AUTODESK UNIVERSITY

MEP20450

Efficient and Collaborative BIM workflows for Mechanical Engineers

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Hoare Lea

Learning Objectives

- Understand how Revit can improve the workflows of a mechanical engineer
- Get inspiration for using Dynamo, add-ins and core Revit to automate your processes
- Put some helpful tips and tricks into practice to save loads of time
- Discuss how emerging technologies will change mechanical engineers' workflows

Description

In this session, we'll look at ideal workflows for using Revit software, and how to avoid key time-wasting traps, as discovered the hard way by an experienced Revit-using mechanical engineer. Using heating system design workflow as an example, we will look at ways to automate the process using core Revit features, Dynamo, and bespoke add-ins. We'll also give some specific technical tips and tricks to help engineers get the most out of their Revit software systems and spaces. This is a follow-up to the 2013 class on improving efficiency by using Revit MEP software for mechanical calculations.

Your AU Expert

Ben Roberts is a chartered mechanical engineer based in the UK, where he holds the position of BIM Delivery Leader for Hoare Lea, a role which involves pushing the boundaries of software tools and enabling teams to deliver projects as efficiently and effectively as possible. He specialises in using BIM models for design calculations, has spent several years improving the design capability of Revit, and rolled out calculation methods throughout Hoare Lea's 12 offices.

Ben is an active member of the CIBSE BIM steering group, the BSRIA BIM Network, and is involved in developing many industry standards for MEP BIM delivery. He has written articles for a variety of construction industry journals on the subject of BIM, and regularly presents and lectures on the subject around the world.

This is Ben's second class at AU, following 2013's "Beyond 3D: improving efficiency by using Revit MEP for mechanical calculations".

Heating Workflow

Using the design of a heating system from inception to completion, the below notes will take you through methods for automating parts of the process using Revit, Dynamo and some bespoke add-ins. These methods can help you to save significant amounts of time, and prove that we are getting closer to enabling instant and accurate feedback on design decisions.

The below process shows methods for designing in Revit at early stages without exposing yourself to risky detailed coordination issues.

Part 1: Concept Design

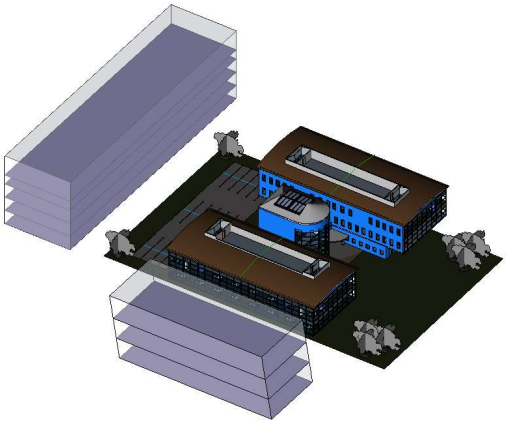
The best opportunities for energy saving come at the very beginning of the project; engineers and architects can bring their knowledge and skills together to optimize the concept design. Historically, engineers haven't been able to provide feedback on energy analysis very quickly, but this is changing.

Inisght360 uses Energy Plus to calculate dynamic heating & cooling loads, and provides a simple interface to highlight the areas that will save most energy, giving a constantly updating value for annual energy consumption.

It isn't a full plant sizing tool (yet), but the values are a very useful for rapid comparisons of options and assessing impact of design decisions.

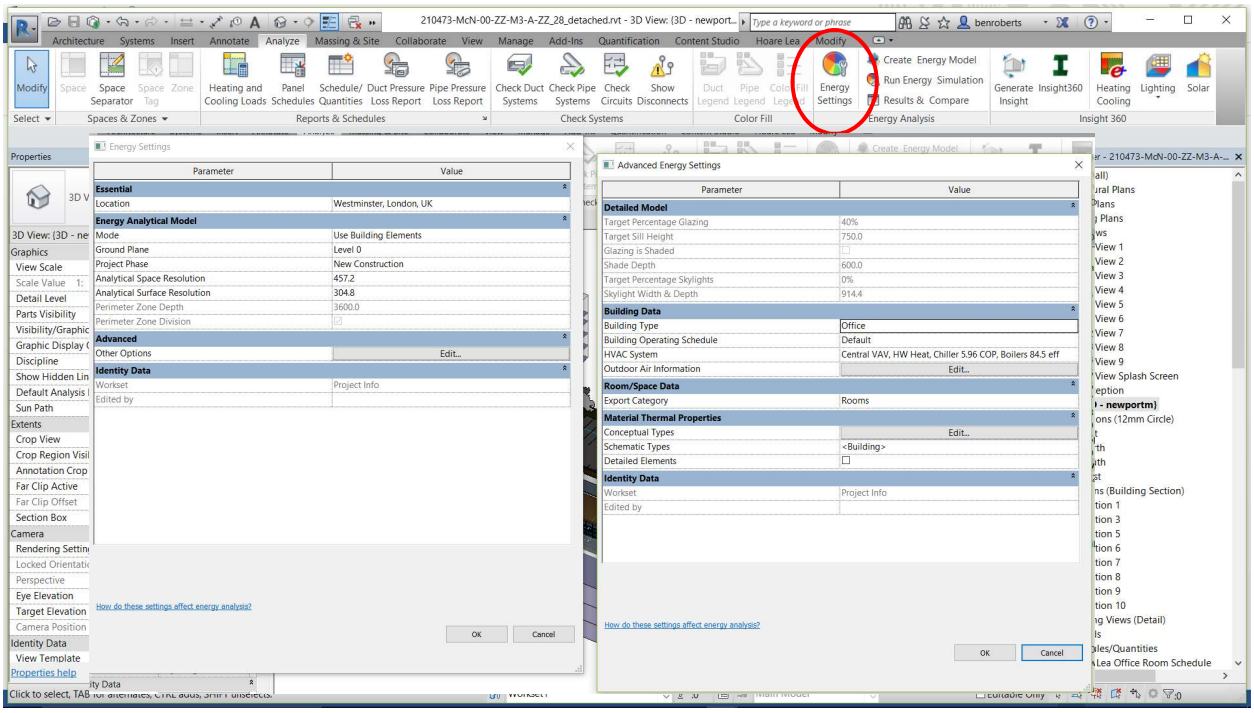
Create Masses or building elements

You can use masses, normal Revit families, or both for your conceptual energy analysis



Set Energy Settings

Go to Analyze > Energy Settings, and set the location, building type, and construction types as you need them. Make sure Export Category is set to what you need: Rooms or Spaces.



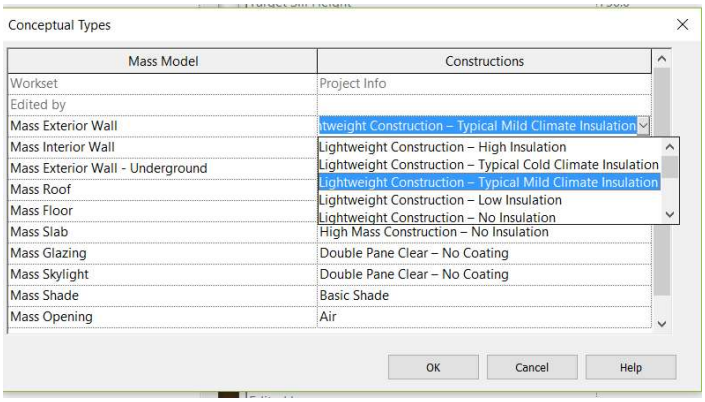
Define the materials

There are 3 different ways of setting construction properties:

- Conceptual Types (applies to masses)
- Schematic Types (default types for each element type – wall, window, etc.)
- Detailed Elements (takes specific thermal properties from materials in walls, roofs, etc.)

1. Conceptual Types

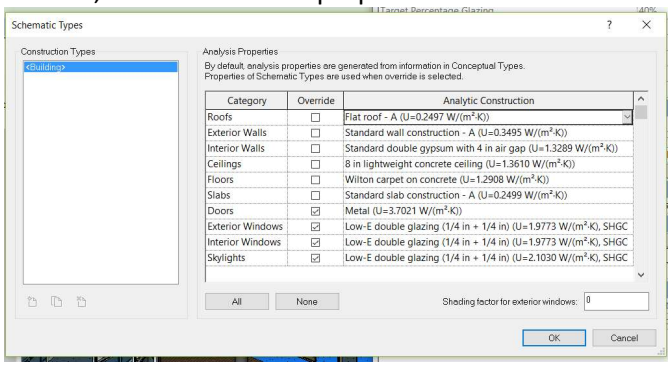
   These types apply to masses. They are very generalised and aim to simply make fundamental comparisons between (e.g.) heavyweight or lightweight constructions.



2. Schematic Types

Applied to the spaces or rooms in the energy model, these settings allow a little more control of the construction properties that are used in the analysis, such as U values and g values, but without having to define detailed thermal properties of individual materials.

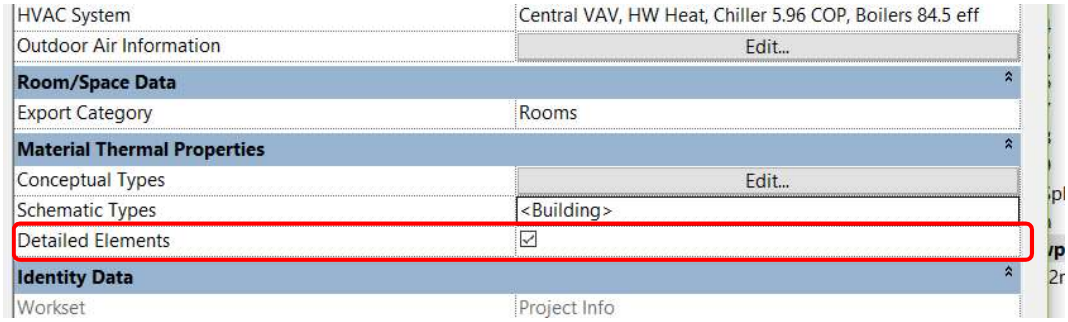
You can choose whether each category is overridden with these values, or not. If you un-tick the box, Revit will use the properties set in the model elements (see next point).



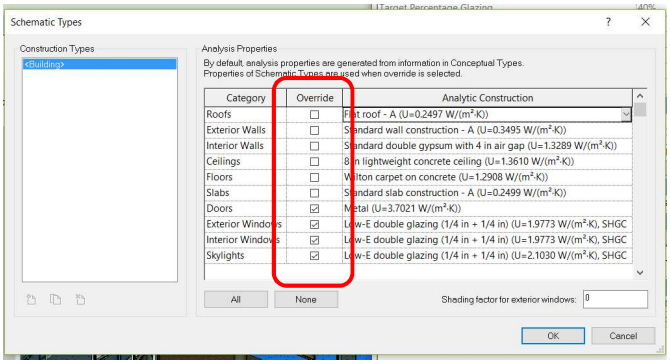
3. Detailed Elements

This method is the most accurate, and allows for each separate wall, floor, roof, ceiling, door or window type to have different properties. However, it takes a bit more time to set up…

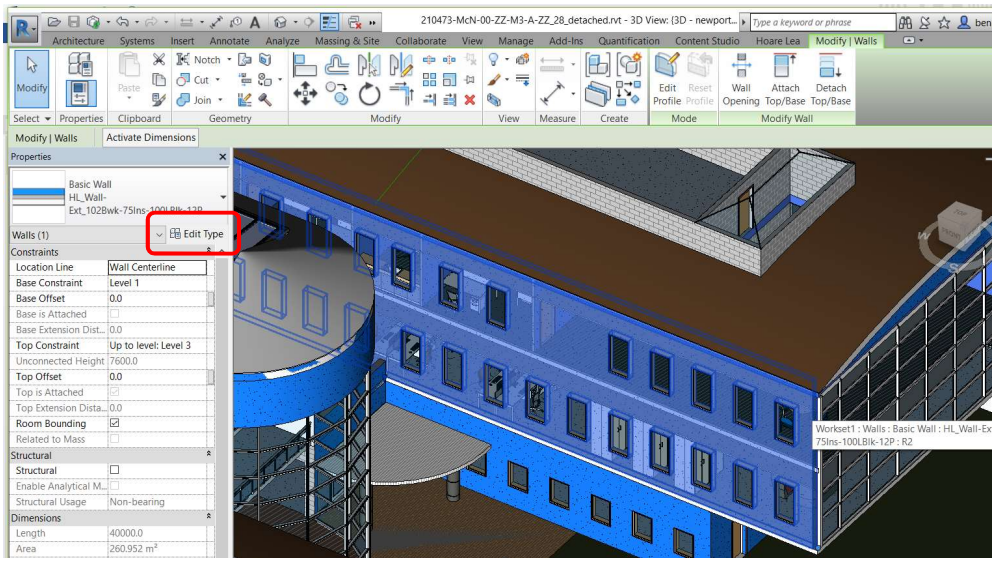
1. Under Energy Settings, tick the box next to “Detailed Elements”



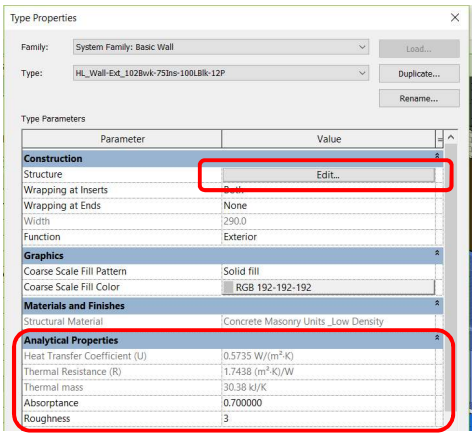
2. Under “Schematic types”, untick the overrides on whichever categories you want to do in detail.



