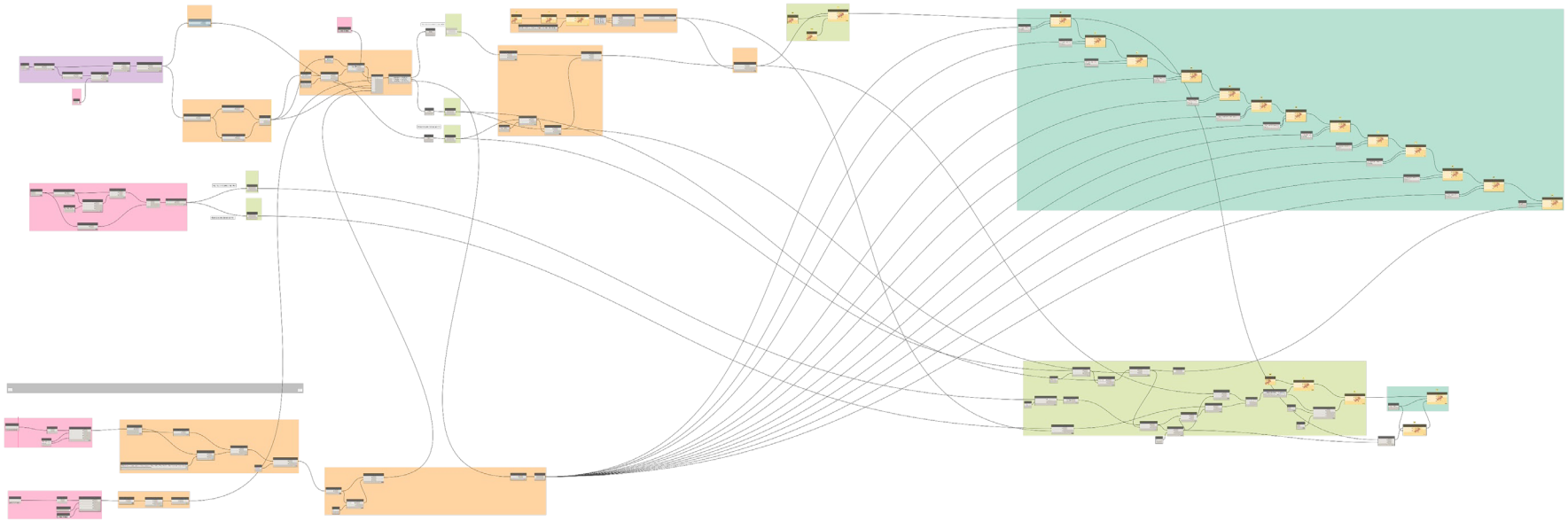
Define attributes for land use, examples below:

Attribute name	Description	Type	Example Values	Constraint 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

Dynamo – Step 01

- Dynamo Logic

GET	INPUT	PROCESS	OUTPUT	SET
Get objects from host application	User input and preparation	Processing logic	Notable output, object creation	Set values on objects in the host application model



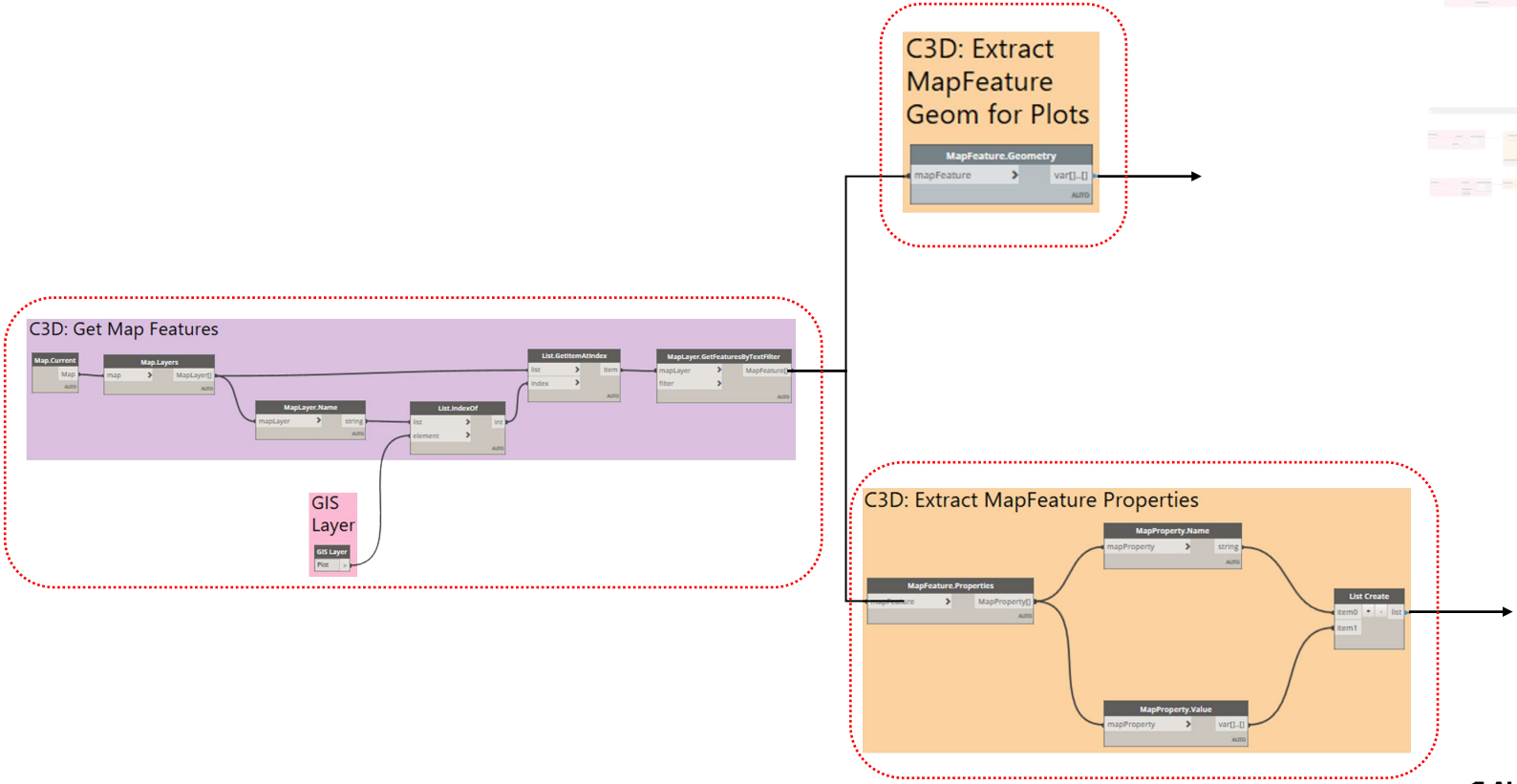
Dynamo – Step 01

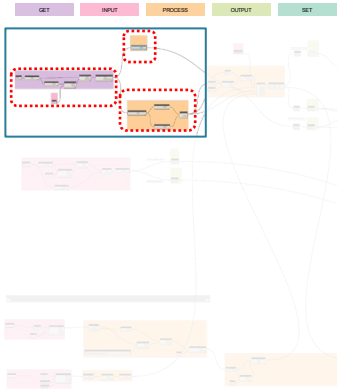
- Extract GIS data from Civil 3D and store in Dynamo

GET	INPUT	PROCESS	OUTPUT	SET
Get objects from host application	User input and preparation	Processing logic	Notable output, object creation	Set values on objects in the host application model

Dynamo – Step 01

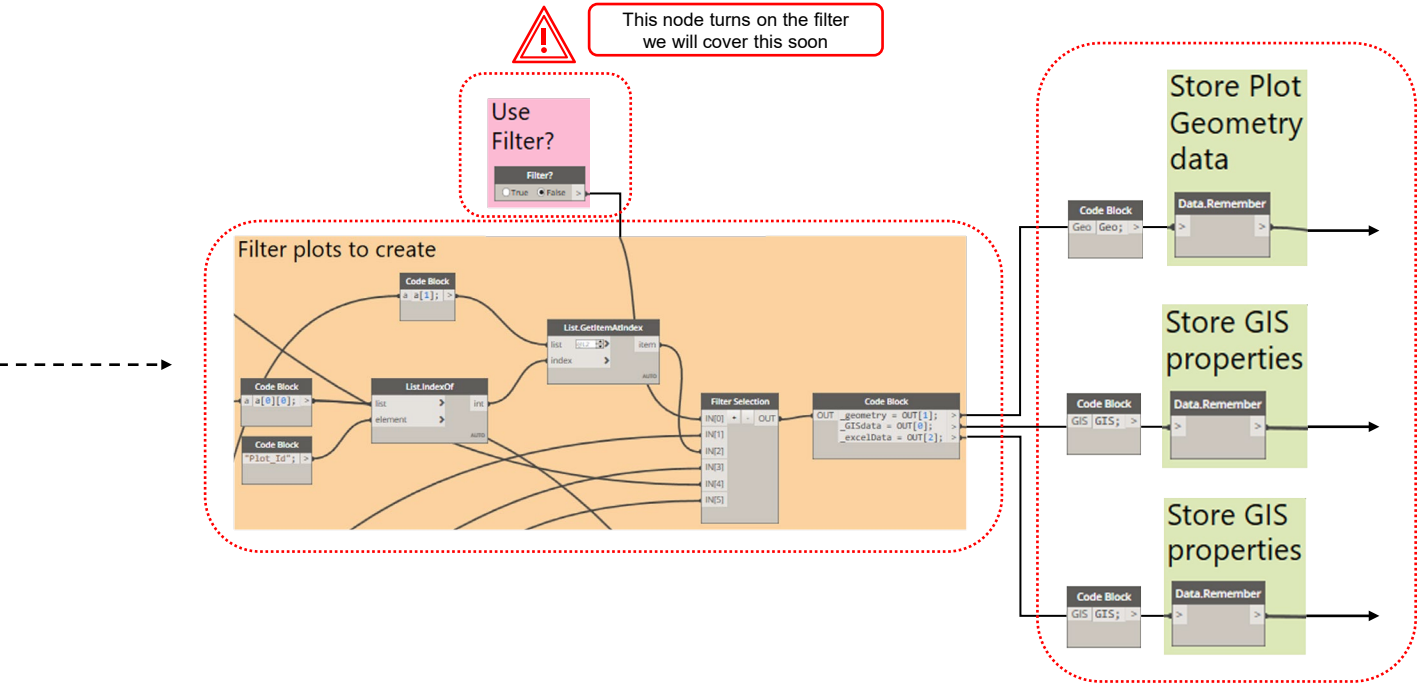
Extract GIS data from Civil 3D and store in Dynamo

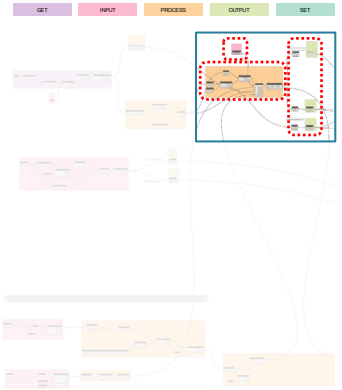




Dynamo – Step 01

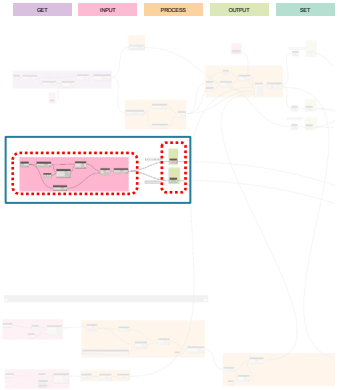
Extract GIS data from Civil 3D and store in Dynamo