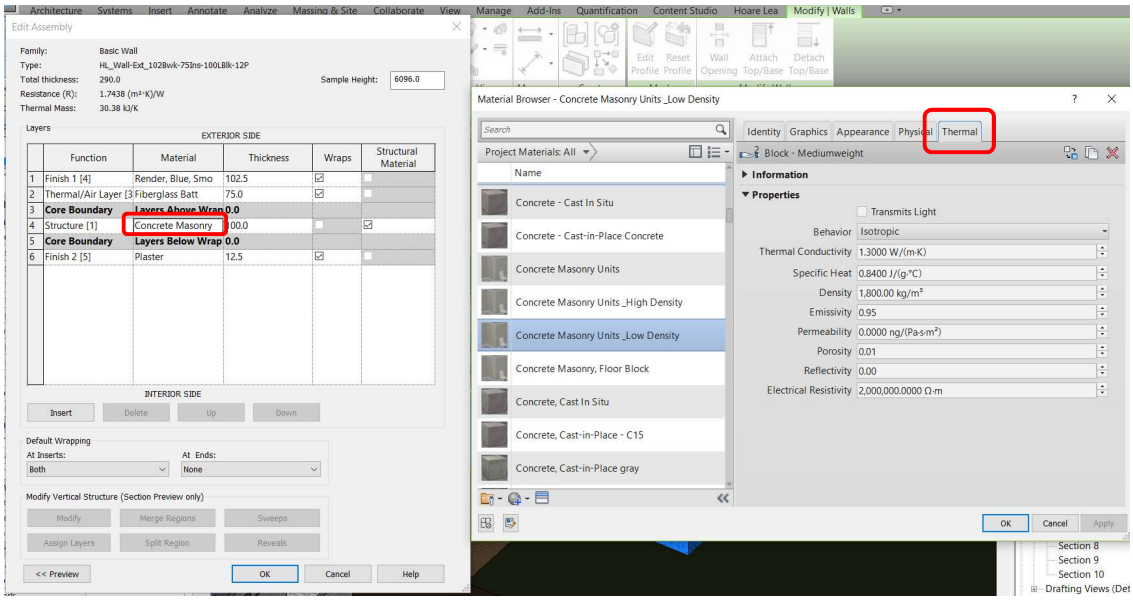
3. Select an element (e.g. a wall) and click “Edit Type”



4. Note the thermal properties shown in the type properties. Click “Edit…” next to the Structure setting.



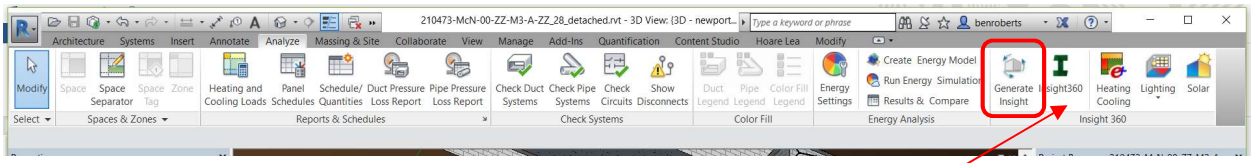
5. In here, the thermal properties of each individual material can be added. You may have to add the thermal tab, and search for the relevant material.



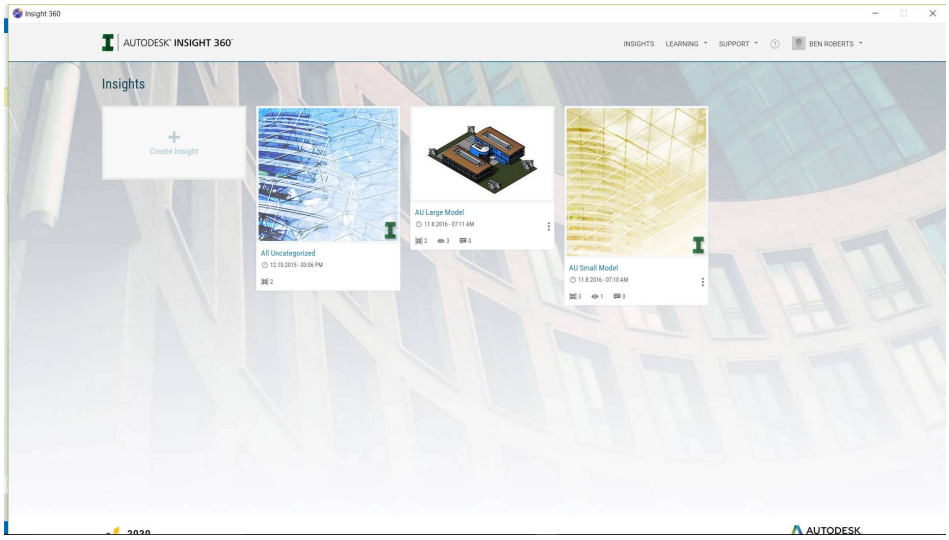
6. Click OK on those dialogue boxes, then repeat for all wall types, floors, roofs, windows, and doors as required.

Generate Insight

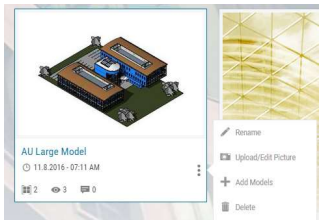
1. Make sure you have installed Insight360: https://insight360.autodesk.com/oneenergy
2. Click “Generate Insight” under Analyze, on the Insight360 Panel



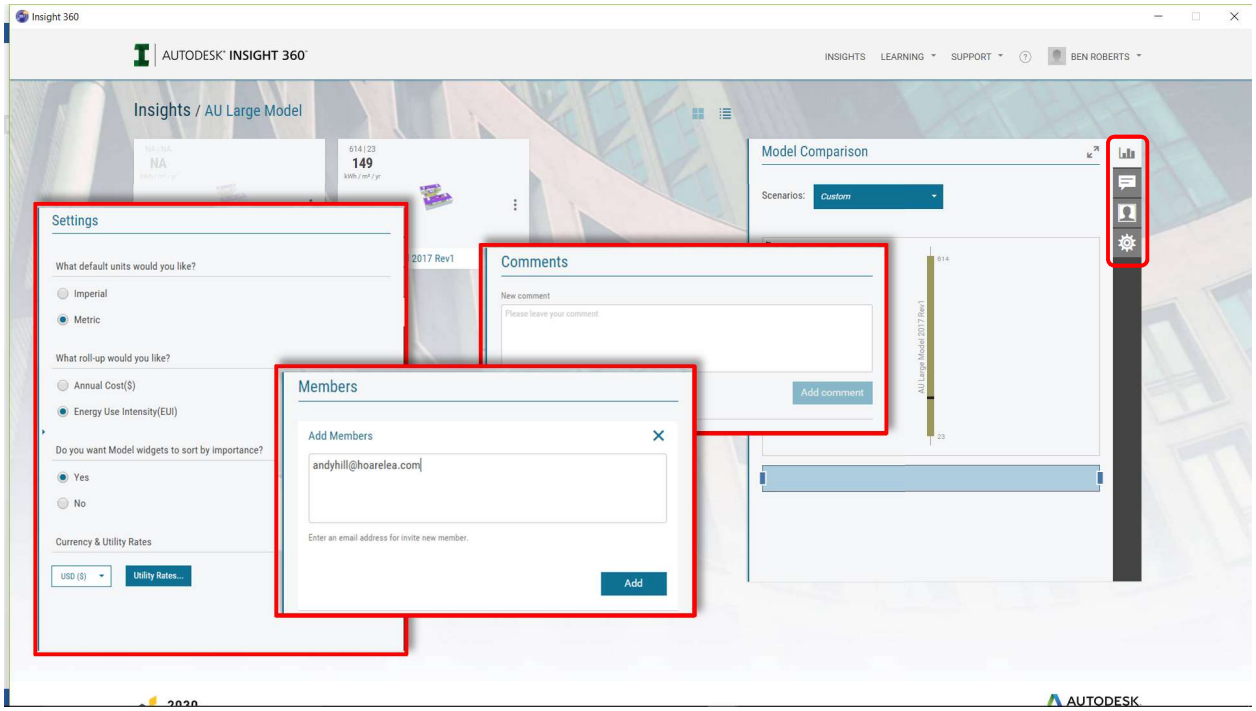
3. Once the analysis is finished, you will receive an email with a link to the cloud based interface, or you can access it by clicking on the “Insight360” button, above. Or, you can go to www.insight360.autodesk.com
4. Sign in with your Autodesk account (or just create an account – it’s pretty quick), and you’ll see the analyses on the home page.



5. You can create new insights in order to group model options together, then rename each insight and give them pictures for easier reference.

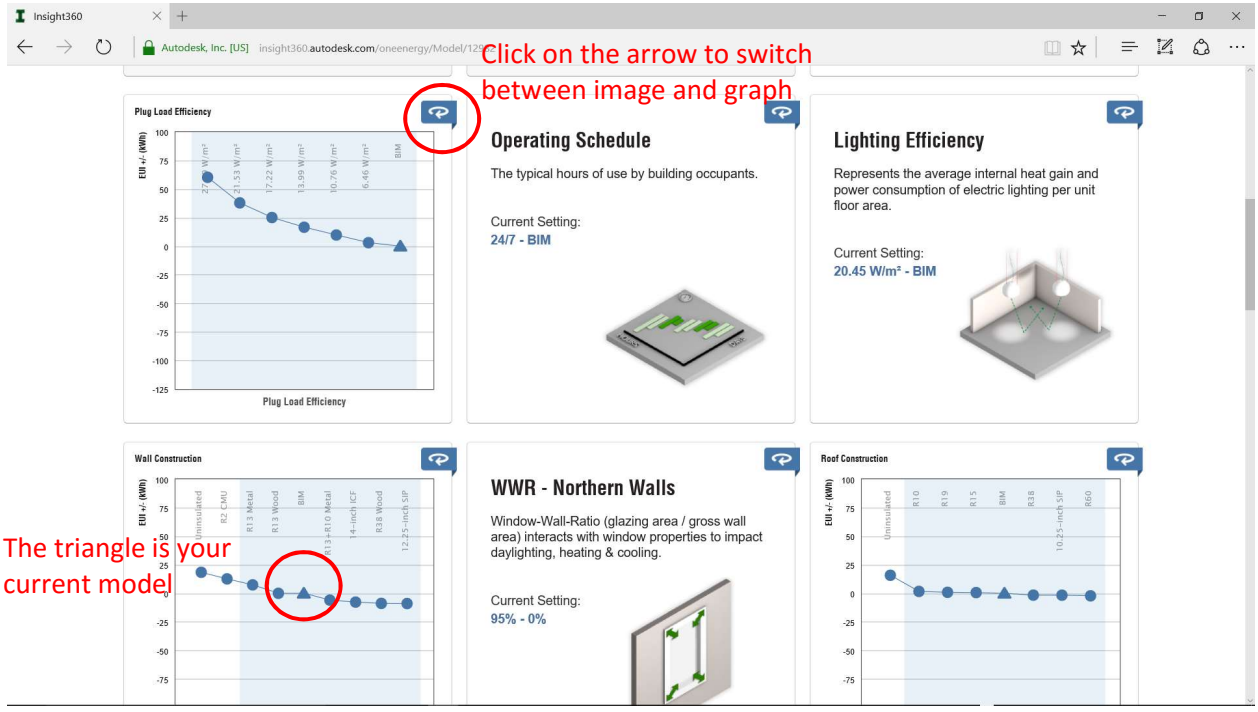


6. Within each insight you can then compare models, allow other people to access the model, and comments, and control the basic setup.



Play with the Variables

Click on the model you want to play with, and start adjusting the limits of each node to see the impact on the overall energy consumption…



Part 2: Spaces, treatment plans and room data sheets

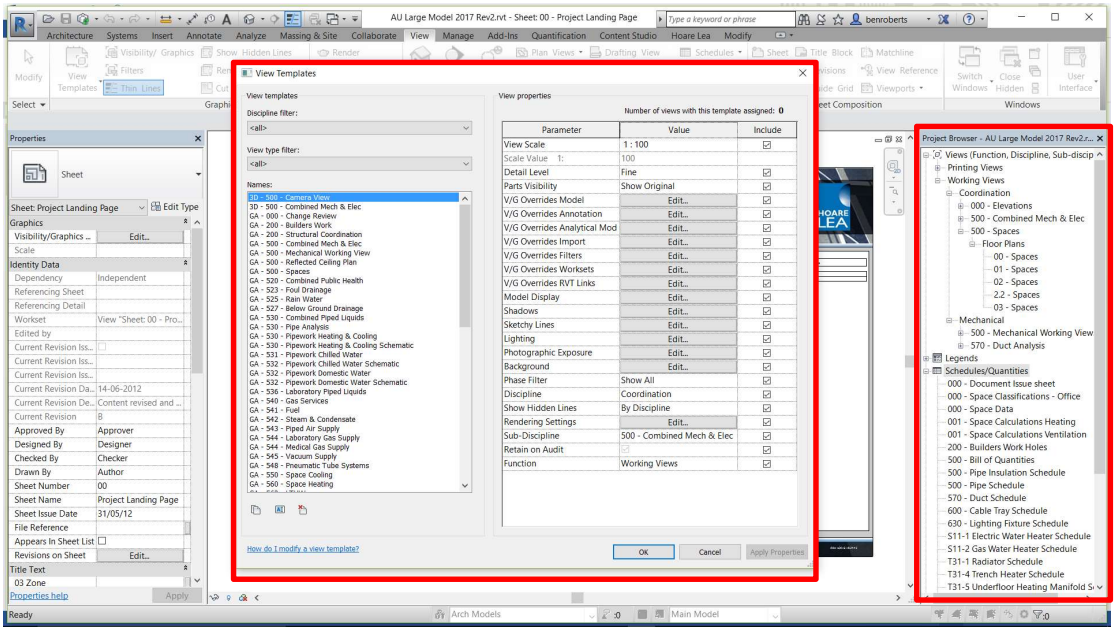
For schematic design stage, spaces can be used to convey much of your design without having to model any elements.

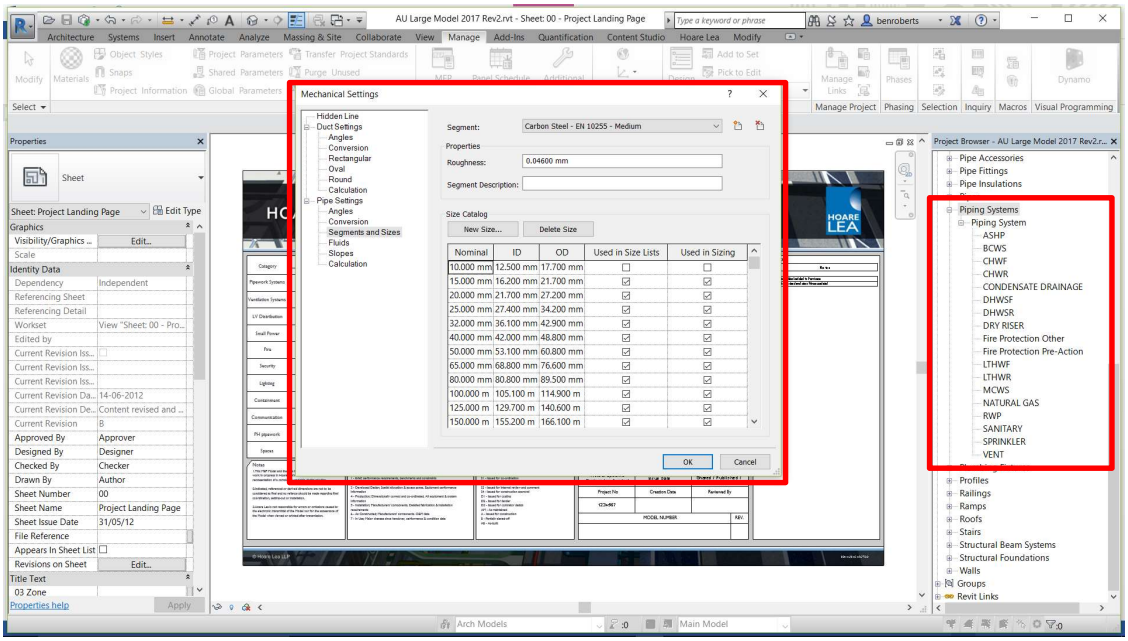
Open from Template & Link in Model(s)

For this process, I am relying heavily on having a template already set up with:

- View Templates for layouts, treatment plans, sections & 3D views.
- Pre-defined system types and their properties
- Pre-defined settings for pipe sizes, thicknesses & roughness
- Calculation methods set to my preferences
- Schedules for spaces and equipment
- Key Schedule for space types
- Some pre-loaded families

This will save lots of time when creating systems and views, and carrying out calculations.



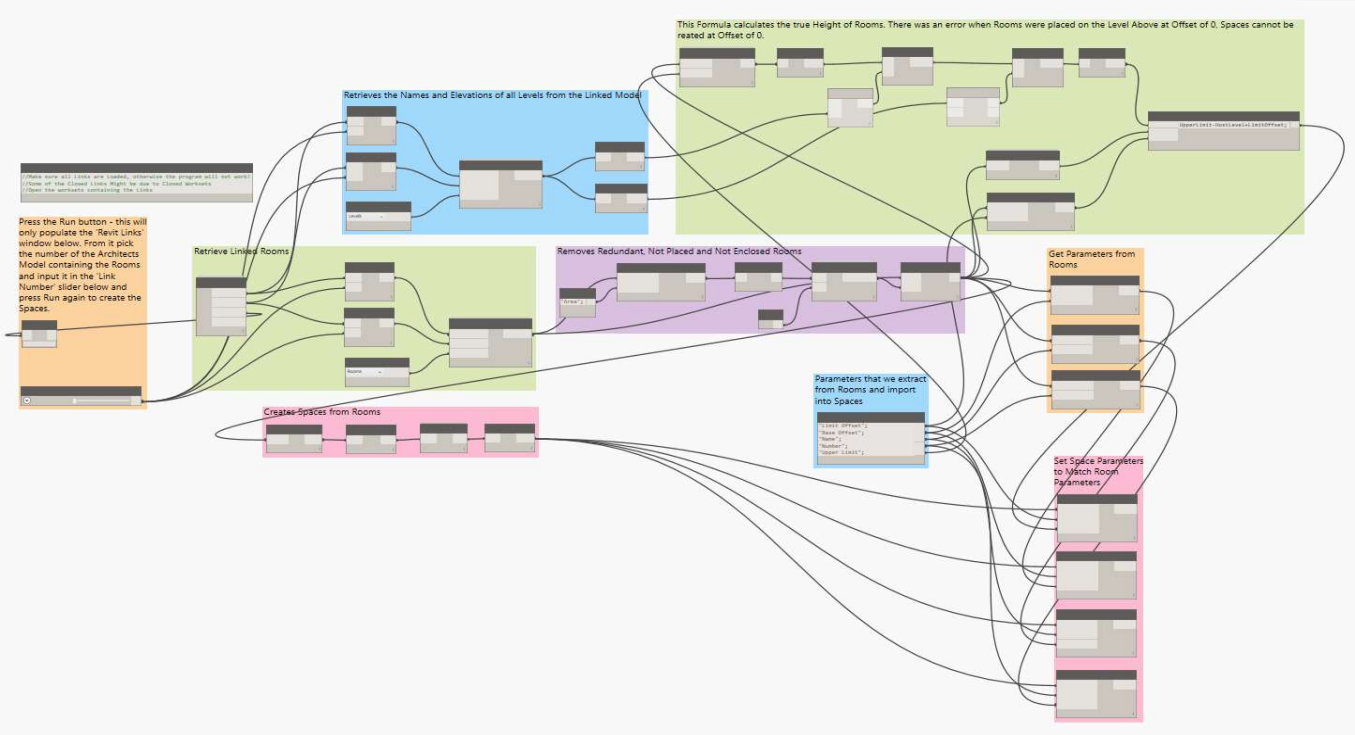


Add Spaces & Names (using Dynamo)

The standard way to add spaces is to open each level in turn, ensure the offsets are sufficient for double height spaces, etc. then use the Space Naming Utility to copy names and numbers for the relative rooms.

Dynamo can speed this process up by creating spaces from the rooms in the linked model. In the below script, this is the method we used:

1. User input: pick the linked model(s) from which you want to copy the rooms
2. Retrieve Linked Rooms
3. Retrieve the names and elevations of all Levels in the linked model
4. Calculate the height of rooms (this is needed because levels will most likely be named differently in your model than in the architectural model)
5. Removes redundant, not placed and not enclosed rooms
6. Create spaces from rooms
7. Get parameters from rooms and push into spaces



Add Environmental Data to Spaces (Using relational data link add-in)

1. In the template, a key schedule was created for a new shared parameter “Space Classification”.

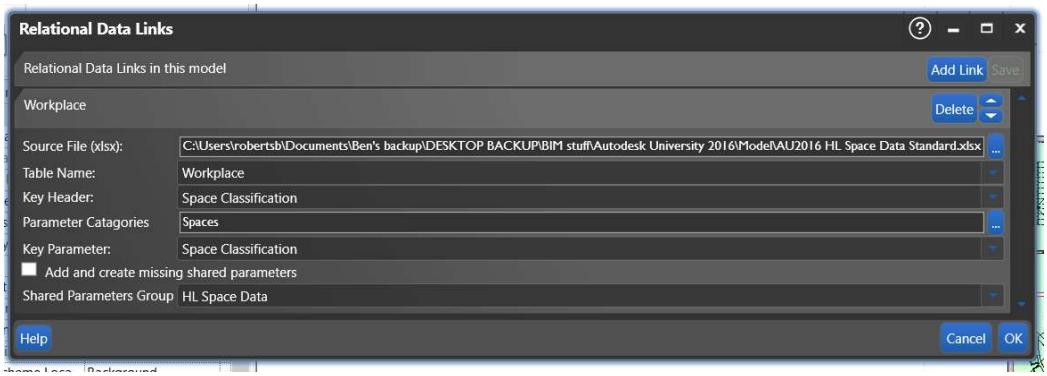
<000 - Space Classifications - Office>

A	B
Key Name	Space Classification
1	Large Conference Room
2	WC
3	Meeting Room
4	1 Person Office
5	Circulation
6	Plant Area
7	Service Riser
8	Reception
9	Conference Room
10	IT Room
11	Quiet Room
12	Open Plan Office
13	Lounge Area
14	Training Room

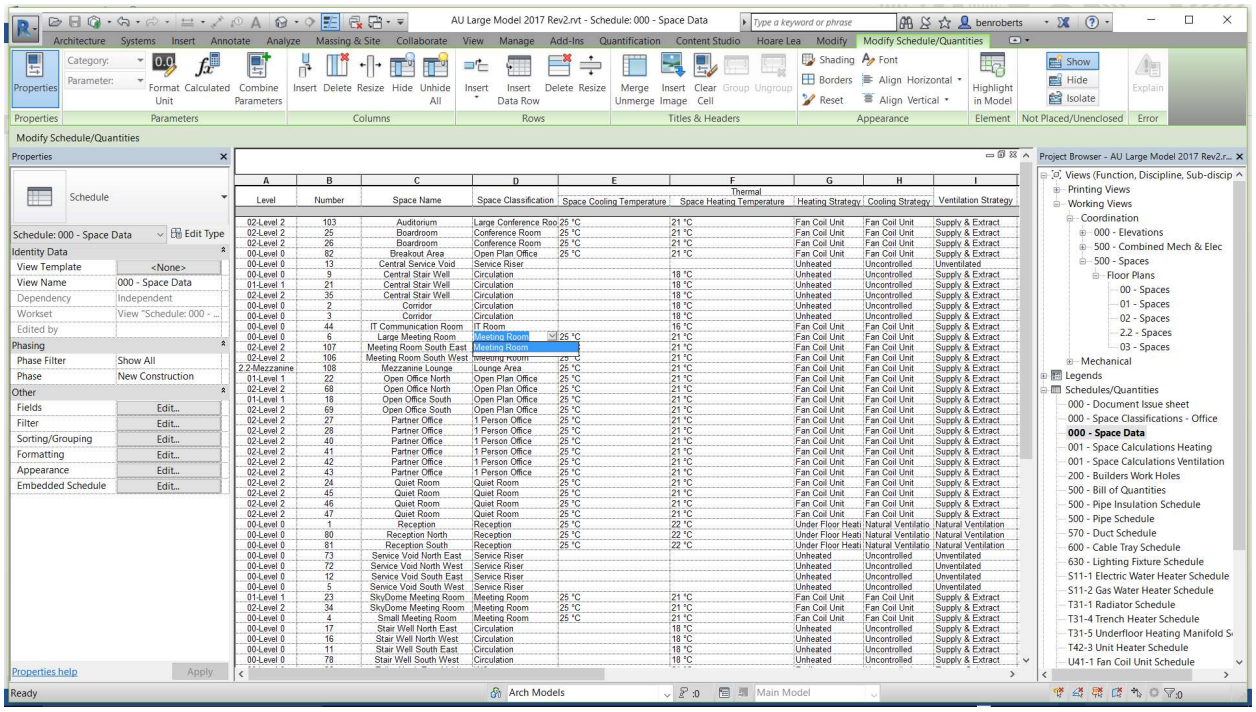
2. Environmental data is predefined in excel for each space classification