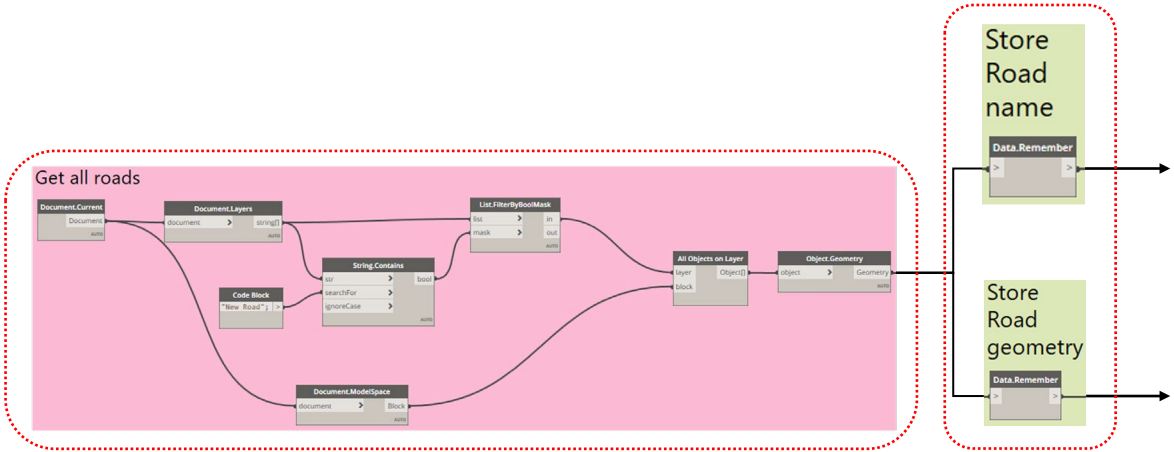


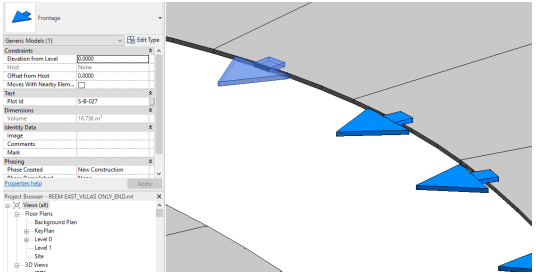


Dynamo – Step 01

- Extract GIS data from Civil 3D and store in Dynamo



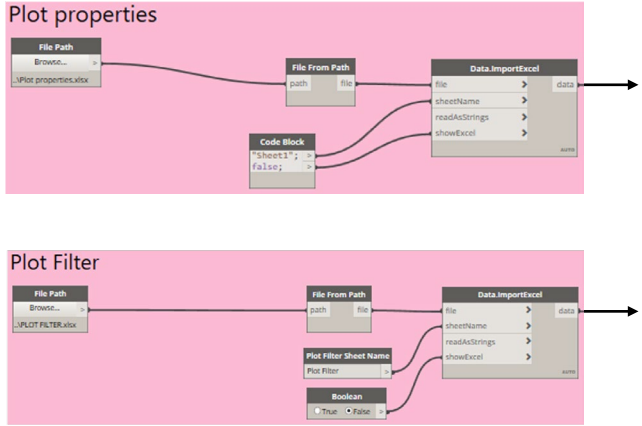




This information will be used to place the frontage arrow

Dynamo – Step 01

- Extract GIS data from Civil 3D and store in Dynamo



	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Max Covered Area Ratio	Max FAR	Max GFA	Land use	Typology of Bedroom	Zone	No. of Floors	height	Parking G	Setback Road	Setback Side	Setback Back	Res. GFA
2	60.00%	0.68	1170	Residential	VILLA 6BR	North	G+1	12	5	6m	3m	3m	1170.00
3	60.00%	0.65	1170	Residential	VILLA 6BR	North	G+1	12	5	6m	3m	3m	1170.00
4	60.00%	0.82	1590	Residential	VILLA 7BR	North	B+G+1	12	6	6m	3m	3m	1590.00
5	60.00%	0.81	1590	Residential	VILLA 7BR	North	B+G+1	12	6	6m	3m	3m	1590.00
6	60.00%	0.83	1590	Residential	VILLA 7BR	North	B+G+1	12	6	6m	3m	3m	1590.00
7	60.00%	0.81	1590	Residential	VILLA 7BR	North	B+G+1	12	6	6m	3m	3m	1590.00
8	60.00%	0.79	1590	Residential	VILLA 7BR	North	B+G+1	12	6	6m	3m	3m	1590.00
9	60.00%	0.86	1590	Residential	VILLA 7BR	North	B+G+1	12	6	6m	3m	3m	1590.00
10	60.00%	0.80	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
11	60.00%	0.77	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
12	60.00%	0.78	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
13	60.00%	0.84	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
14	60.00%	0.84	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
15	60.00%	0.83	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
16	60.00%	0.78	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
17	60.00%	0.81	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
18	60.00%	0.79	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
19	60.00%	0.81	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
20	60.00%	0.79	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
21	60.00%	0.79	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
22	60.00%	0.68	600	Residential	VILLA 4BR	North	G+1	12	3	6m	3m	3m	600.00
23	60.00%	0.68	600	Residential	VILLA 4BR	North	G+1	12	3	6m	3m	3m	600.00
24	60.00%	0.69	600	Residential	VILLA 4BR	North	G+1	12	3	6m	3m	3m	600.00
25	60.00%	0.61	600	Residential	VILLA 4BR	North	G+1	12	3	6m	3m	3m	600.00
26	60.00%	0.81	600	Residential	VILLA 4BR	North	G+1	12	3	6m	3m	3m	600.00
27	60.00%	0.82	600	Residential	VILLA 4BR	North	G+1	12	3	6m	3m	3m	600.00
28	60.00%	0.82	600	Residential	VILLA 4BR	North	G+1	12	3	6m	3m	3m	600.00
29	60.00%	0.81	600	Residential	VILLA 4BR	North	G+1	12	3	6m	3m	3m	600.00
30	60.00%	0.80	600	Residential	VILLA 4BR	North	G+1	12	3	6m	3m	3m	600.00
31	60.00%	0.74	600	Residential	VILLA 4BR	North	G+1	12	3	6m	3m	3m	600.00
32	60.00%	0.75	600	Residential	VILLA 4BR	North	G+1	12	4	6m	3m	3m	600.00
33	60.00%	0.74	600	Residential	VILLA 4BR	North	G+1	12	4	6m	3m	3m	600.00
34	60.00%	0.78	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
35	60.00%	0.82	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00
36	60.00%	0.77	880	Residential	VILLA 5BR	North	G+1	12	4	6m	3m	3m	880.00

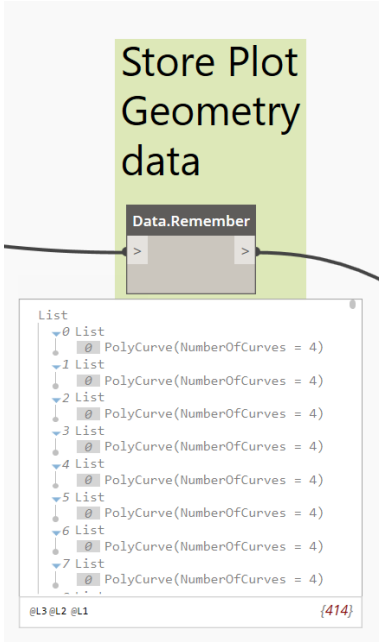
	A	B	C
1	Plot Id		
2	N-A-001		
3	N-A-002		
4	N-A-003		
5	N-A-004		
6	N-A-005		
7	N-A-006		
8	N-A-007		
9	N-A-008		
10	N-A-009		
11	N-A-010		
12	N-A-011		
13	N-A-012		
14	N-A-013		
15	N-A-014		
16	N-A-015		
17	N-A-016		
18	N-A-017		
19	N-A-018		
20	N-A-019		
21	N-A-020		
22	N-A-021		
23	N-A-022		
24	N-A-023		
25	N-A-024		
26	N-A-025		
27	N-A-026		
28	N-A-027		
29	N-A-028		

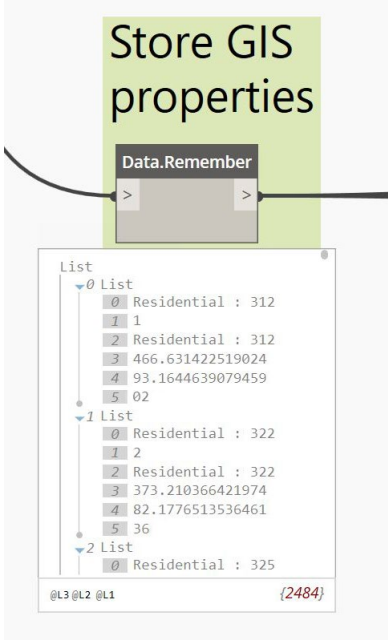
Plot Filter

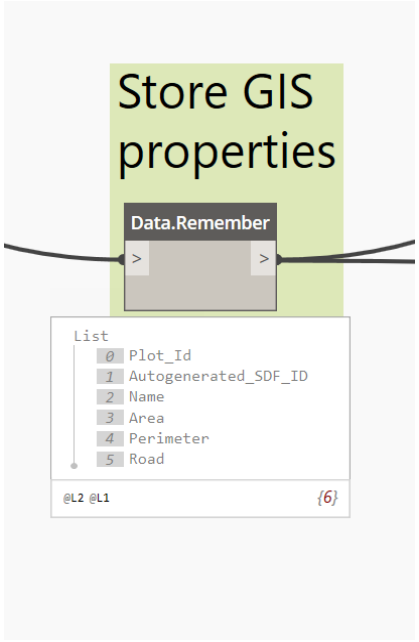
Dynamo – Step 01

- Container nodes

Generative Design View Extension Notes



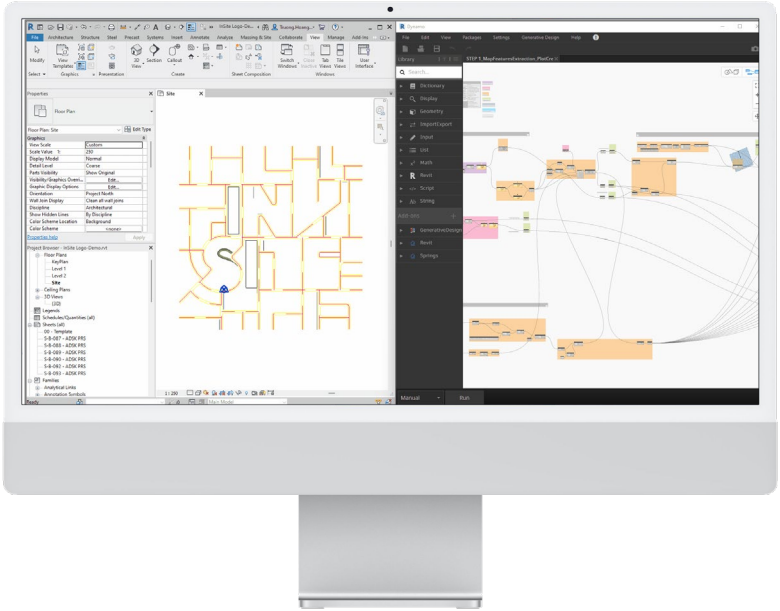




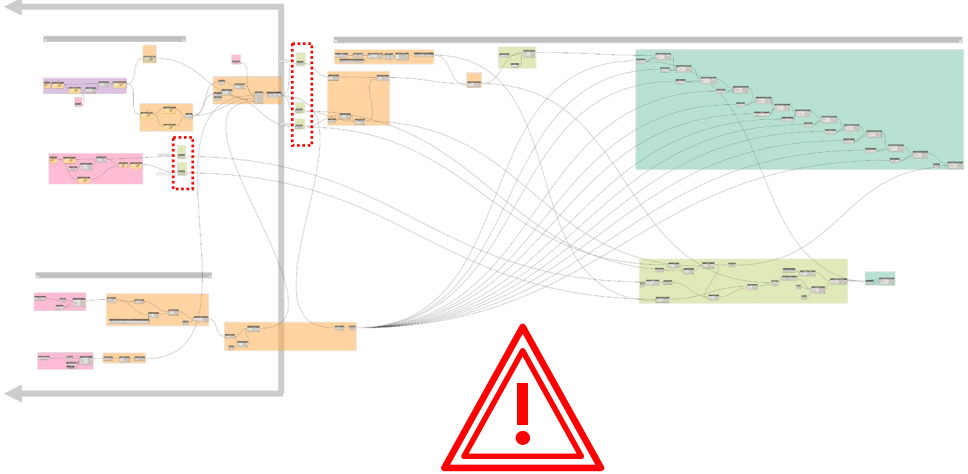
Revit time!

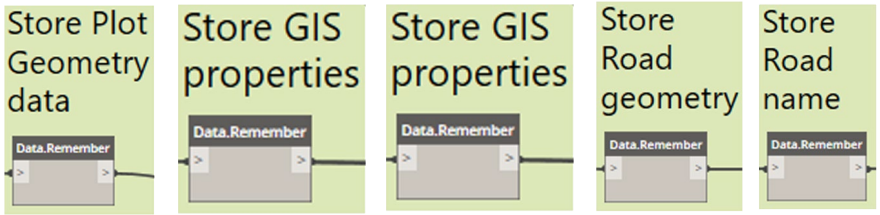
Dynamo - Step 02

Create floors in Revit



C3D Nodes

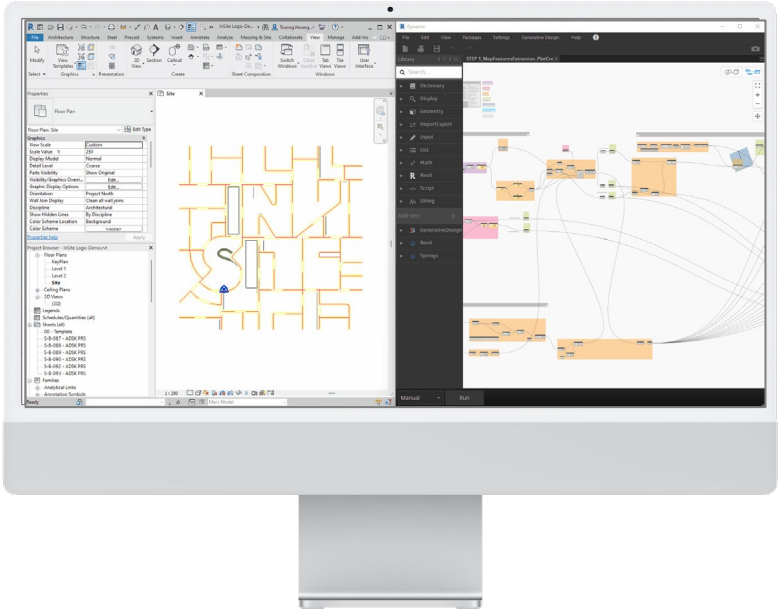


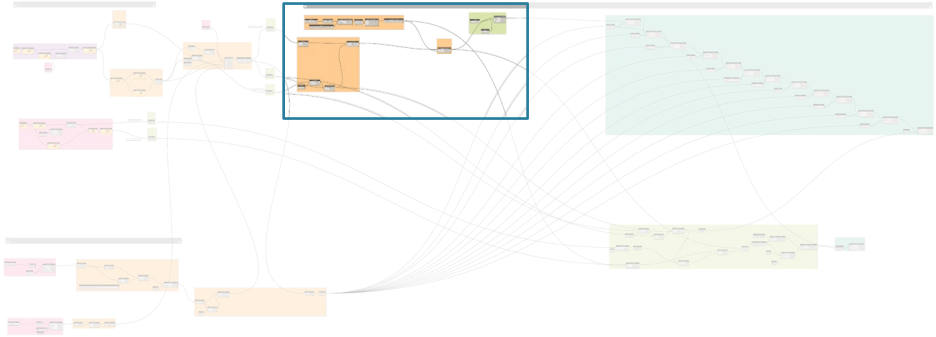


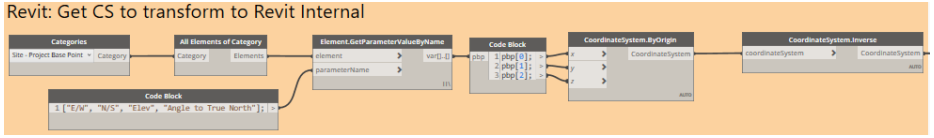
Disconnect nodes

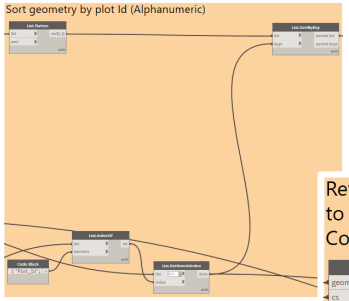
Dynamo - Step 02

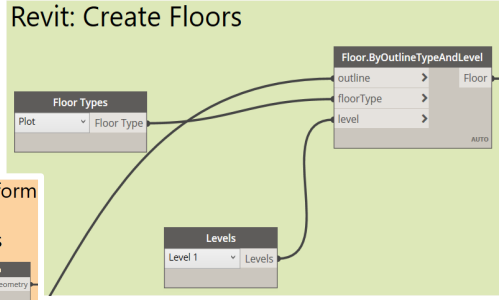
Create floors in Revit

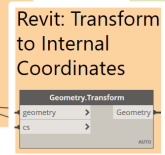






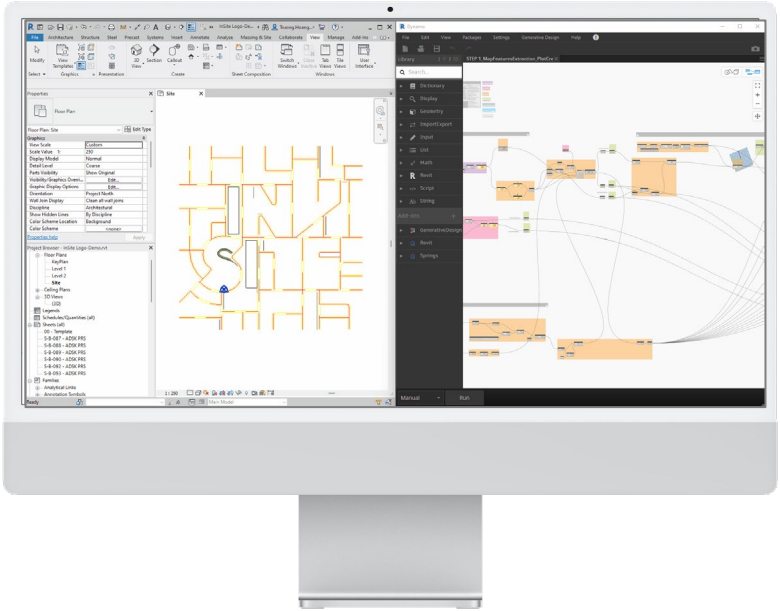


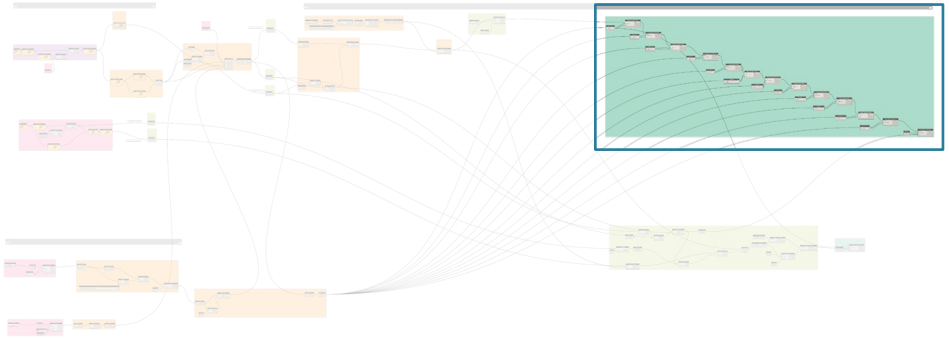


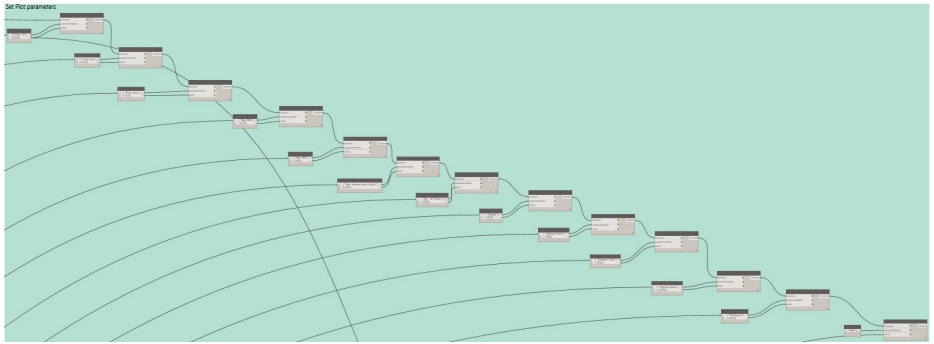


Dynamo - Step 02

Create floors in Revit

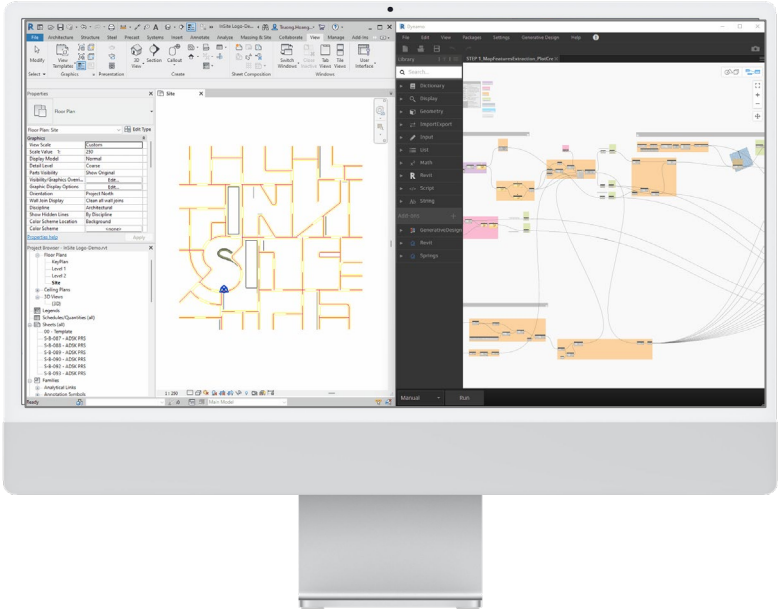


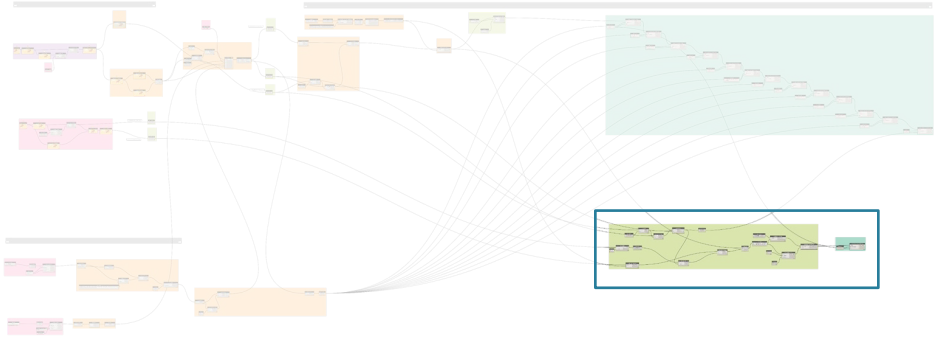


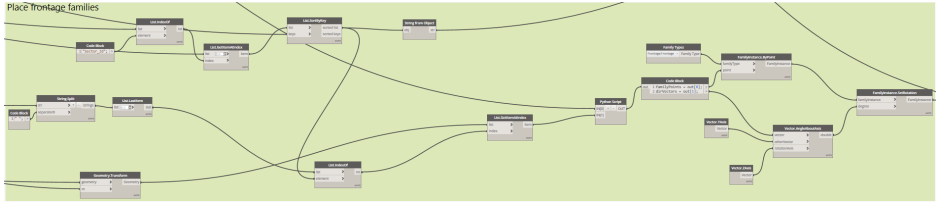