		Category>>>>>	Thermal				Ventilation				
		Parameter>>>>>	Space Cooling Temperature	Space Heating Temperature	Space Heating Strategy	Space Cooling Strategy	Ventilation Strategy	ACH Supply	ACH Extract	AHU Zone	230
		Units>>>>>	°C	°C	N/A	N/A	N/A	ACH	ACH	N/A	
		Type>>>>>	Text	Text	Text	Text	Text	Number	Number	Text	
Space Classifica	Uniclass 2015 Descriptio	Uniclass 2015 Cod	Space Cooling Tempera	Space Heating Tempera	Space Heating Strat	Space Cooling Strat	Ventilation Strate	ACH Supp	ACH Extra	AHU Zon	230
1 Person Office		#N/A	25	21	Fan Coil Unit	Fan Coil Unit	Supply & Extract	3	3	AHU 1	
Circulation		#N/A	Not Controlled	18	Unheated	Uncontrolled	Supply & Extract	2	2	AHU 2	
Conference Room		#N/A	25	21	Fan Coil Unit	Fan Coil Unit	Supply & Extract	3	3	AHU 1	
IT Room		#N/A	Not Controlled	16	Fan Coil Unit	Fan Coil Unit	Supply & Extract	2	2	AHU 2	
Large Conference Room		#N/A	25	21	Fan Coil Unit	Fan Coil Unit	Supply & Extract	3	3	AHU 1	
Lounge Area		#N/A	25	21	Fan Coil Unit	Fan Coil Unit	Supply & Extract	3	3	AHU 1	
Meeting Room		#N/A	25	21	Fan Coil Unit	Fan Coil Unit	Supply & Extract	3	3	AHU 1	
Open Plan Office		#N/A	25	21	Fan Coil Unit	Fan Coil Unit	Supply & Extract	3	3	AHU 1	
Plant Area		#N/A	Not Controlled	16	Radiator	Uncontrolled	Extract Only	2	2	AHU 2	
Quiet Room		#N/A	25	21	Fan Coil Unit	Fan Coil Unit	Supply & Extract	3	3	AHU 1	
Reception		#N/A	25	22	Under Floor Heating	Natural Ventilation	Natural Ventilation	3	3	AHU 1	
Recording Studio		#N/A	24	21	Radiator	Fan Coil Unit	Supply & Extract	3	3	AHU 1	
Service Riser		#N/A	Not Controlled	Not Controlled	Unheated	Uncontrolled	Unventilated	0	0	N/A	
Storage		#N/A	Not Controlled	16	Radiator	Uncontrolled	Extract Only	2	2	AHU 2	
Training Room		#N/A	25	21	Fan Coil Unit	Fan Coil Unit	Supply & Extract	3	3	AHU 1	

3. Using a bespoke add-in, we can map this table to our spaces in Revit

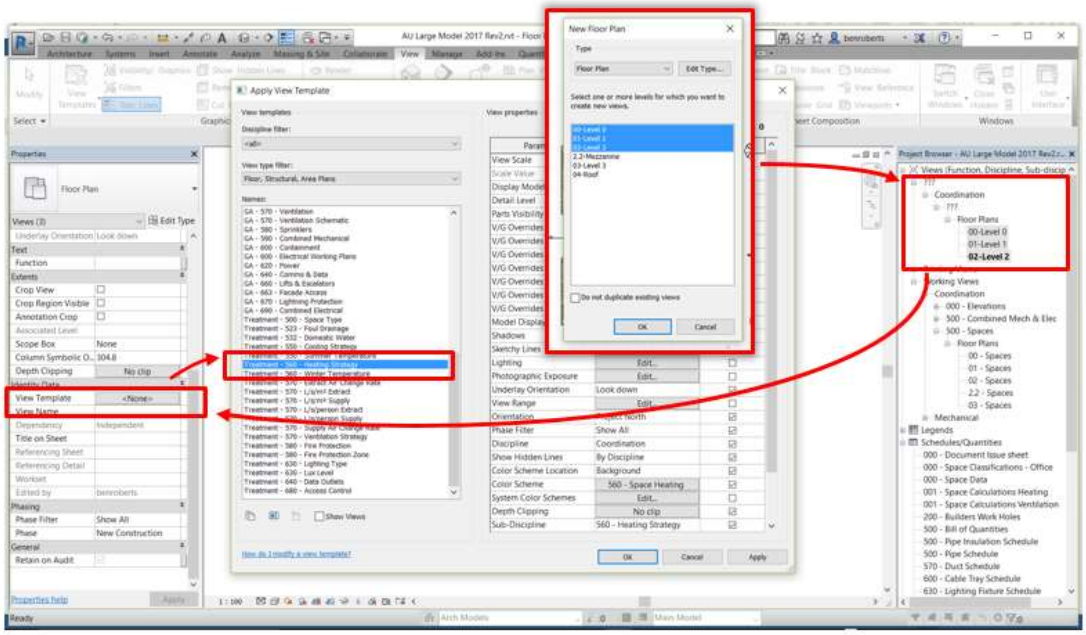


4. Now when we assign a classification to each individual space, the relative data is populated into all the fields in that table

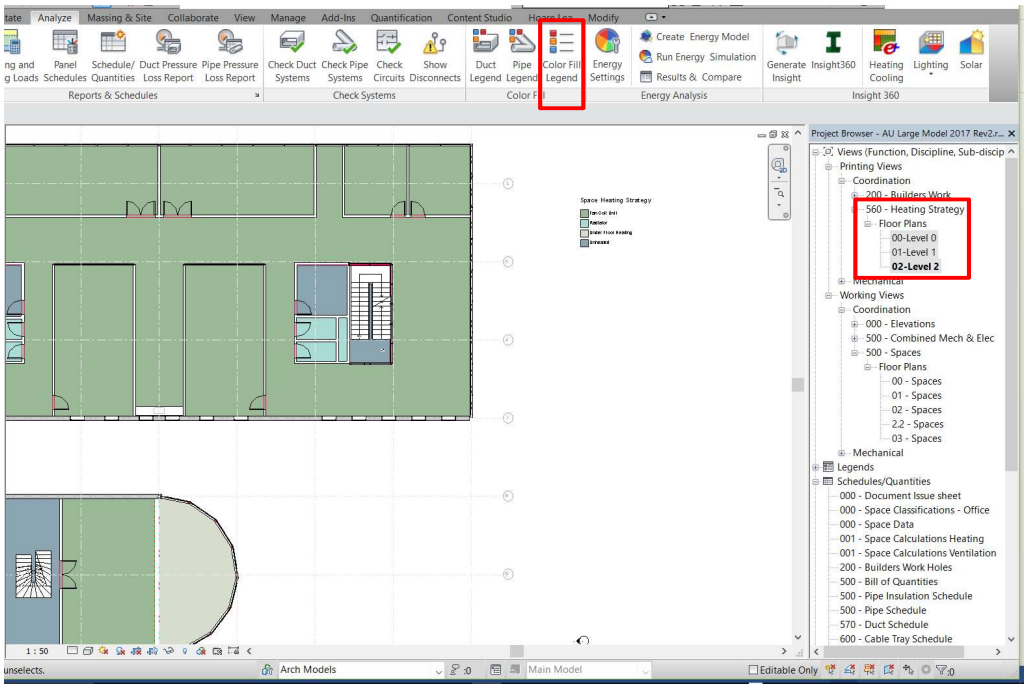


Create Treatment Plans

1. Once we have the data in the spaces, it's very easy to make treatment plans. In this example, treatment plan view templates were pre-defined in the project template so you just have to create new plan views and assign the relevant view template:

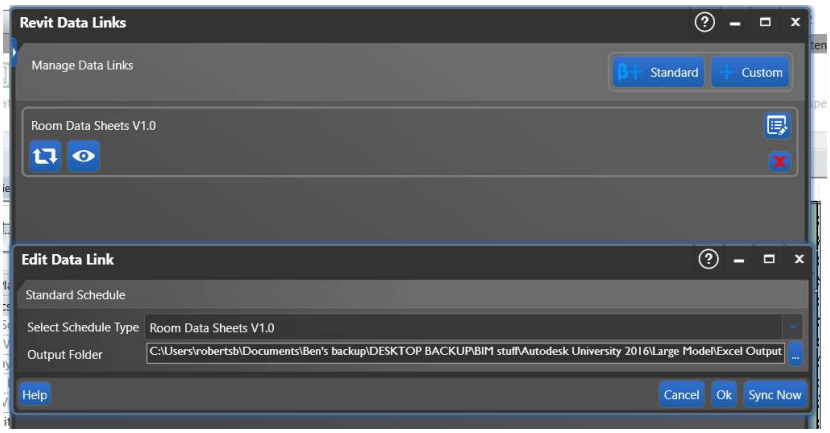


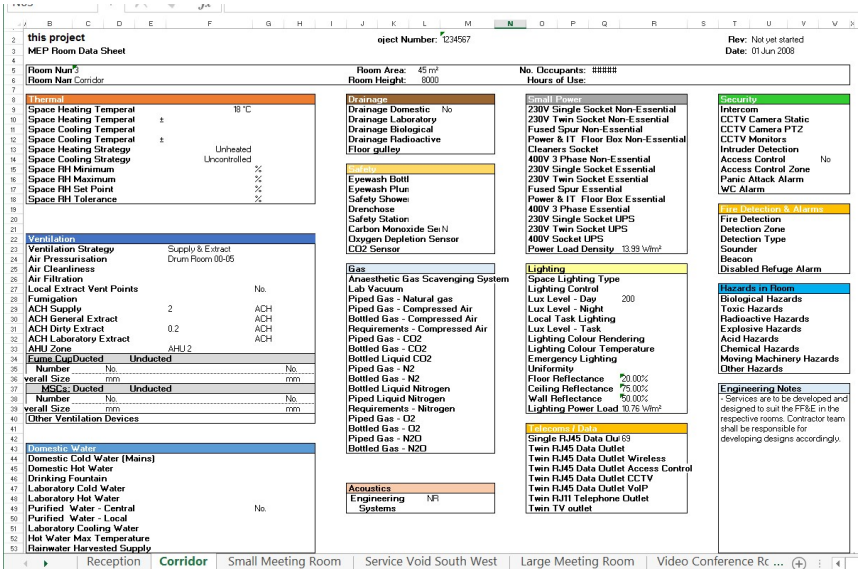
2. Then place a colour fill legend on the plan (Analyze > Color Fill Legend)



Export Room Data Sheets

The final step is to export room data sheets for each individual space. In this case, another bespoke add-in was used in order to map the space data to the standard room data sheet output in Excel. Note in the below image, there is a tab for each individual space.





Now you have the following outputs:

- A model containing spaces and space data
- Treatment plans
- Individual room data sheets

Part 3: Bringing heating loads into spaces

There are currently a few different methods you can use to bring heating load values into your model. The three options shown below allow you to

Option 1: Insight360

Why you would do this:

- Very quick way of doing heating and cooling load calculations
- All the data stays in one place – no need for duplication
- Uses Energy Plus calculation engine

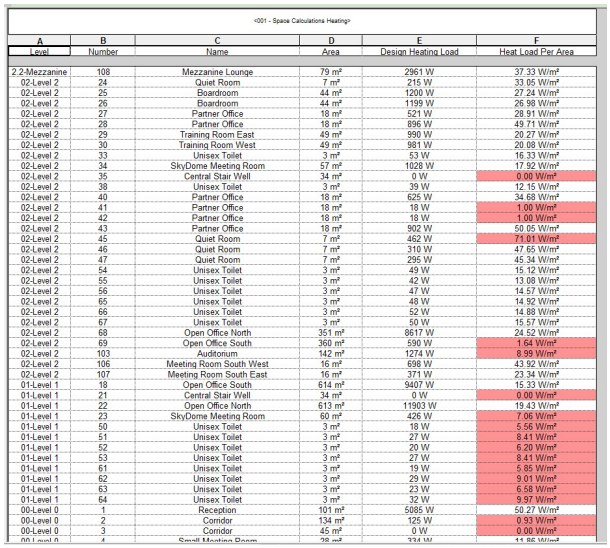
- If the architecture changes, it's very quick to get revised loads

Potential problems:

- Not a steady state load; only dynamic loads
- Complex geometry may cause inaccuracies
- it's difficult to detect where any errors may lie
- Inputs are not necessarily all that clear

Method:

1. Make sure you have installed Insight360: https://insight360.autodesk.com/oneenergy
2. Set thermal properties within walls, windows, doors, floors & roofs (see Part 1: Conceptual Design for details on how to do this)
3. Set Energy Settings (see Part 1: Conceptual Design for details on how to do this)
4. Generate Insight (Analyze > Insight360 > Generate Insight)
5. Open the Heating & Cooling Loads Report (Analyze > Insight360 > Heating & Cooling)
6. The loads will not re-populate spaces, unless you go through the API and make a tool to do this (e.g. bring results back into "Design Heating Load")
7. Create a space schedule that shows the heating load values, and add a calculated parameter to show the heat load per area. This can be used to check for instances of unusually high or unusually low heat loss – add a conditional format for extra clarity:



<001 - Space Calculations Heating>

A	B	C	D	E	F
Level	Number	Name	Area	Design Heating Load	Heat Load Per Area
2.2-Mezzanine	108	Mezzanine Lounge	79 m²	2961 W	37.33 W/m²
02-Level 2	24	Quiet Room	7 m²	215 W	33.05 W/m²
02-Level 2	25	Boardroom	44 m²	1200 W	27.24 W/m²
02-Level 2	26	Boardroom	44 m²	1199 W	26.98 W/m²
02-Level 2	27	Partner Office	18 m²	521 W	28.91 W/m²
02-Level 2	28	Partner Office	18 m²	896 W	49.71 W/m²
02-Level 2	29	Training Room East	49 m²	990 W	20.27 W/m²
02-Level 2	30	Training Room West	49 m²	981 W	20.08 W/m²
02-Level 2	33	Unisex Toilet	3 m²	53 W	16.33 W/m²
02-Level 2	34	SkyDome Meeting Room	57 m²	1028 W	17.92 W/m²
02-Level 2	35	Central Stair Well	34 m²	0 W	0.00 W/m²
02-Level 2	38	Unisex Toilet	3 m²	39 W	12.15 W/m²
02-Level 2	40	Partner Office	18 m²	625 W	34.68 W/m²
02-Level 2	41	Partner Office	18 m²	18 W	1.00 W/m²
02-Level 2	42	Partner Office	18 m²	18 W	1.00 W/m²
02-Level 2	43	Partner Office	18 m²	902 W	50.05 W/m²
02-Level 2	45	Quiet Room	7 m²	462 W	71.01 W/m²
02-Level 2	46	Quiet Room	7 m²	310 W	47.65 W/m²
02-Level 2	47	Quiet Room	7 m²	295 W	45.34 W/m²
02-Level 2	54	Unisex Toilet	3 m²	49 W	15.12 W/m²
02-Level 2	55	Unisex Toilet	3 m²	42 W	13.08 W/m²
02-Level 2	56	Unisex Toilet	3 m²	47 W	14.57 W/m²
02-Level 2	65	Unisex Toilet	3 m²	48 W	14.92 W/m²
02-Level 2	66	Unisex Toilet	3 m²	52 W	14.88 W/m²
02-Level 2	67	Unisex Toilet	3 m²	50 W	15.57 W/m²
02-Level 2	68	Open Office North	351 m²	8617 W	24.52 W/m²
02-Level 2	69	Open Office South	360 m²	590 W	1.64 W/m²
02-Level 2	103	Auditorium	142 m²	1274 W	8.99 W/m²
02-Level 2	106	Meeting Room South West	16 m²	698 W	43.92 W/m²
02-Level 2	107	Meeting Room South East	16 m²	371 W	23.34 W/m²
01-Level 1	18	Open Office South	614 m²	9407 W	15.33 W/m²
01-Level 1	21	Central Stair Well	34 m²	0 W	0.00 W/m²
01-Level 1	22	Open Office North	613 m²	11903 W	19.43 W/m²
01-Level 1	23	SkyDome Meeting Room	60 m²	426 W	7.06 W/m²
01-Level 1	50	Unisex Toilet	3 m²	18 W	5.56 W/m²
01-Level 1	51	Unisex Toilet	3 m²	27 W	8.41 W/m²
01-Level 1	52	Unisex Toilet	3 m²	20 W	6.20 W/m²
01-Level 1	53	Unisex Toilet	3 m²	27 W	8.41 W/m²
01-Level 1	61	Unisex Toilet	3 m²	19 W	5.85 W/m²
01-Level 1	62	Unisex Toilet	3 m²	29 W	9.01 W/m²
01-Level 1	63	Unisex Toilet	3 m²	23 W	6.58 W/m²
01-Level 1	64	Unisex Toilet	3 m²	32 W	9.97 W/m²
00-Level 0	1	Reception	101 m²	5085 W	50.27 W/m²
00-Level 0	2	Corridor	134 m²	125 W	0.93 W/m²
00-Level 0	3	Corridor	45 m²	0 W	0.00 W/m²
00-Level 0	4	Small Meeting Room	28 m²	334 W	11.86 W/m²

Option 2: Export to other software tool, then import results

Why you would do this:

- Use the software that you are comfortable with for your analysis
- Save time by not creating a new thermal model from scratch
- Make sure all your space names match exactly between Revit and the thermal model

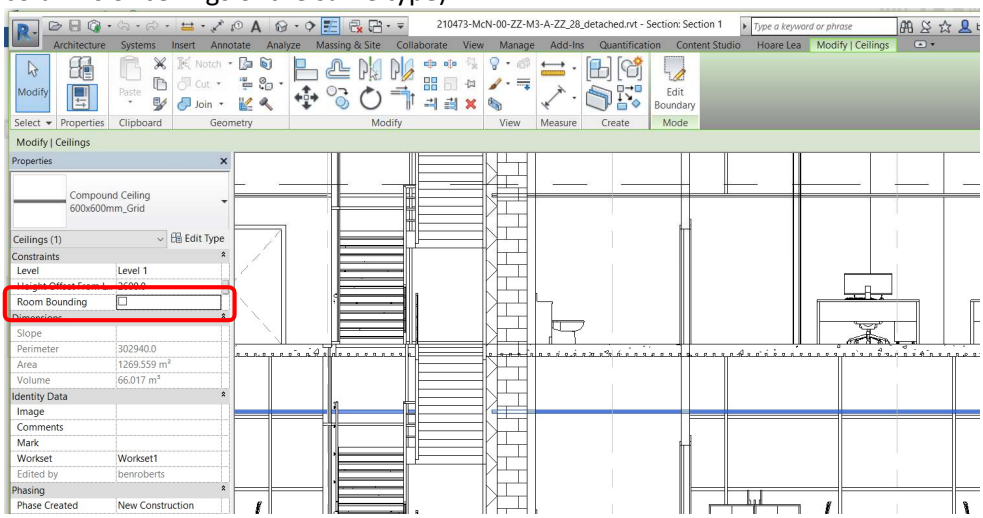
Potential problems:

- Complex geometry often corrupts in gbXML export
- Changes in the geometry are difficult to merge

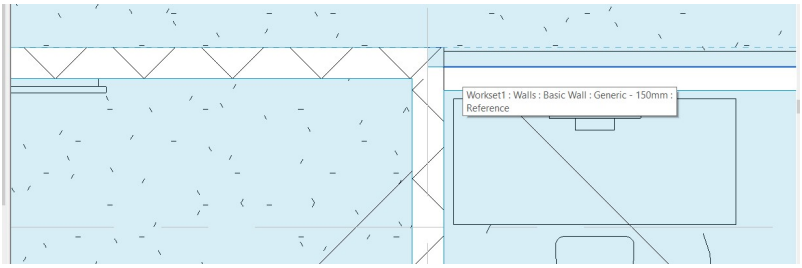
Method:

1. You will need to save a detached copy of the architectural model so you can edit the geometry

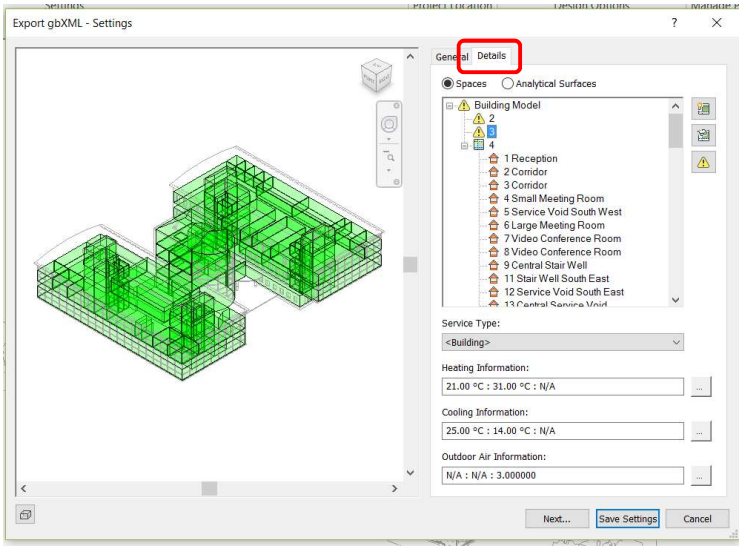
2. Set columns and ceilings to “non-room bounding” (use “select all instances” to get all columns or ceilings of the same type)



3. Ensure the geometry is as simple as possible by aligning walls and removing unnecessarily fiddly details



4. Check the gbXML warnings and fix any problems (R > Export gbXML)



5. Export gbXML

6. Setup and run your analysis in your chosen software (e.g. Trane Trace, IES, etc.)
7. Export the results to Excel
8. Use an Excel link tool to export your Revit spaces to Excel, then map the heat load values to the spaces and re-import into Revit

Option 3: Start from scratch in other software tool then import results

Why you would do this:

- Complete control over the geometry
- Complete control over the fabrics, space types and thermal settings

Potential problems:

- Easy to get space names misaligned with Revit model, so can be troublesome re-importing loads into Revit
- Changes in the geometry may not be included
- More time consuming than previous 2 methods

Method:

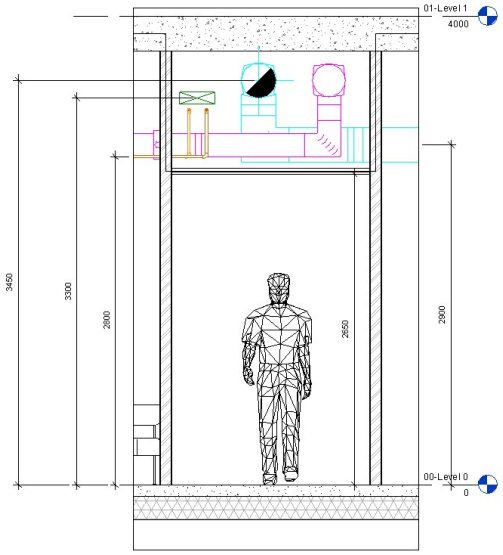
1. Create a model from scratch in your chosen software (e.g. Trane Trace, IES, etc.)
2. Make sure you name the spaces exactly the same as in Revit, so you can map the results across later
3. Setup and run your analysis
4. Export the results to Excel
5. Use an Excel link tool to export your Revit spaces to Excel, then map the heat load values to the spaces and re-import into Revit

Part 4: Placing terminals & pipes, and sizing terminals

Once you have heat loads in your spaces, it's time to add the heating terminals, and connect them back to the boiler. Here are a few tips that can help this process go quicker; in this example the emitters and pipes are modelled with default values, then the heating duty is added to the emitters using Dynamo, and they automatically resize and update the piping flowrates.

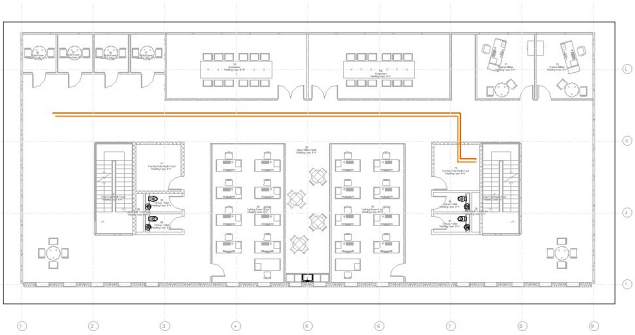
Create a corridor section and routing plan before you start

Coordination is so much easier if you plan it from the start; trying to coordinate your services after you've added everything to the model is a nightmare! Pick some typical details such as a corridor, connection to terminals, or utility cupboards, and work out how these sections will work in advance – especially take a note of all the different offsets.



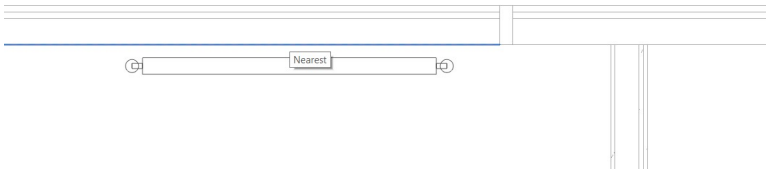
Draw the primary pipes in first

1. Calculate the largest size you'll need in each primary distribution route, then add that size all the way from the riser to the end (we're going to reduce the sizes for each section later).