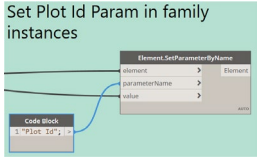
Dynamo - Step 02

Create floors in Revit



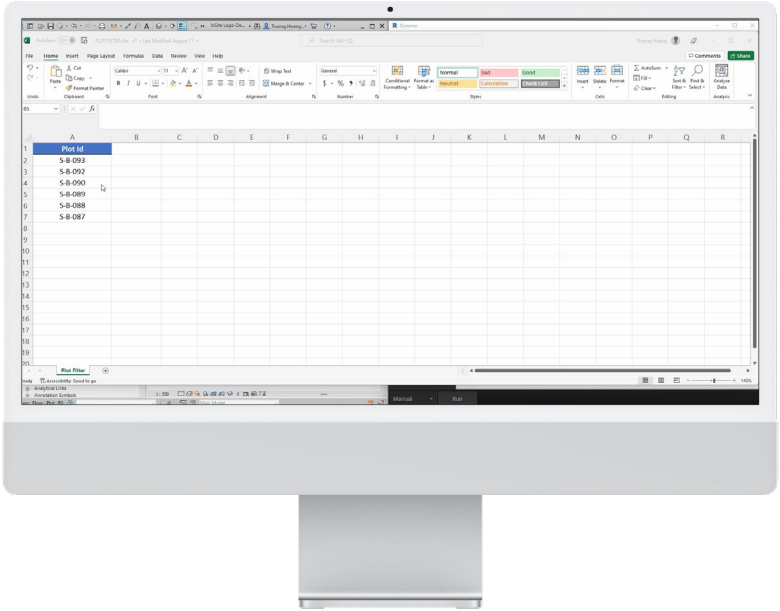


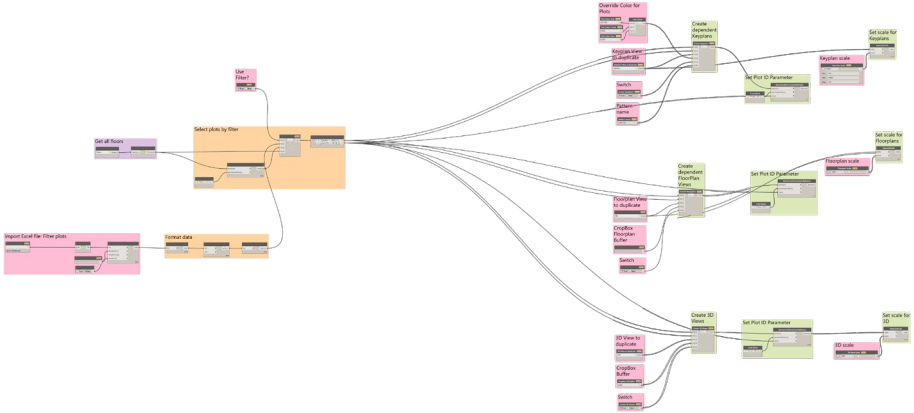




Dynamo - Step 03

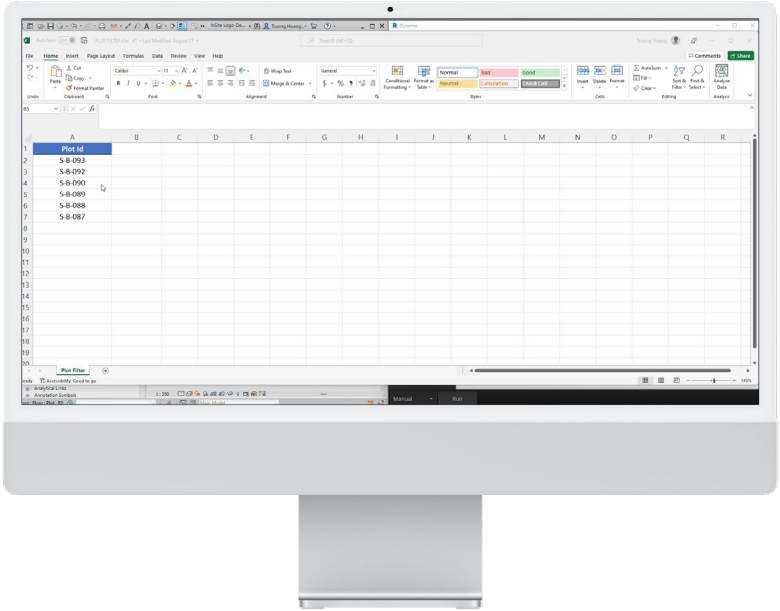
- Create views

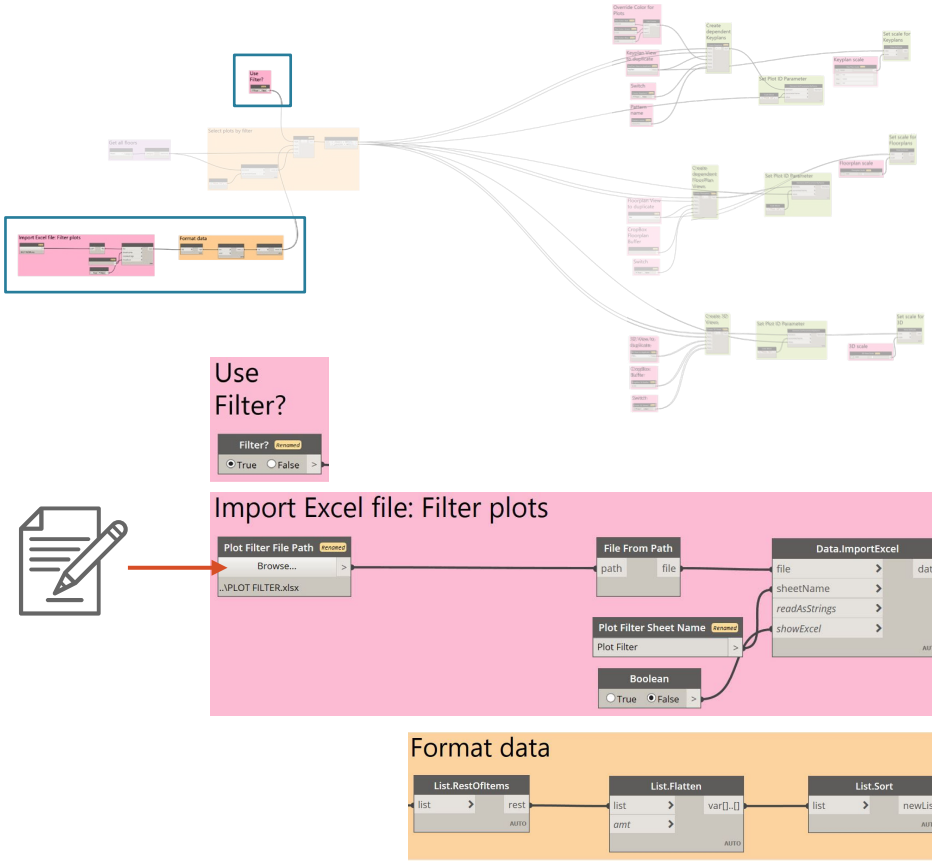




Dynamo - Step 03

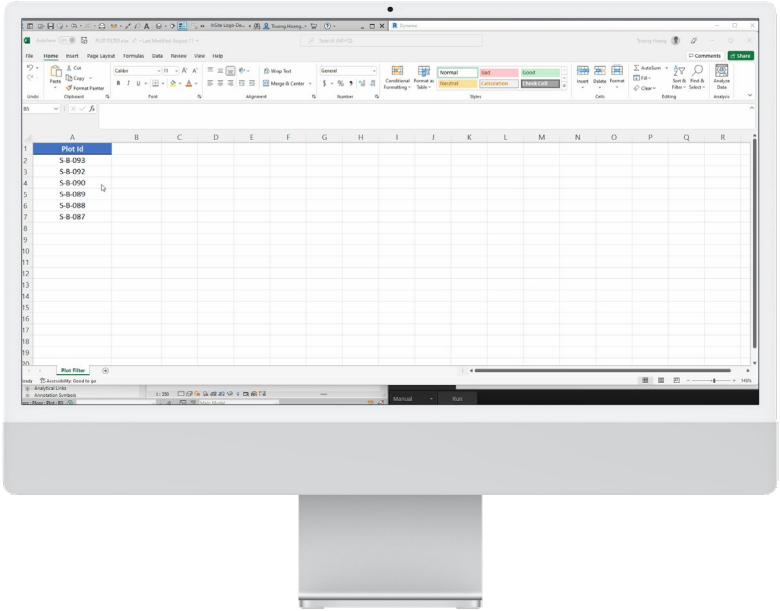
- Create views

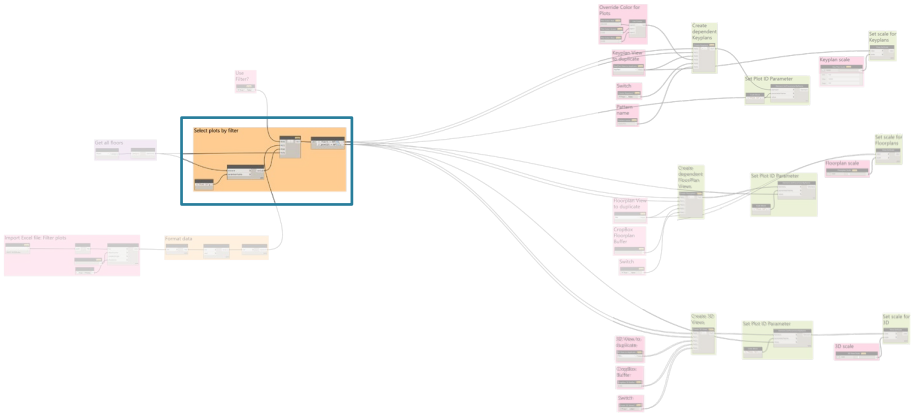


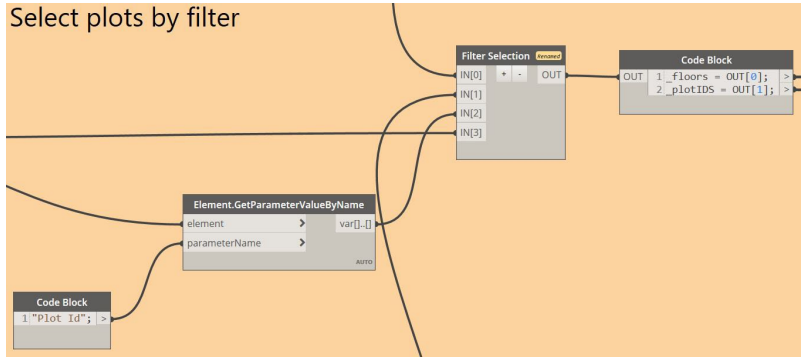


Dynamo - Step 03

- Create views

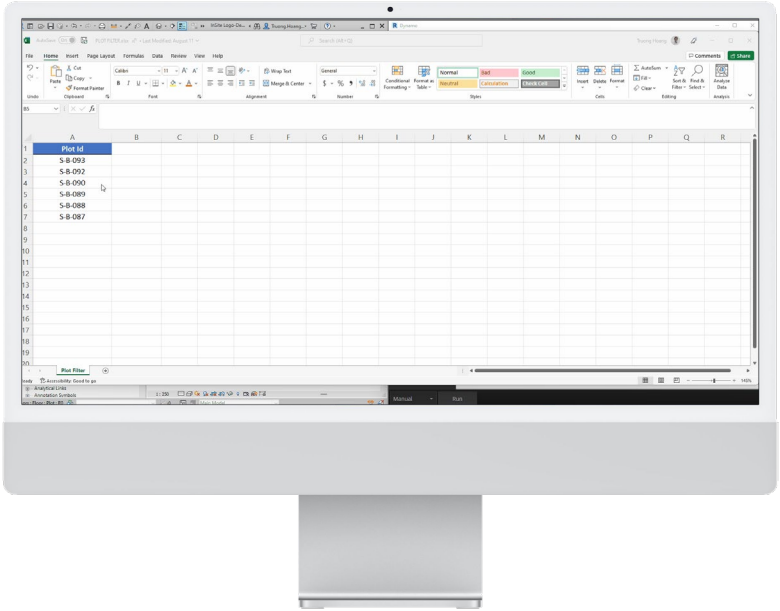


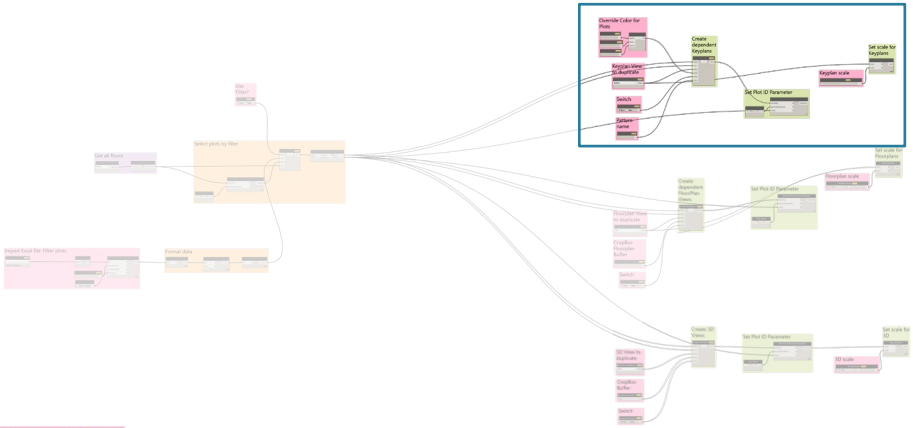


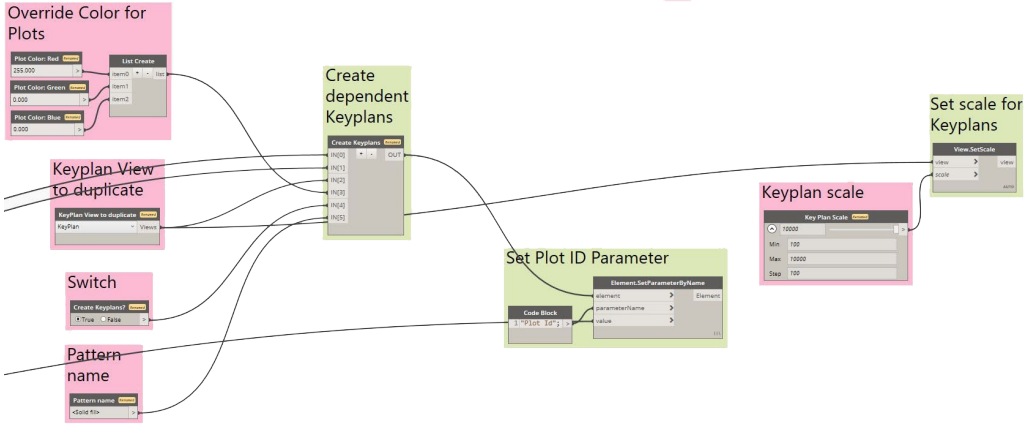


Dynamo - Step 03

- Create views

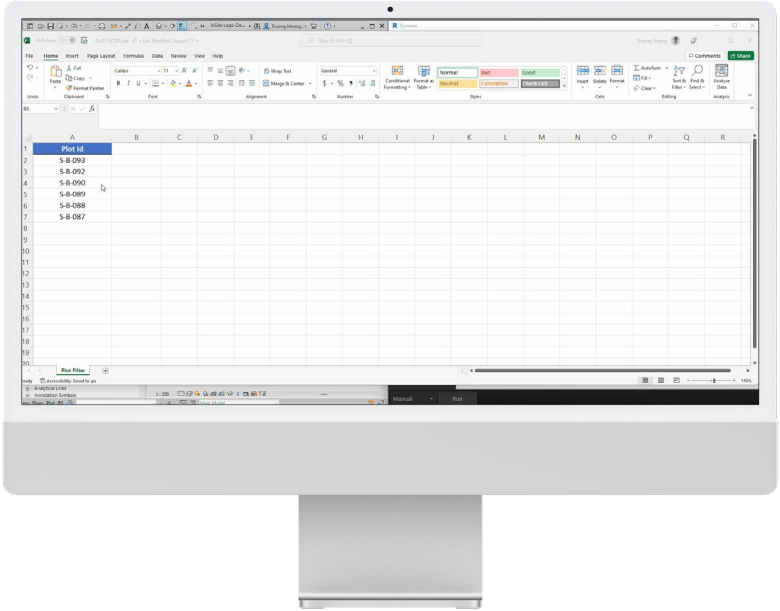


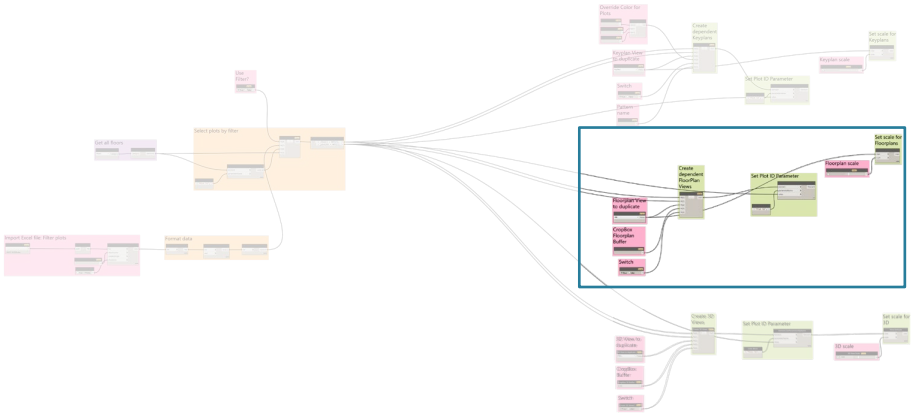


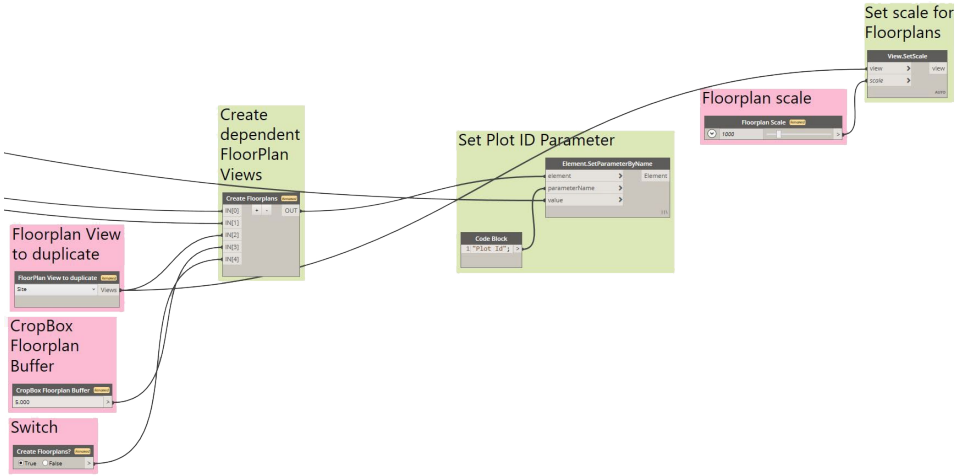


Dynamo - Step 03

- Create views

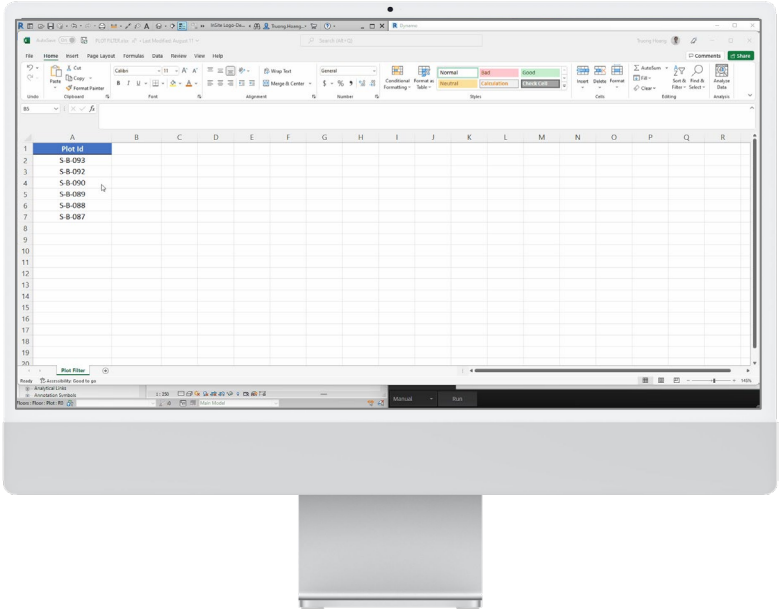


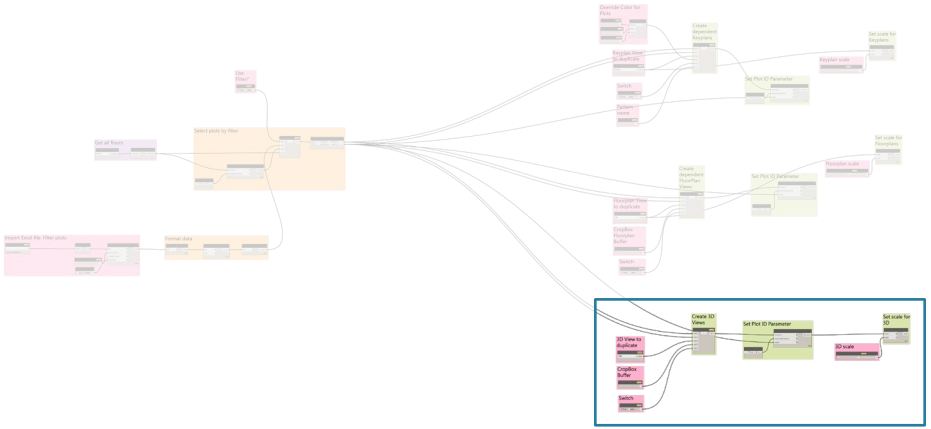


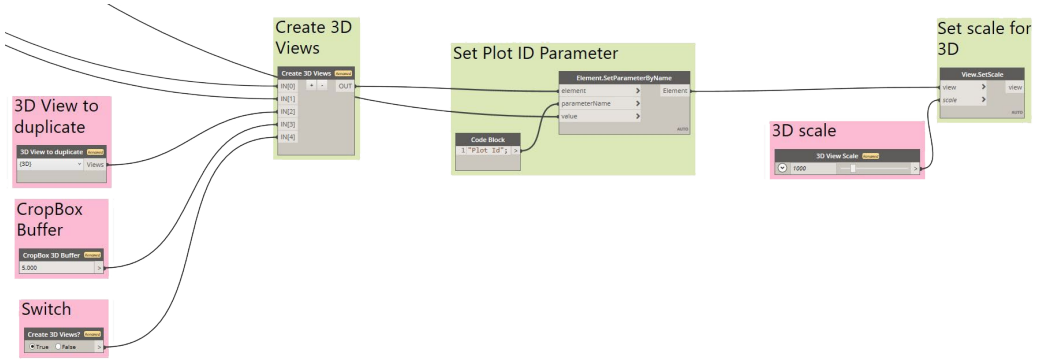


Dynamo - Step 03

- Create views

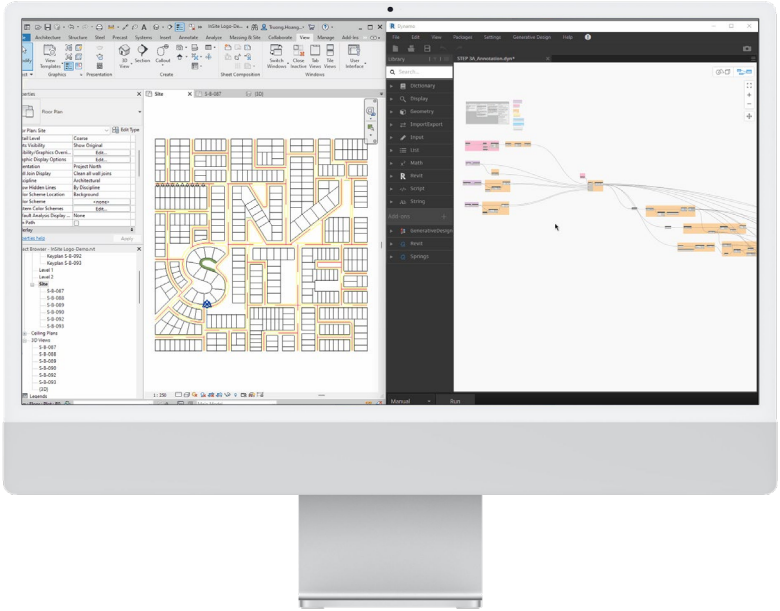


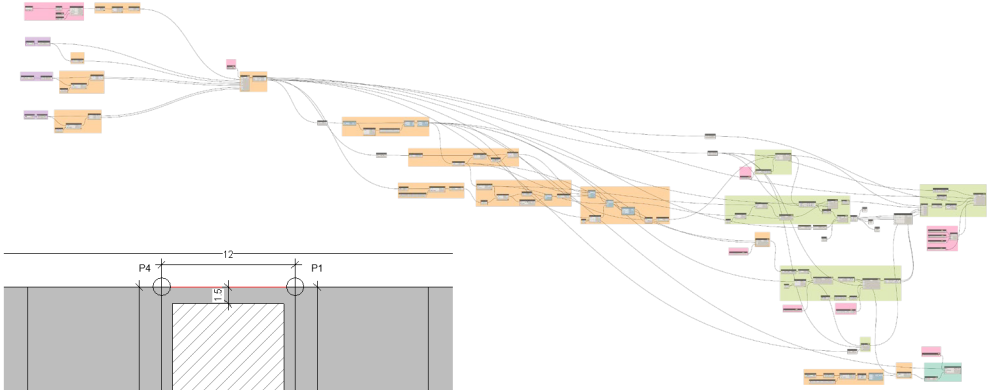


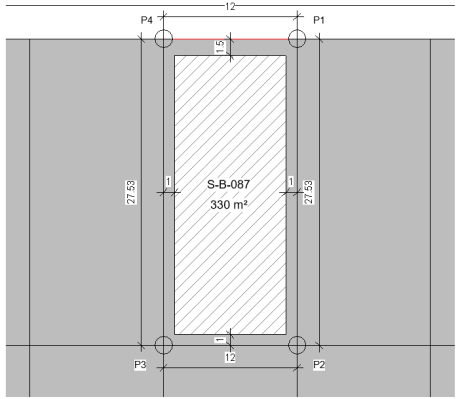


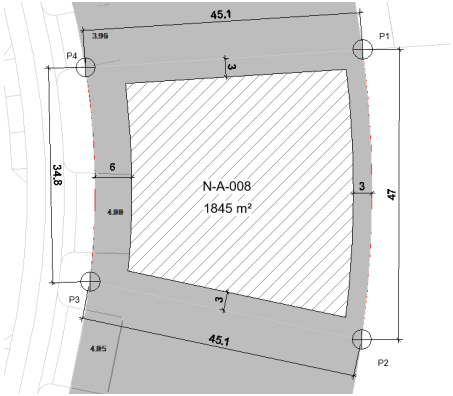
Dynamo - Step 04

- Create annotation







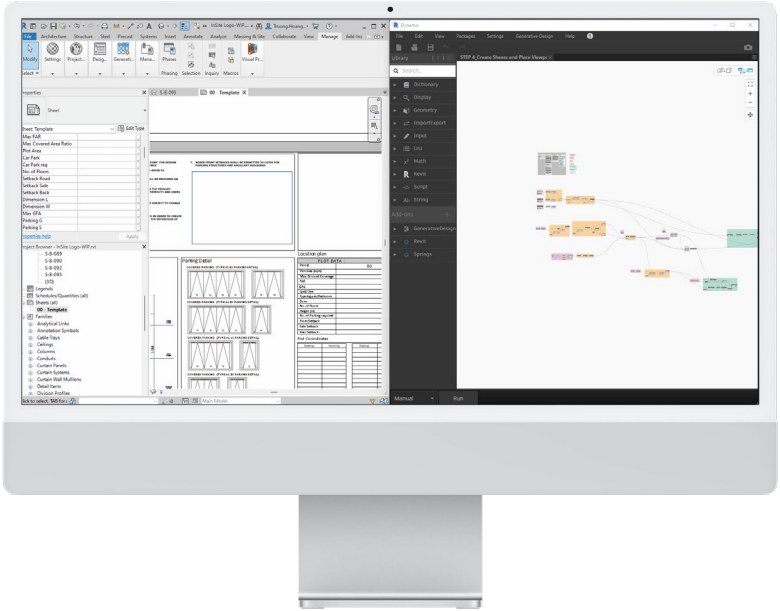


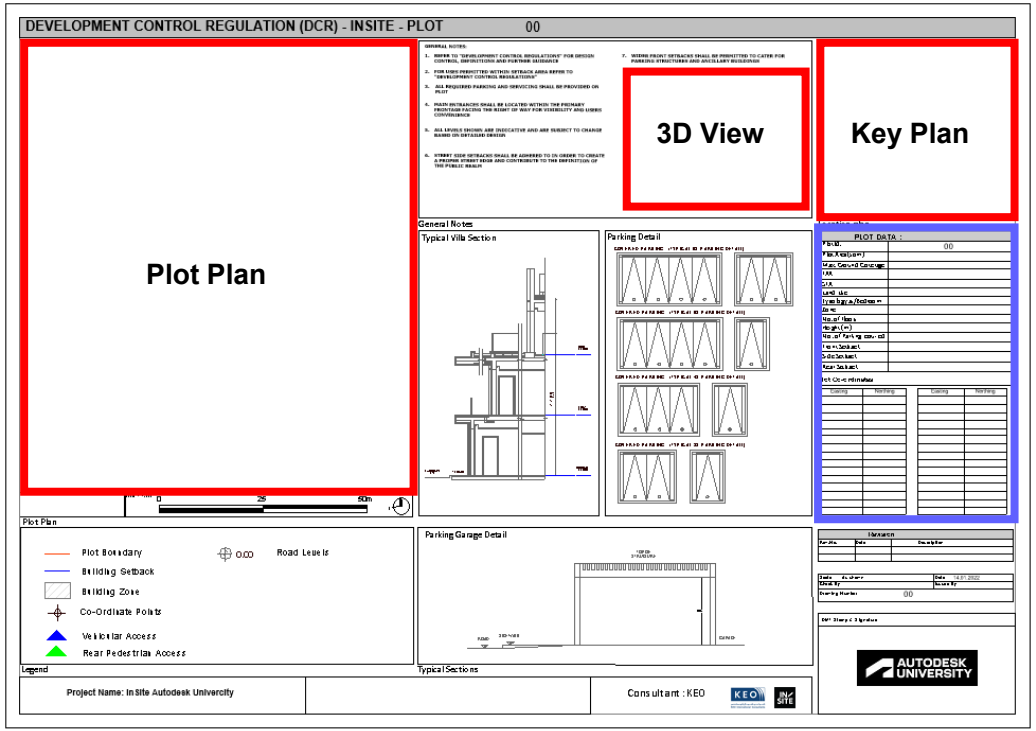
Elements automated

- Building zone
- Set back dimensions
- Plot outer dimensions
- Plot name & heights
- Coordinates points
- Plot boundary