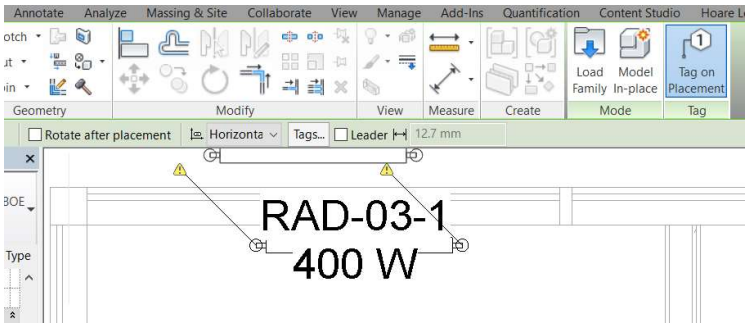


Add one terminal and pipe it up

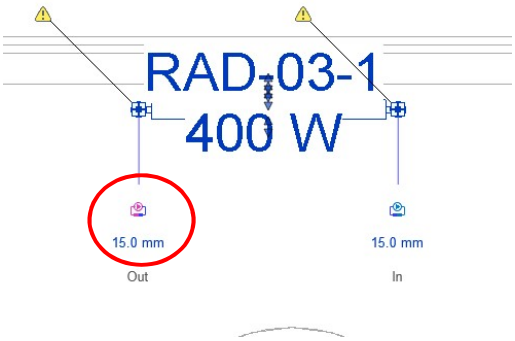
1. In this example, the radiator family is offset 50mm from the insertion point so you can click on the wall to place it quickly.



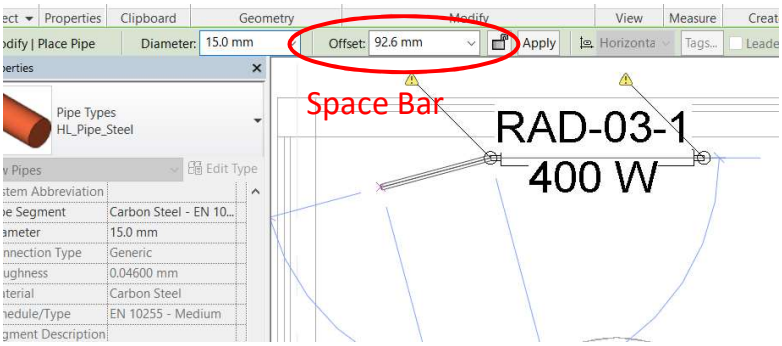
2. Select "Tag on Placement"; in the case I've chosen to show the mark and heat output in the tag (which are default values for now)



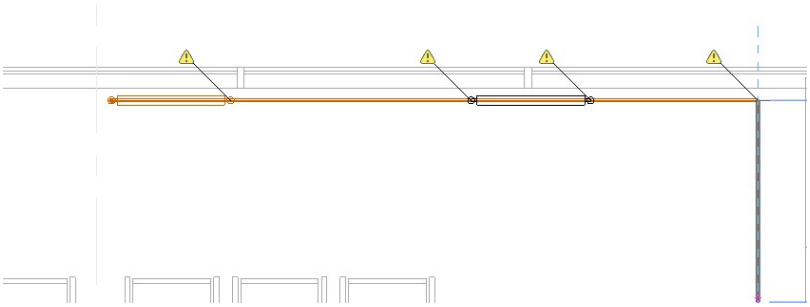
3. To connect the pipes quickly but properly in plan…
    a. Click on a system connector symbol to start drawing a pipe (return in this case)



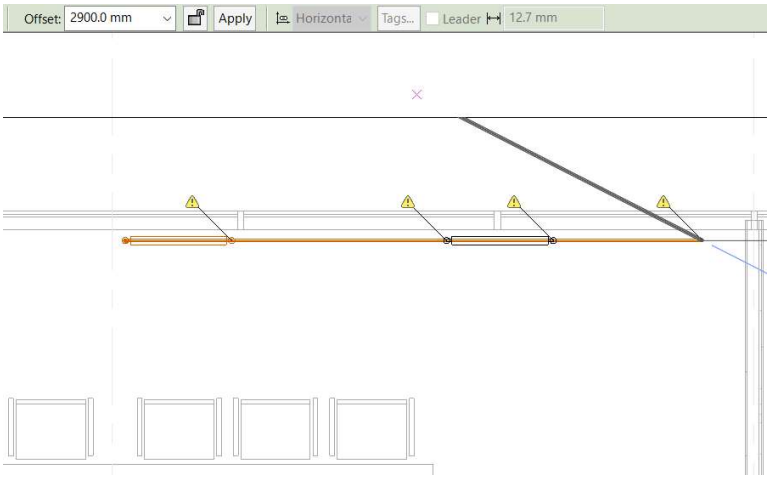
    b. Hit space bar to change the offset to the right height



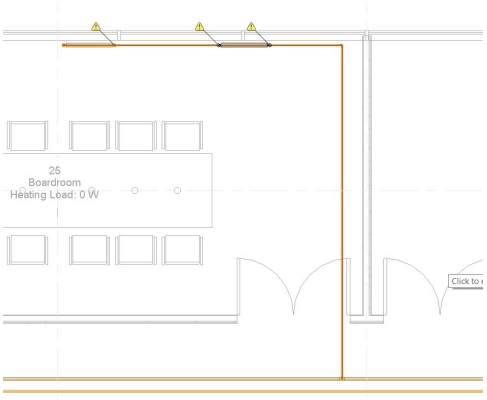
    c. Draw out beneath other radiators on that wall up to the corner of the room



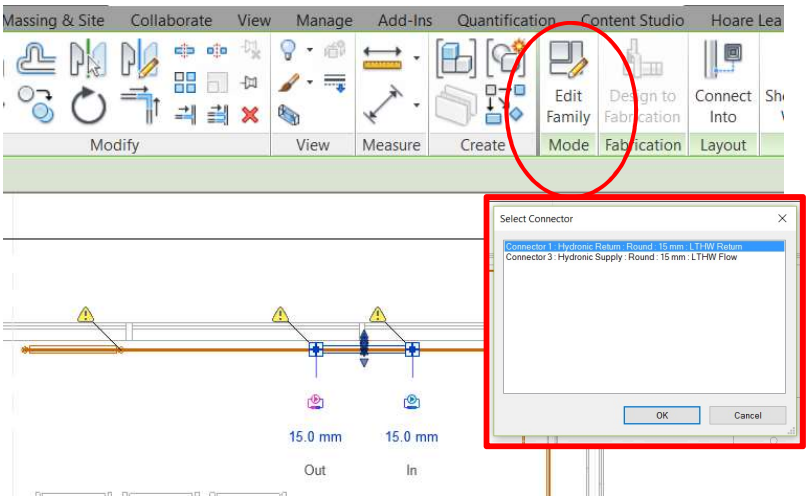
d. Change offset to within ceiling void



e. Join to primary distribution in corridor



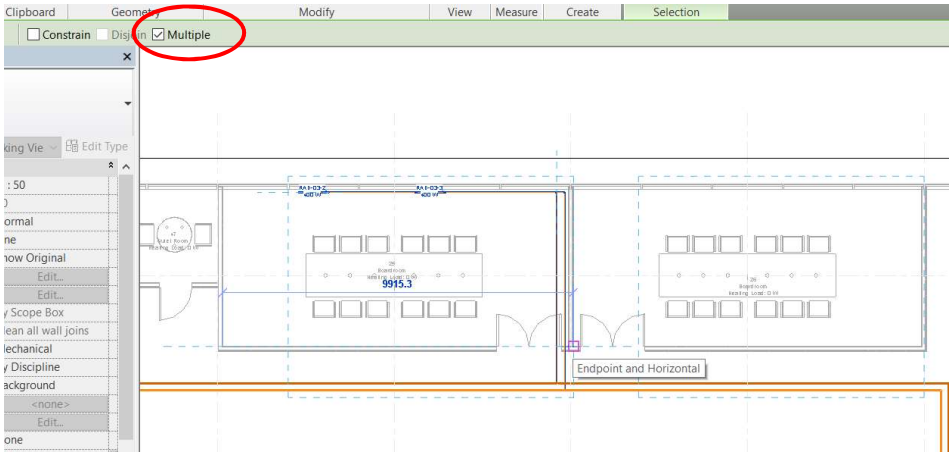
f. Join the other radiator into the pipe using “Connect Into”, choose the appropriate connector, then click on the pipe.



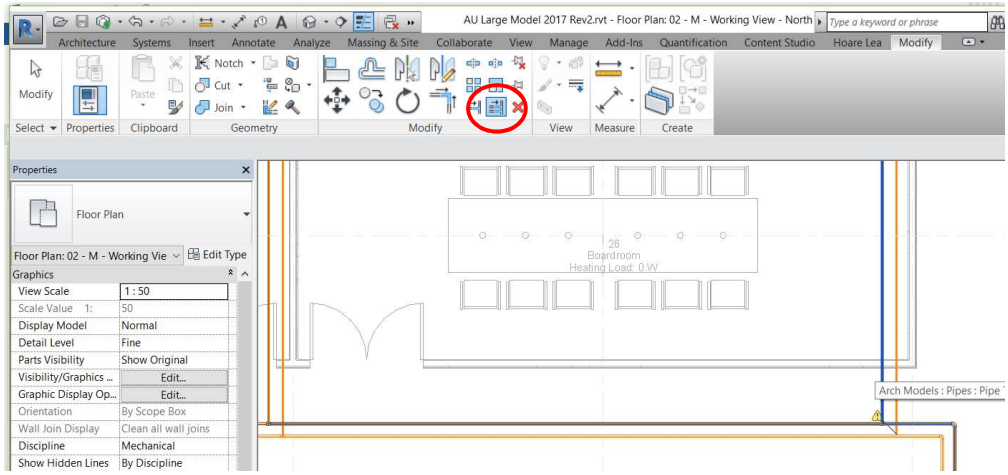
g. Do the same for the flow pipe

Copy and paste to similar rooms

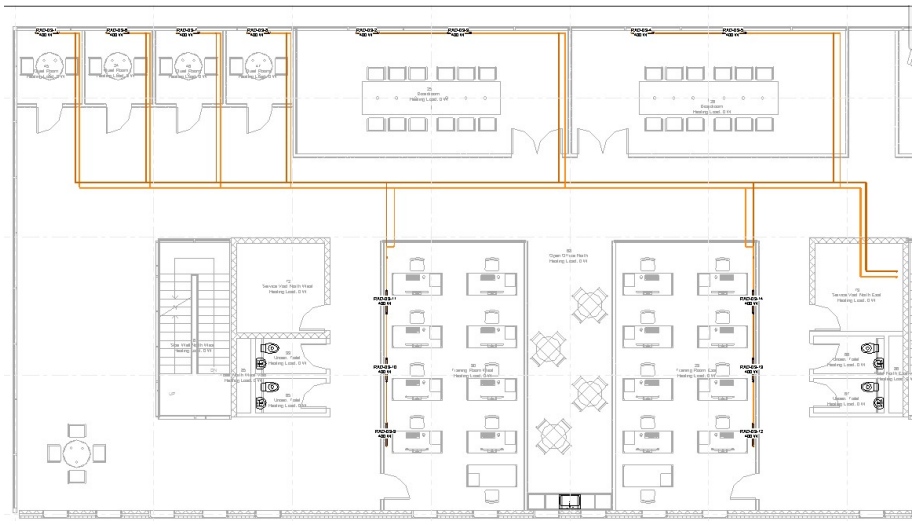
1. Use tab to select the radiator and it's adjoining pipework (not including the primary pipes), and ctrl to add the radiator tag
2. Copy (CO) and select the "multiple" option
3. Use a corner of the room for a common reference point