Dynamo - Step 05

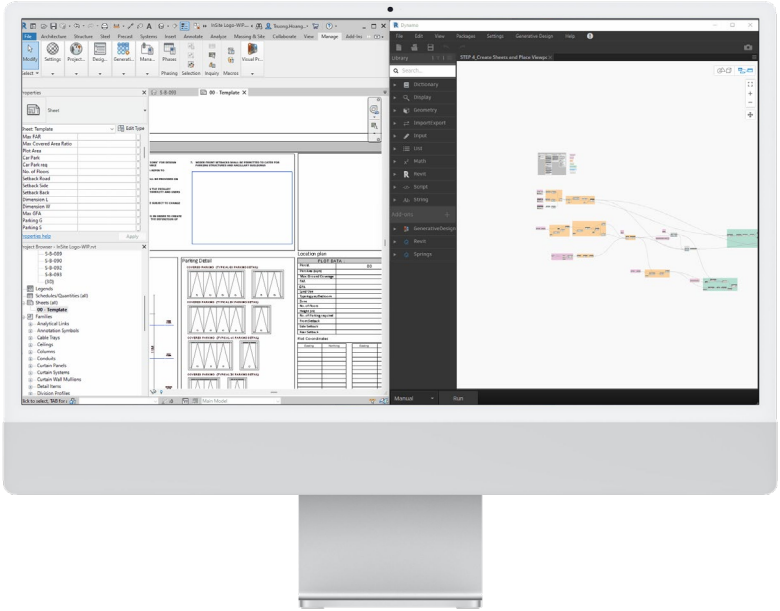
- Create sheets

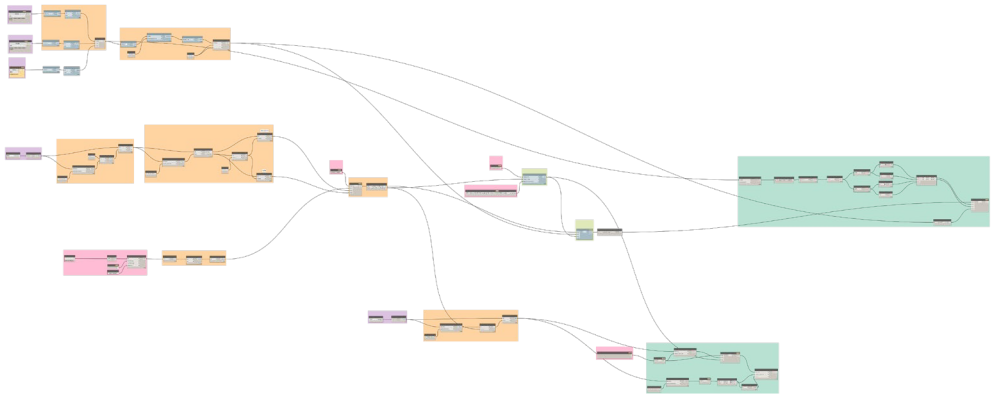




Dynamo - Step 05

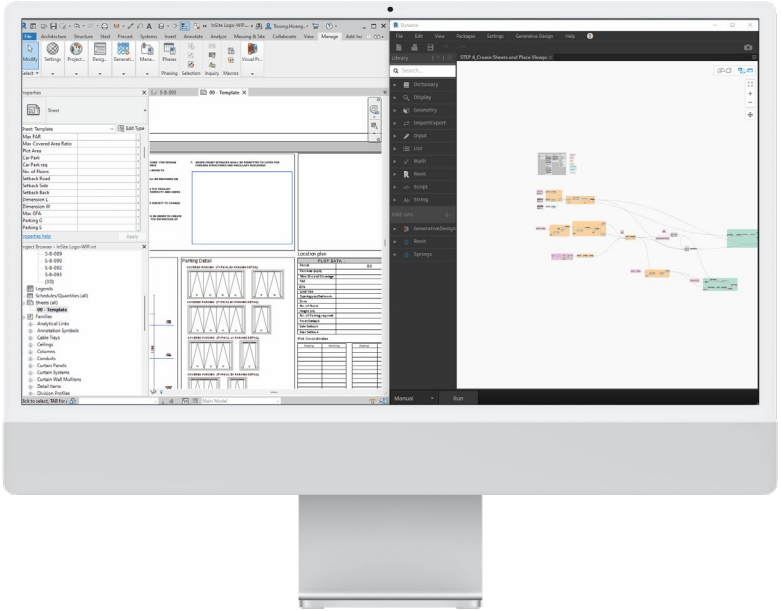
- Create sheets

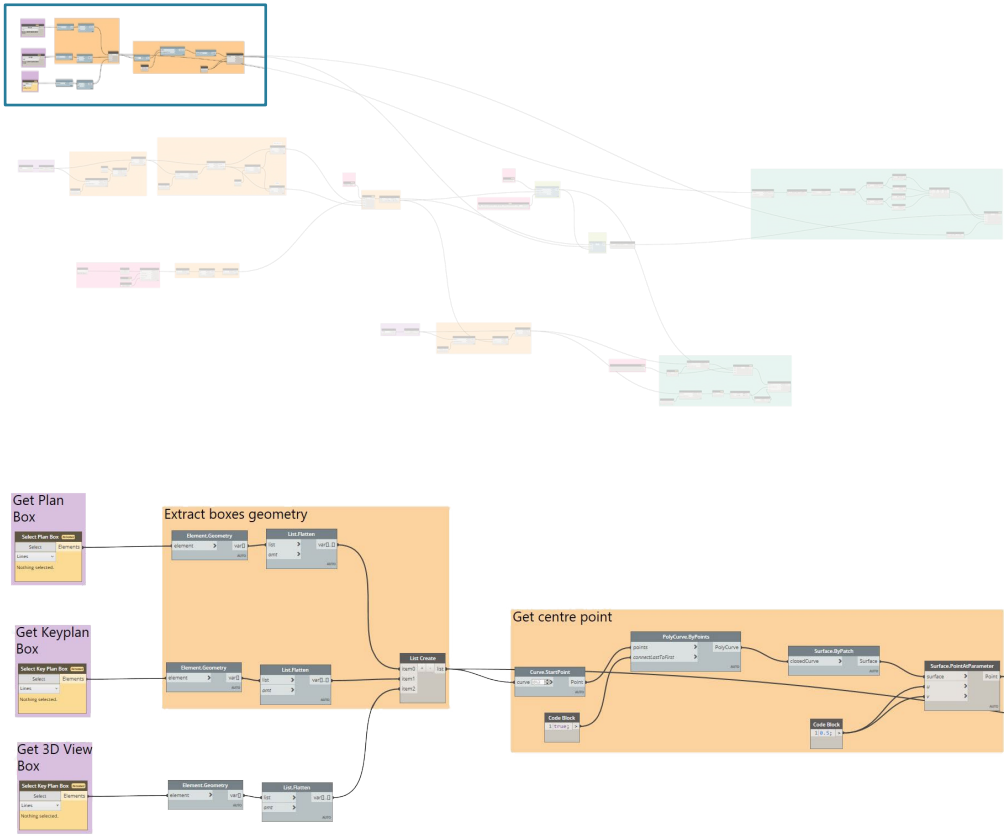




Dynamo - Step 05

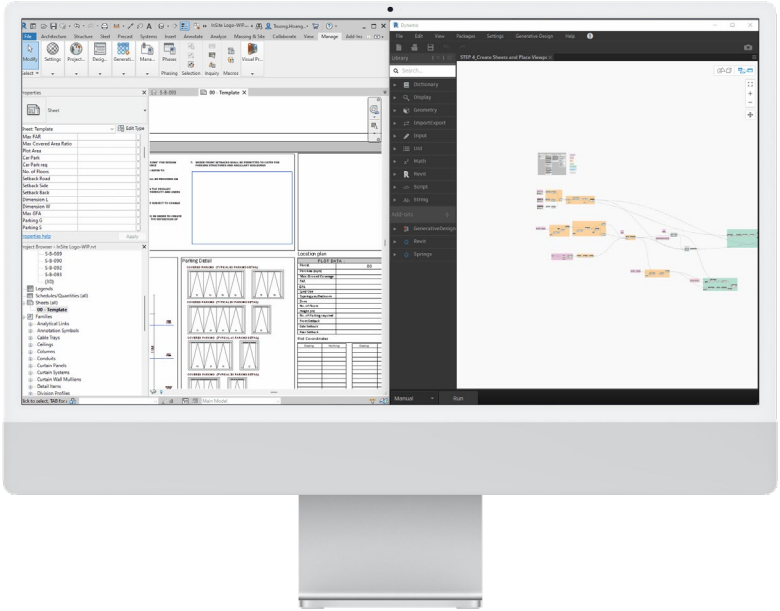
- Create sheets

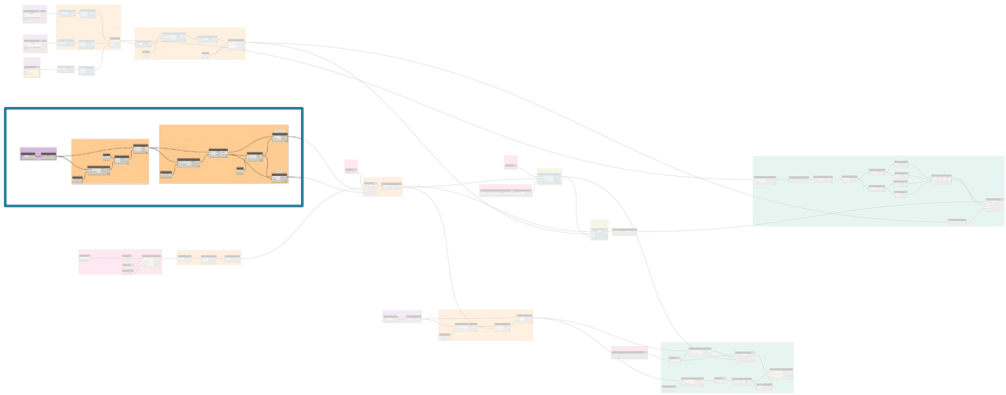


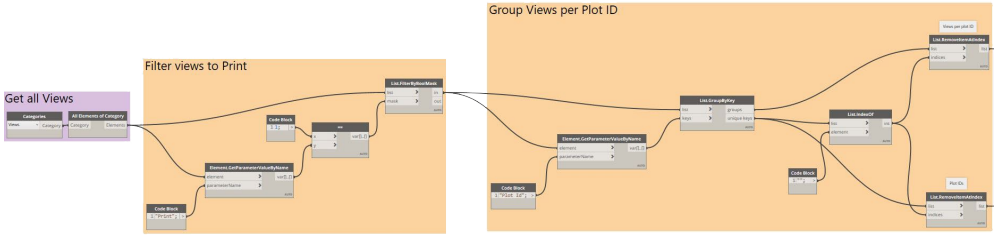


Dynamo - Step 05

- Create sheets

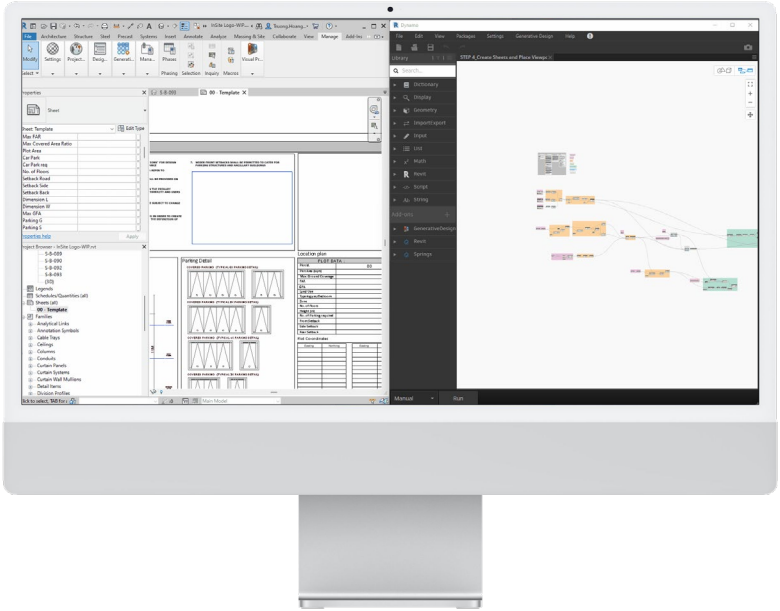


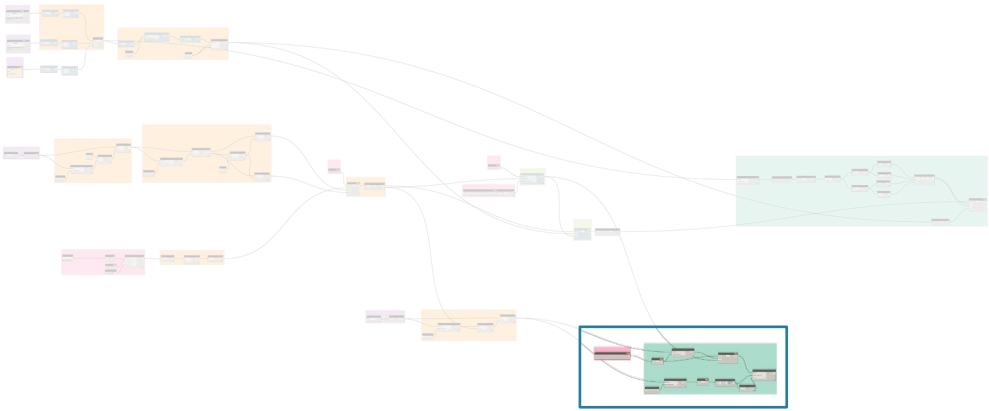


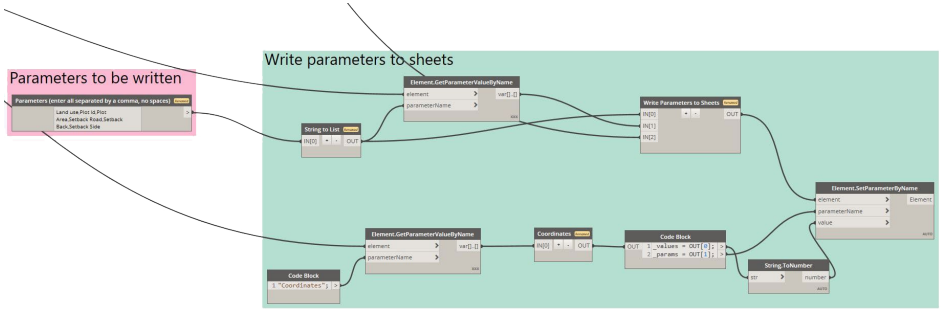


Dynamo - Step 05

- Create sheets

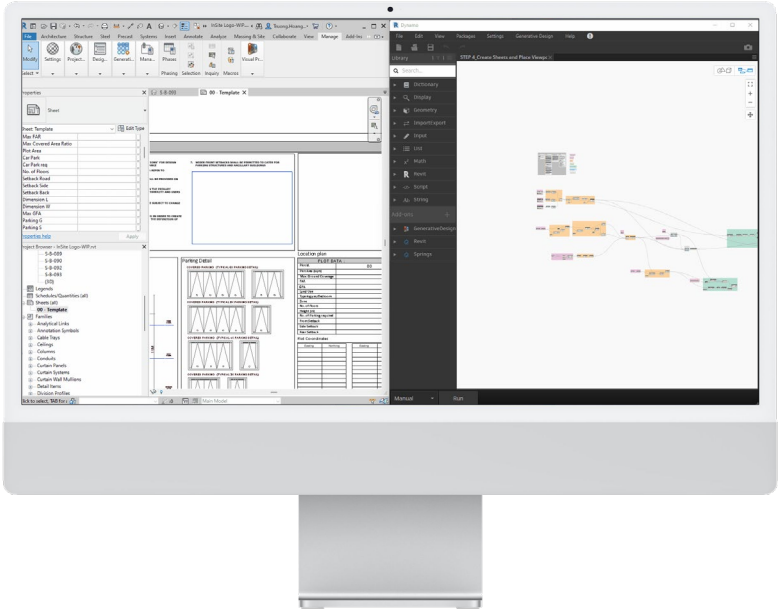


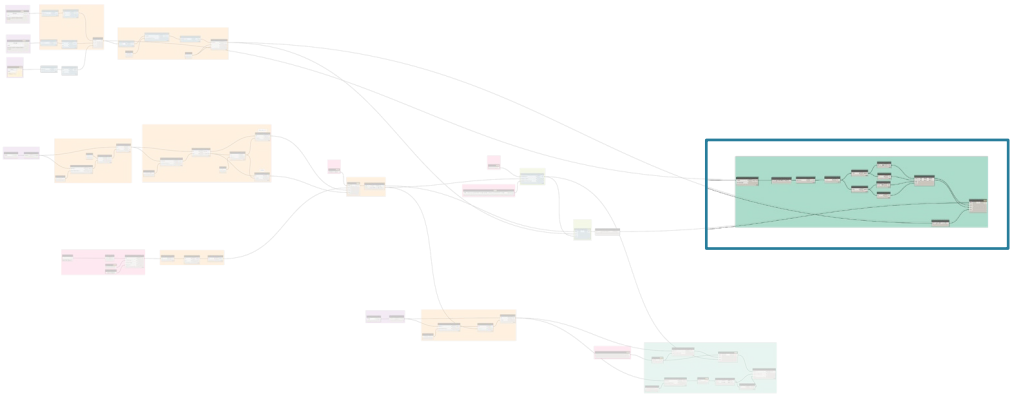




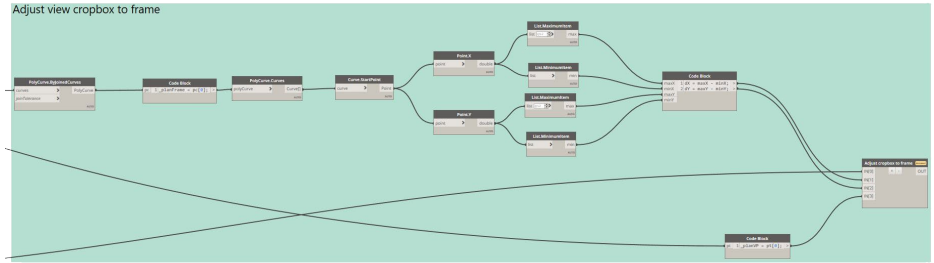
Dynamo - Step 05

- Create sheets



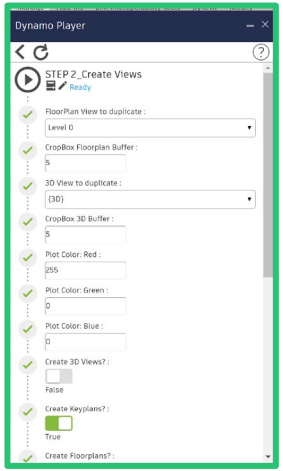


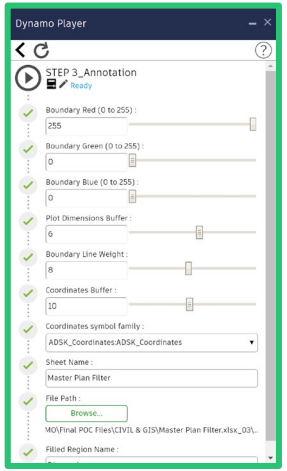
414 plots
This process took over 1hr to complete