4. Join the pipes into the primary distribution using "Trim/Extend Multiple Elements"

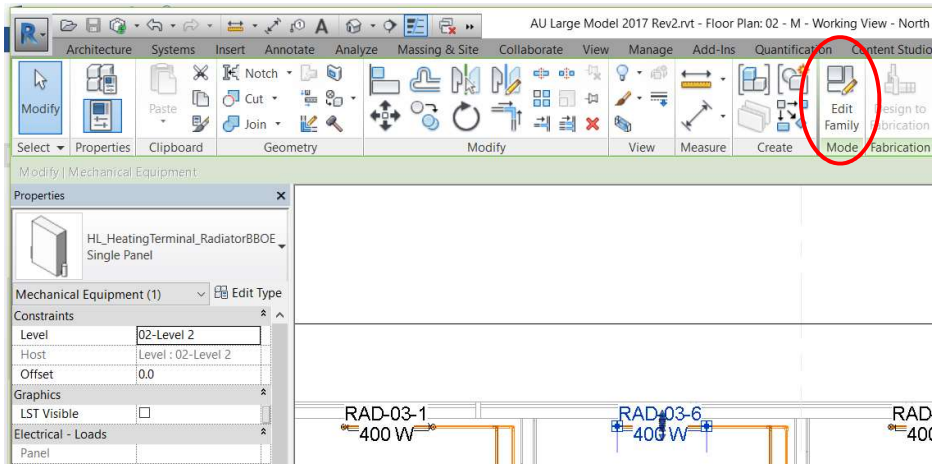


5. You now have a connected pipework system:

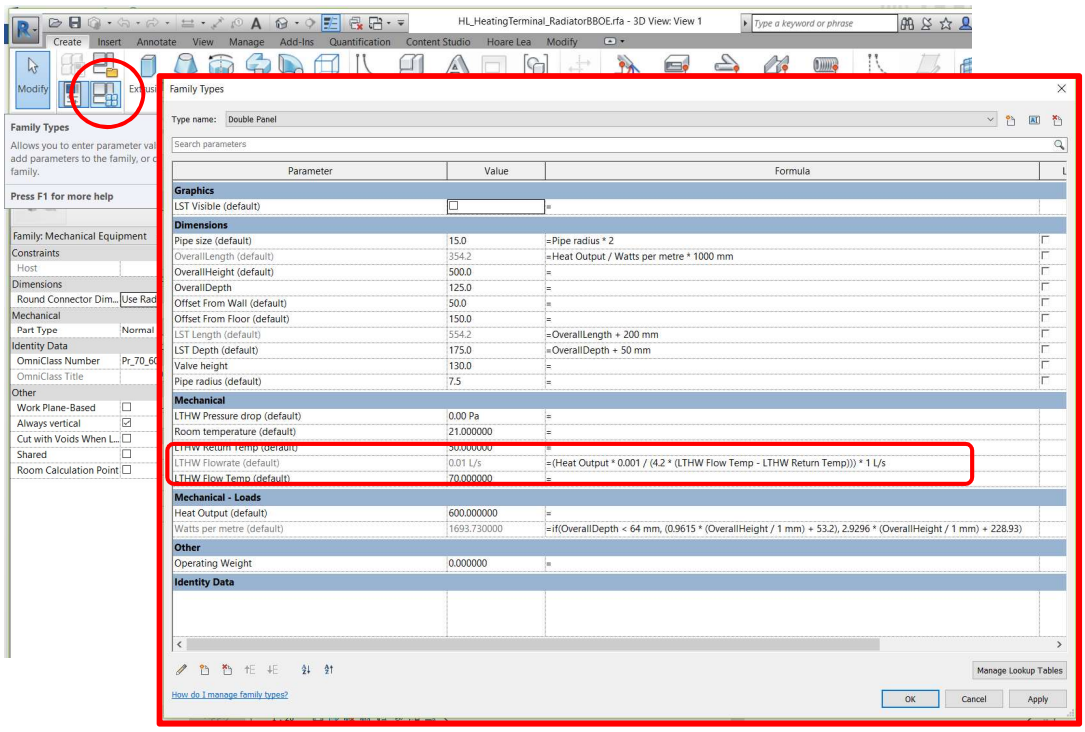


Add formulae into the terminal family

1. Open the radiator family in the family editor



2. Click on the “Family Types” button and add a formula to family for flowrate

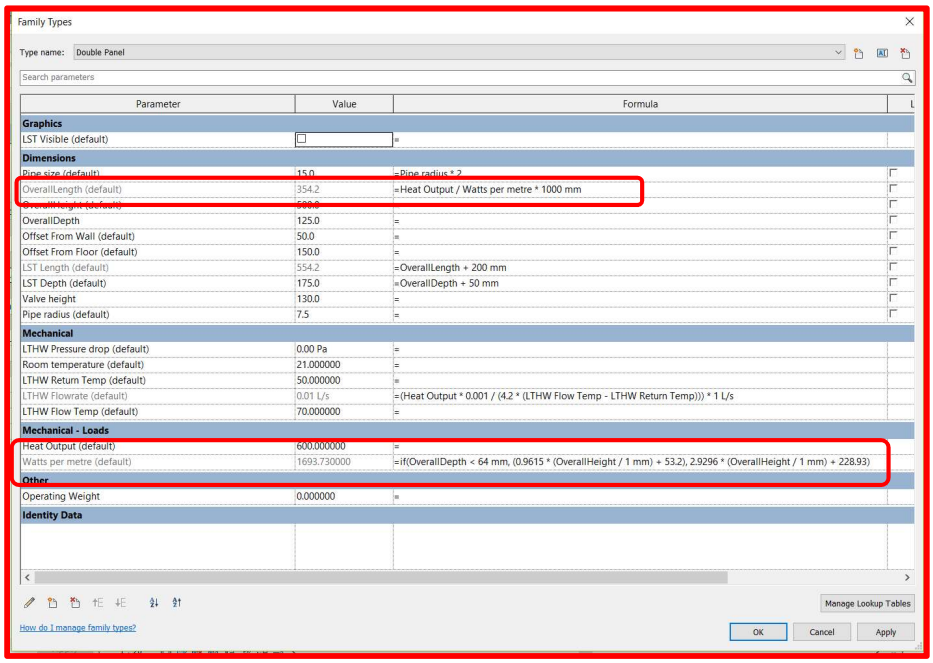


a. Add parameters for flow and return water temperatures
b. In the flowrate parameter, under the formula column, add in the equation for flowrate:

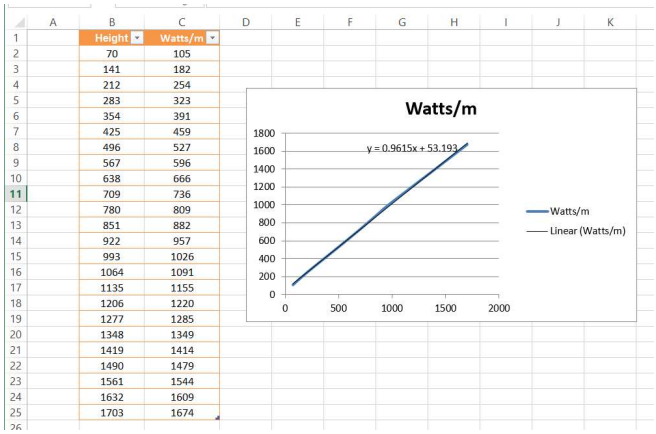
   (Heat Output * 0.001 / (4.2 * (LTHW Flow Temp - LTHW Return Temp))) * 1 L/s

   Note that the "* 1 L/s" has been added in order to convert into the correct units.

3. Add a formula to family for sizing



a. Add a new parameter “Watts per m”, or “Btu per hr per m” (don’t use “/” as Revit will see this as a divide sign)
b. In this example, we used manufacturers’ data in Excel to work out the relationship between height, heat output and length…



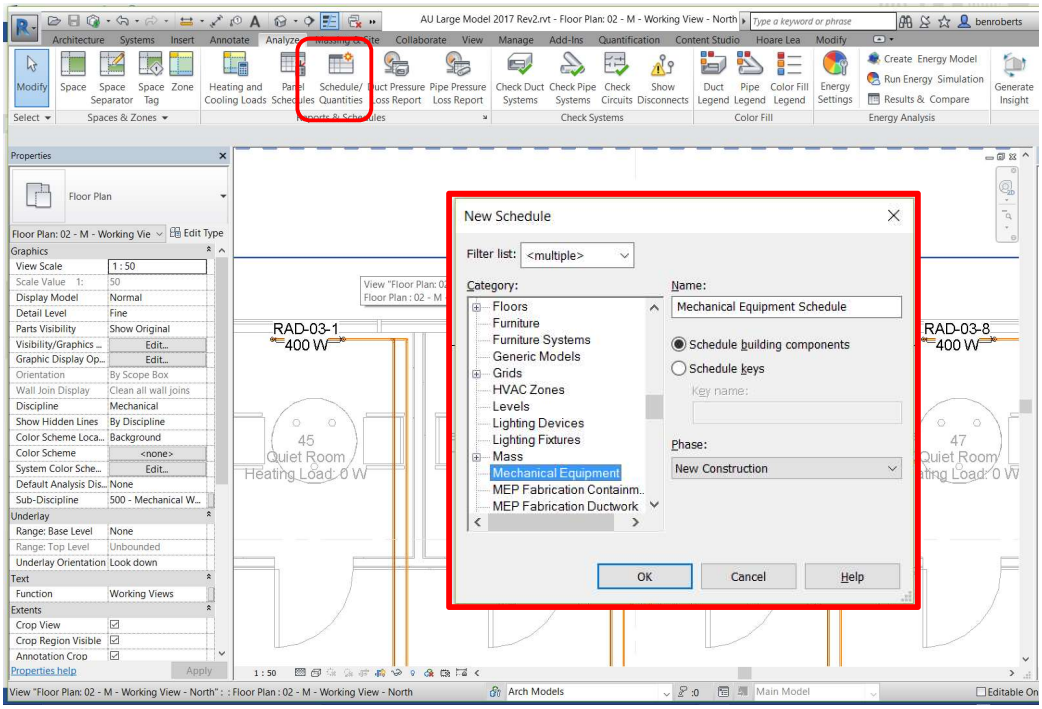
Height	Watts/m
70	105
141	182
212	254
283	323
354	391
425	459
496	527
567	596
638	666
709	736
780	809
851	882
922	957
993	1026
1064	1091
1135	1155
1206	1220
1277	1285
1348	1349
1419	1414
1490	1479
1561	1544
1632	1609
1703	1674

c. …Then copied the formula into Revit
d. Make sure the heat output value isn’t zero, else this will cause an error (“Can’t Create Type”)

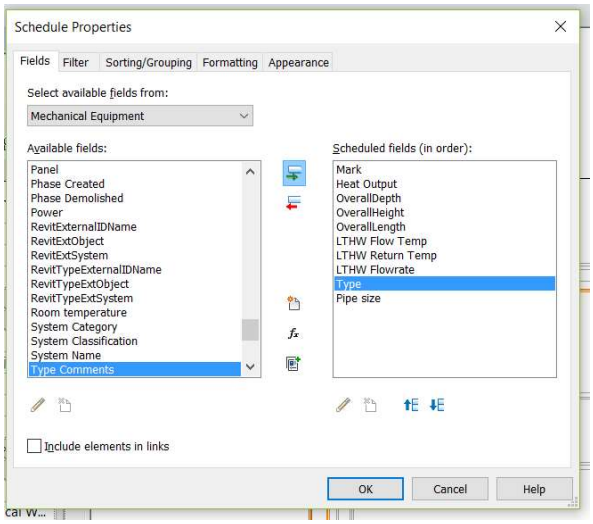
4. Load the family back into the project and overwrite the parameter values

Create a radiator schedule

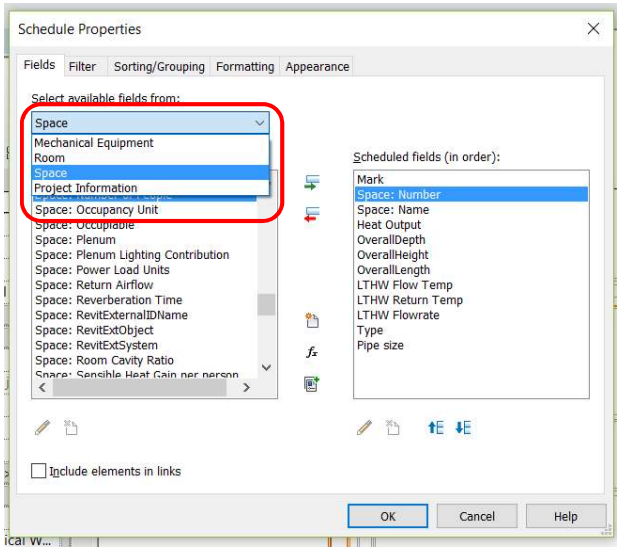
1. Go to Analyze > Schedule / Quantities, then select Mechanical Equipment



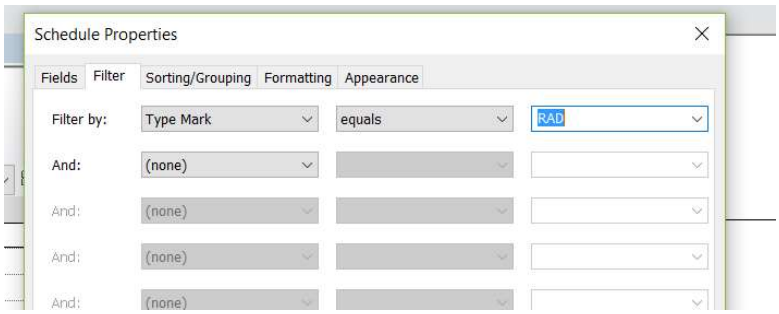
2. Add the parameters you need from the equipment (e.g. Mark, Dimensions, Heat Output, Flowrate, etc.)