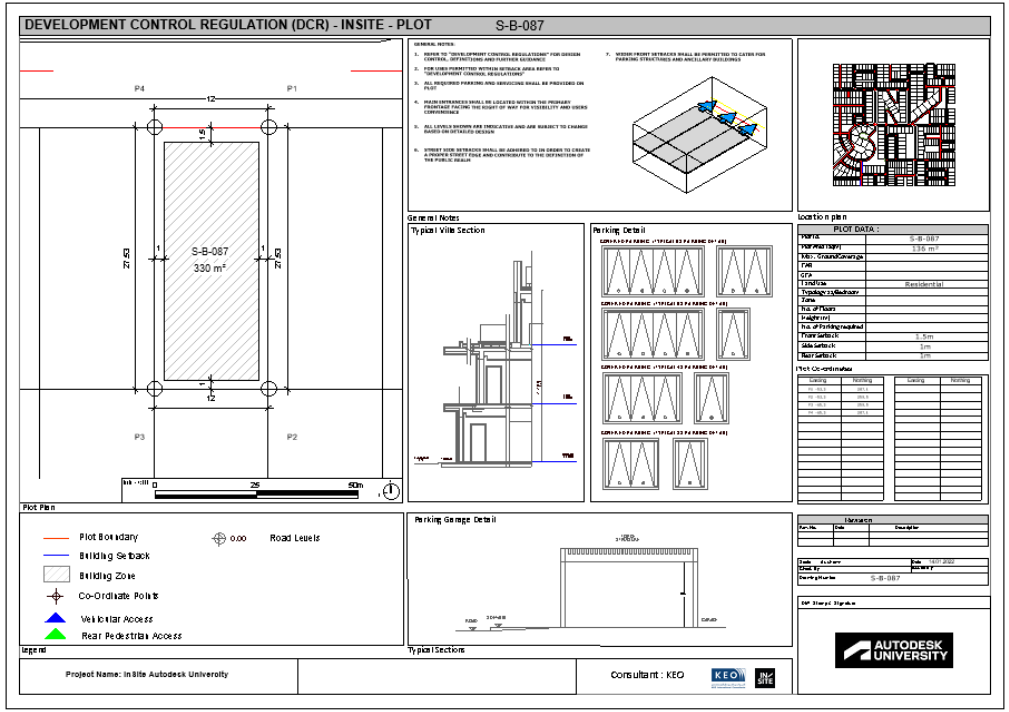


Final Outcome

- What we achieved



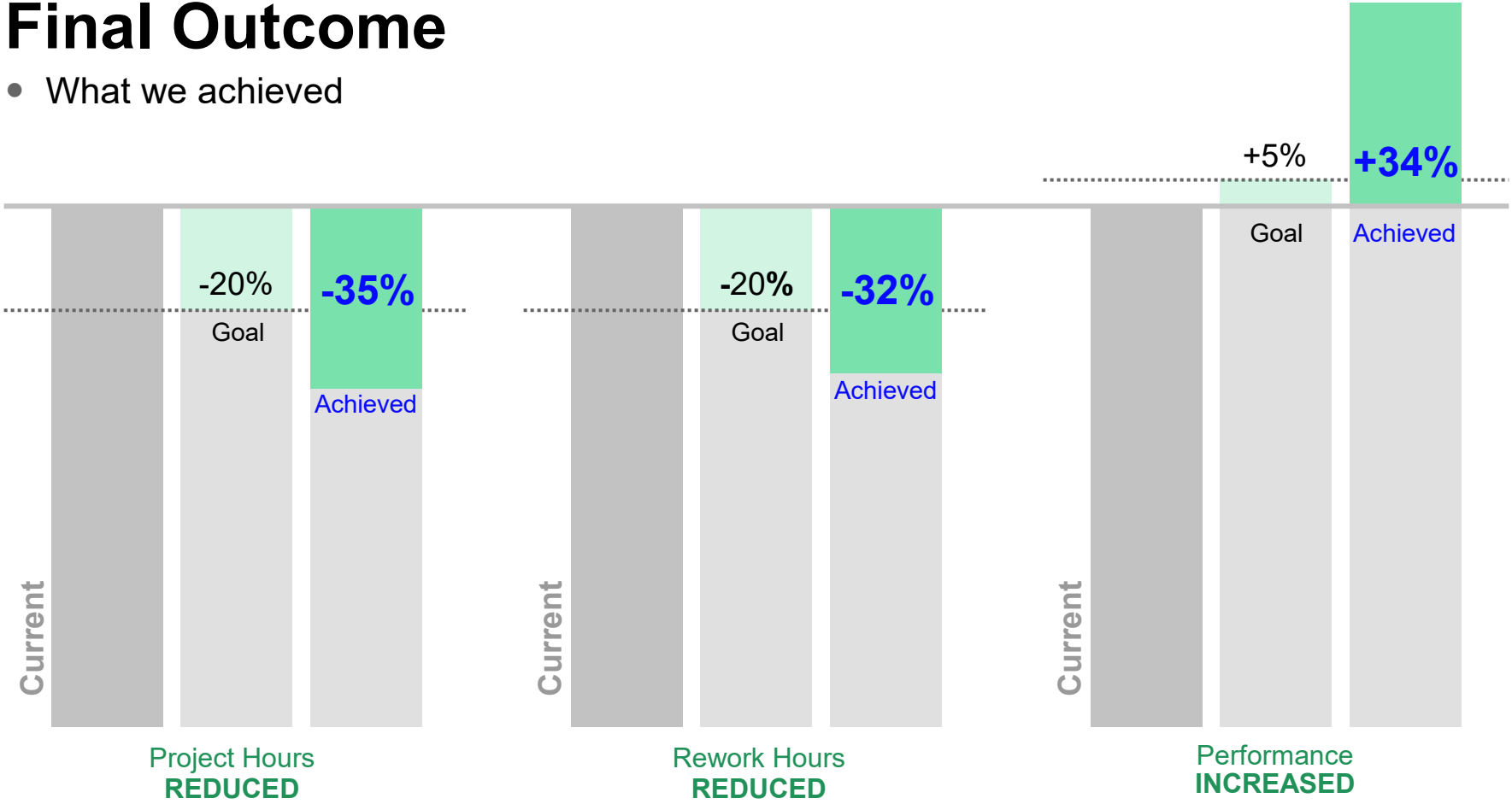


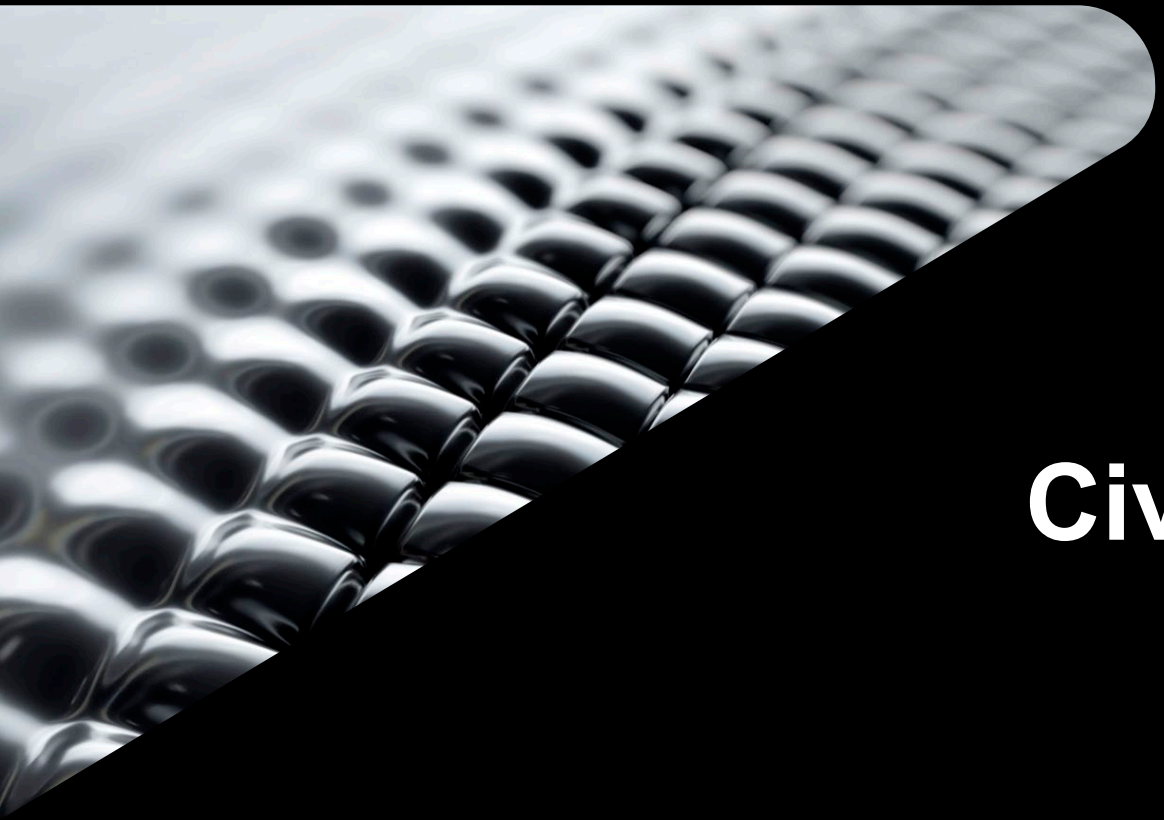


All graphs except Step 1 optimized for Dynamo Player

Final Outcome

- What we achieved





Civil3D Solution

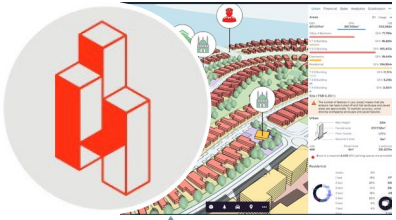
What did we develop

Moving to Civil3D – Why?

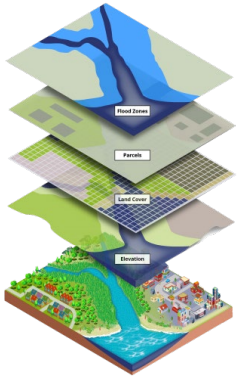
- Handle large areas better than Revit
- Has built-in parcel object which is perfectly suitable to model plots
- Utilize built-in Civil 3D labelling for documentation
- Has Property Set Data, suitable for storing and extracting data of plot
- We have created Civil 3D Add-in to support master planning tasks in Civil 3D

New workflow

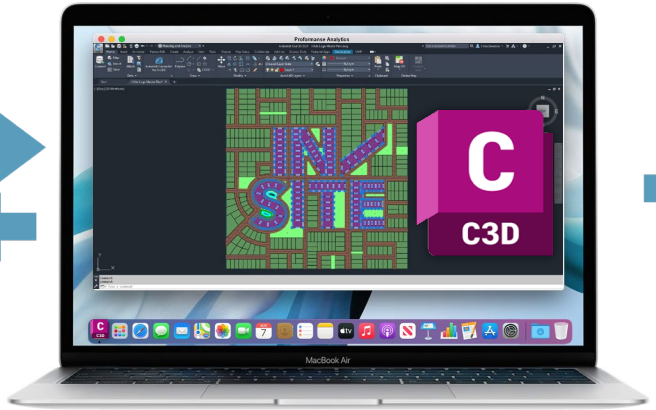
- Next level of connected data



DCR / Production



ArcGIS ESRI



Planning statistics

File set up

- C3D preparation

PLOT TYPOLOGY

By Parcel Style

Create parcel styles, each style corresponding to one typology

Set parcel style to the desired typology

By Property Set Data

Create a list of property data, each item corresponding to one typology. Set the property data value to the desired typology

PLOT ADDITIONAL DATA

Using Property Set Data

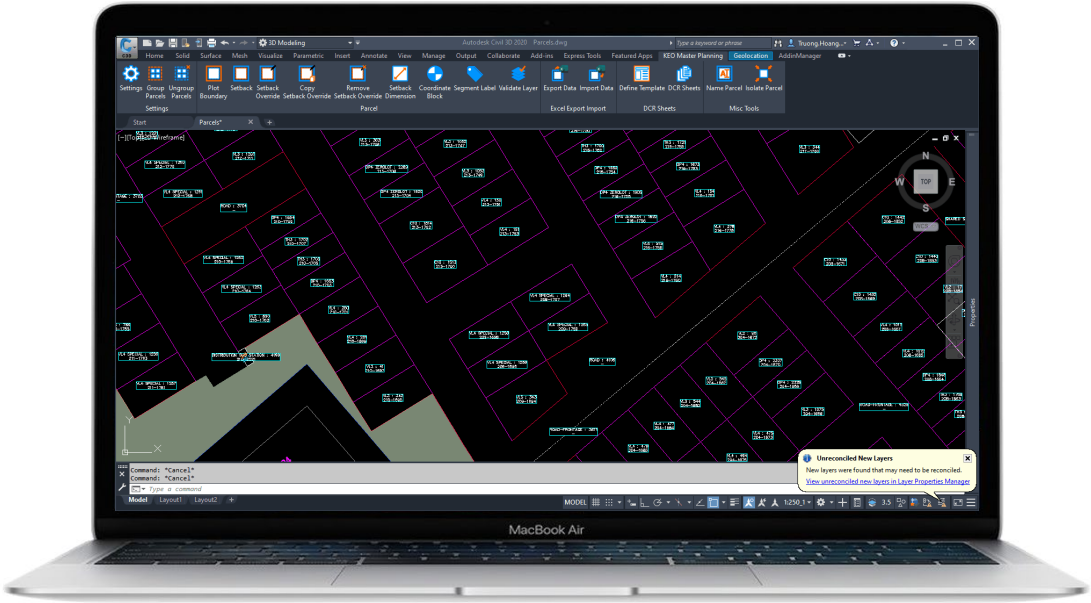
Create as much Property Data as required to store additional data for each parcel

Parcel Manipulation

- Data of each plot can be entered directly on the property palette of Civil 3D via property set data or by importing Excel data

- The plugin provides functionalities to work with parcels such as:
  - Identify plot orientation (North, North East,…)
  - Identify adjacent plots
  - Find the direct distance to other typologies
  - Pushing plot coordinates to plot data
  - Find text within plot boundary and assign it to any plot data - useful when getting data from other software

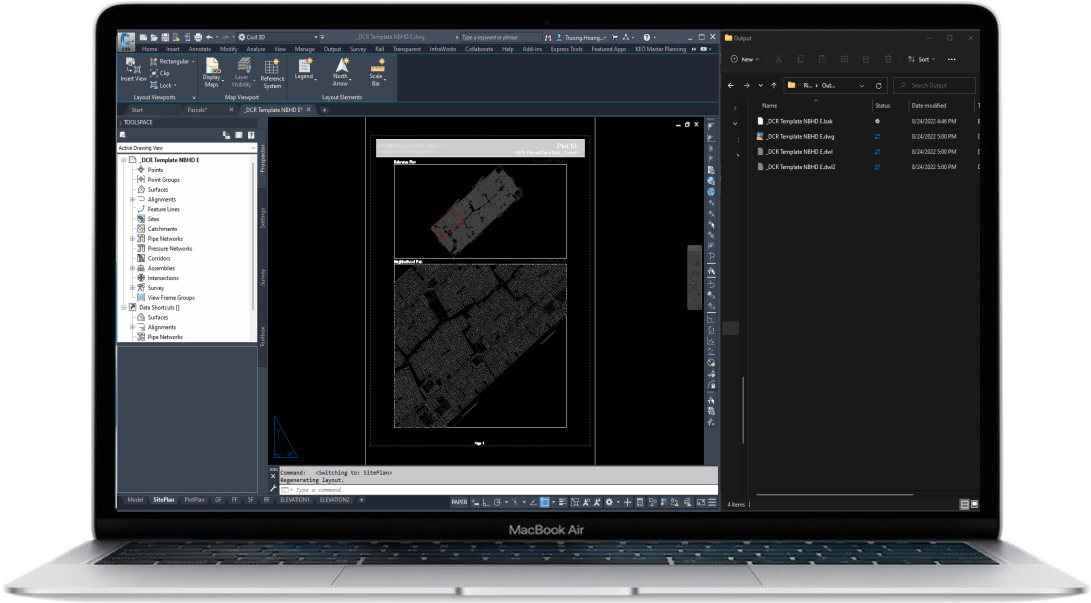
Generate Setback



- Setback is generated based on the plot's typology. Setback distance is identified by each typology
- User assigns setting for setback distance and setback object style can also be customized
- Setback dimensioning will be generated after generating setback boundary

DCR Sheets generation

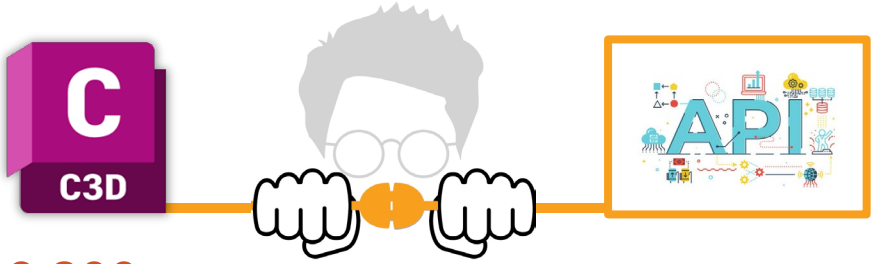
- The Time Saver



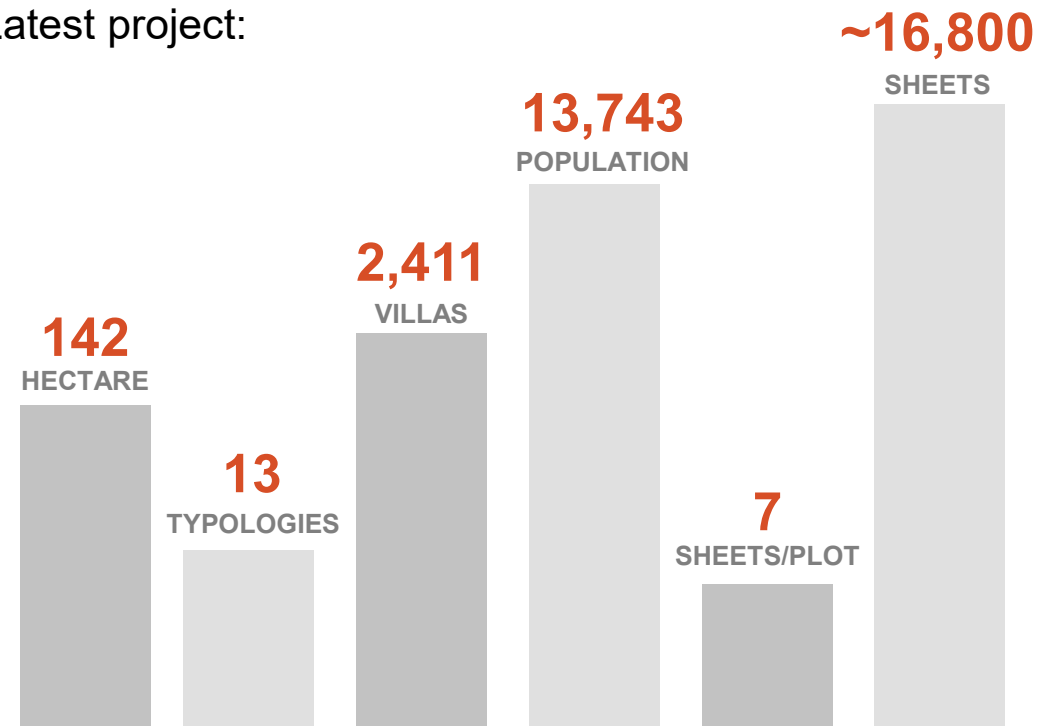
- DCR Sheet is fully customizable using a template
- Objects which compose a template include:
  - Ordinary AutoCAD/Civil 3D objects as static content; remaining are dynamic content
  - Key plan
  - Plot plan
  - Coordinate schedule
  - Block selector
  - Field
- DCR sheets will be generated as one file per plot; each file can also contain multiple sheets

Final outcome

- Connecting the power of C3D with API



Latest project:



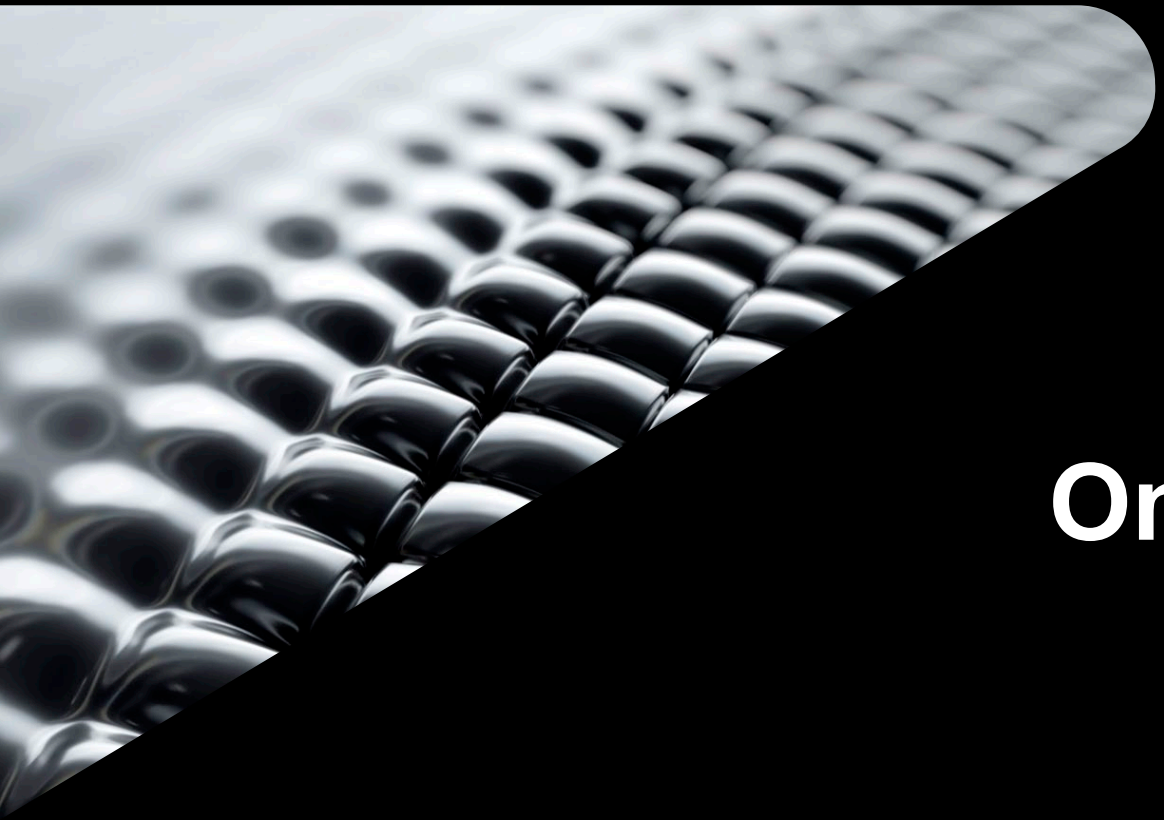
840 hours

Plot sheets alone

Completed in 24 hours

97%

time-saving



Online Platform

What's next for the models


GIRAFFE?
AUTODESK UNIVERSITY

Giraffe Technolo

Most digital solutions are heavy, detail-orie
only technical users.

Giraffe platform is light and simple. It’s eas
delivery of robust, complete solutions.

It allows users to build models in real-time
businesses need to consider:

search and discover

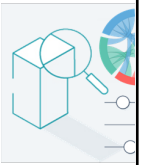
Layer library & layer search

Source opportunities

track

Permission, share track and tag projects, teams and data

Manage projects



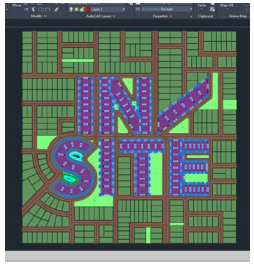
canvas

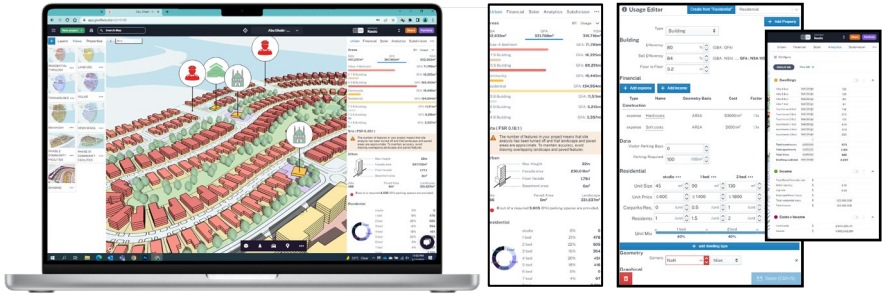
draw and see data

Do early st
design

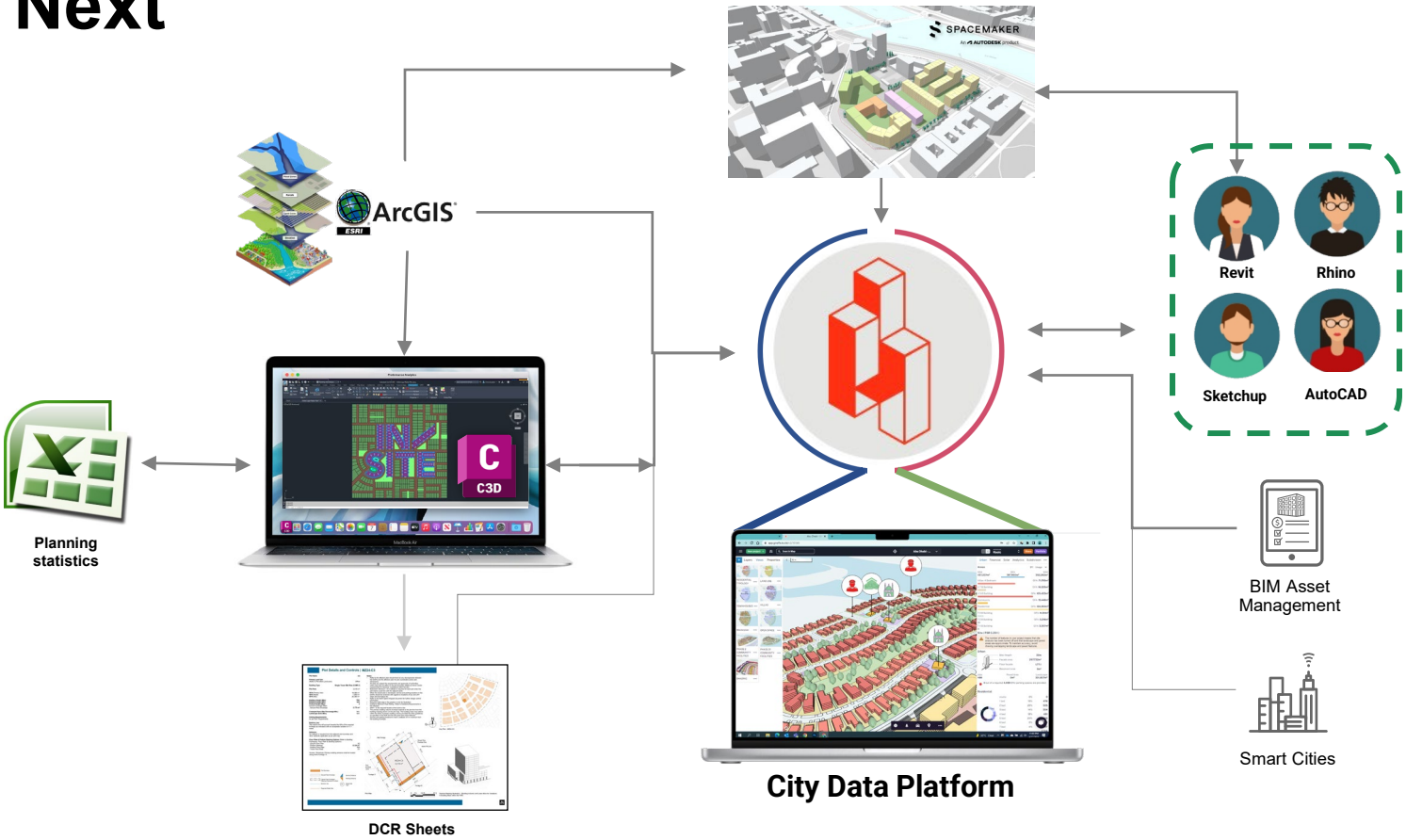
Civil3D to Giraffe

Digital engagement tool





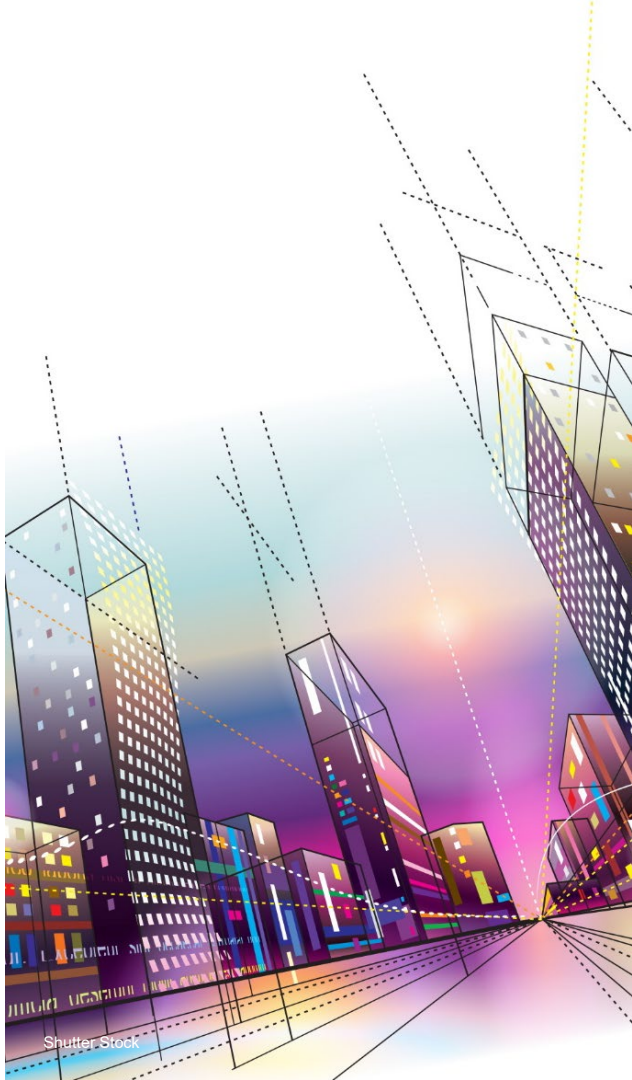
What's Next


SPACEMAKER
ArcGIS
ESRI
Revit
Rhino
Sketchup
AutoCAD
C3D
Planning statistics
BIM Asset Management
Smart Cities
City Data Platform
DCR Sheets

Final Thoughts

Its about connected data and process

- Taking the time to understand the process and connecting data in independent toolsets adds high value
- Understanding where the time is lost on your projects is key
- Data quality needs to be a key focus
- The process can be different to ours, but pieces can be interchangeable, and small changes can have significant gain
- Master planning has great automation potential



AUTODESK UNIVERSITY