3. Add parameters you need from the Space (Name, Number)



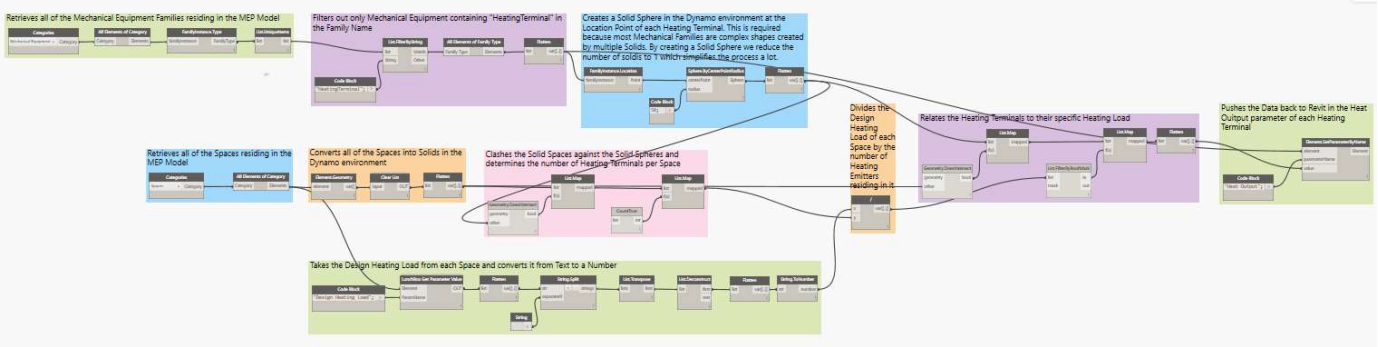
4. Add a filter to show only radiators; in this example we have used Type Mark set to “RAD”



Push the heat load from spaces into terminals (using Dynamo)

Now the magic happens! We have used a dynamo script to take the heat load from the spaces and push it into the terminals. Here's how it works…

1. Retrieves all of the MEP families residing in the MEP model
2. Filters out Mechanical Equipment with "Heating Terminal" in the name
3. Creates a solid sphere at the location of each terminal
4. Retrieves all spaces and converts them into solids
5. Clashes the terminals against the spaces to determine the number of terminals per space
6. Divides the heat load from the space by the number of terminals
7. Pushes the resultant heat load into each terminal



With their new heating duties, the radiators will now resize and the new flowrates will pass into the connecting pipes. Warning: this is very satisfying!

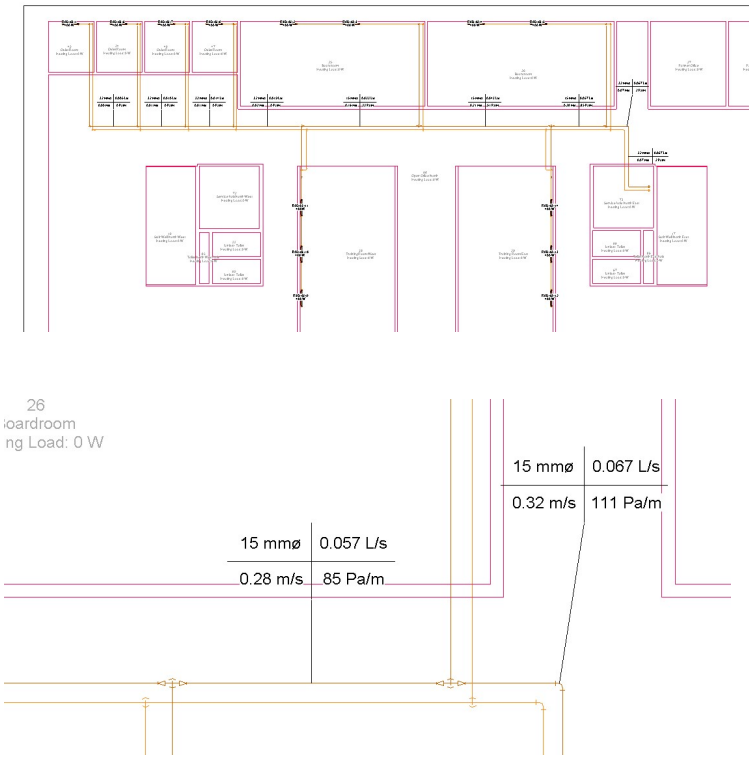
Part 5: Sizing pipes and boiler duty

Now we have a connected network with the correct heat loads and flowrates, all we have to do is size the pipes and main plant equipment.

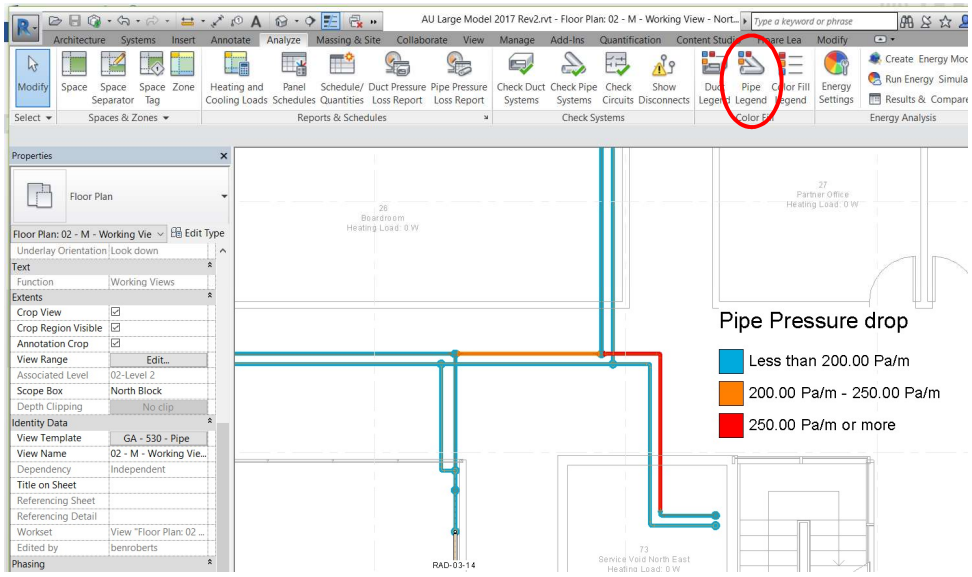
Create layouts for schematics and colour schemes

Revit doesn't do schematics in the way we'd like it to, but you can create distribution schematics very quickly on each floor in order to check the design.

1. Schematic layouts: Just copy a pipework layout and change to single line (Medium or Coarse detail), switch off the linked models (or switch of architectural and structural categories), then add tags that show the flowrate, pipe size, velocity and pressure drop



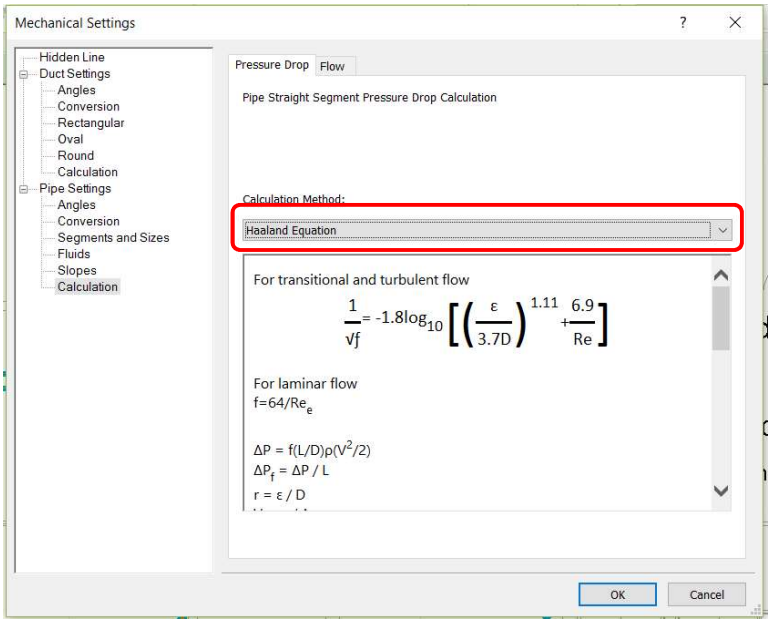
2. System colour schemes: Duplicate the pipework layout view again, and this time just add a pipe legend (Analyze > Pipe Legend). You can define the values in the legend and the colours you use.



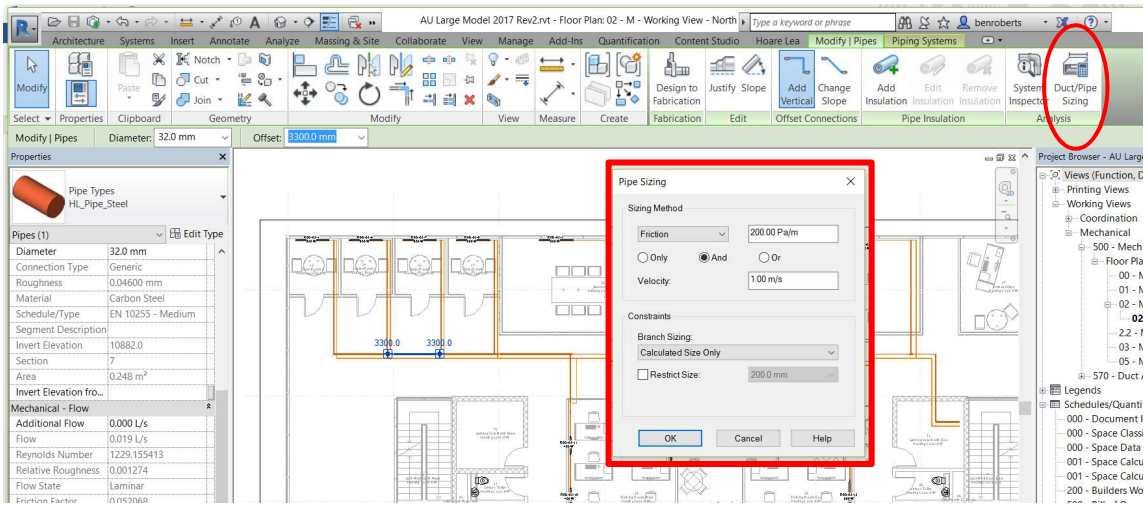
3. Save view template from these two views so that next time you can make them even quicker.

Size pipework

So, Revit's inbuilt calculation allows you to choose which method you prefer to use for pipe sizing (Manage > MEP Settings > Mechanical Settings…

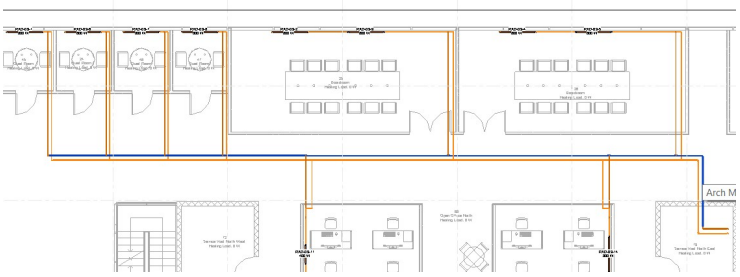


This is the calculation that will be carried out when you run the Duct/Pipe Sizing Tool (Analyze > Duct/Pipe Sizing)



The art lies in selection!...

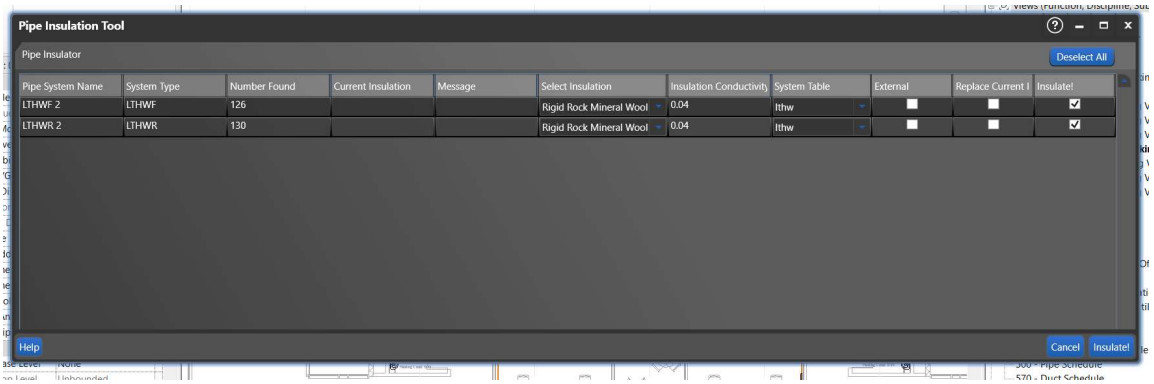
Don't try and size the whole system in one go, unless it's very simple; just pick a section of the primary pipework and size each bit at a time:



Tip: select one piece of pipe, then hover over another piece and push tab – Revit will select all pipework between the two pieces.

Add Insulation

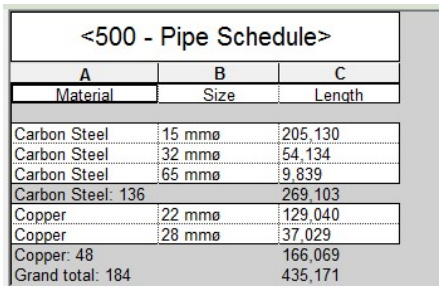
The standards method for applying insulation is to select the pipe, click “Add Insulation”, and specify the type and thickness. To significantly speed this up, we have made an add-in. The materials (type) and thicknesses are defined by the tables in our insulation specifications. Revit assigns the right type and thickness based on the pipe material, size, system type, temperature, and whether it is outside or inside…



We have also created this as a live updater, so the insulation can be added straight away as the pipework is drawn.

Create a bill of quantities for pipes

This is very simple, but often overlooked. Just create a schedule (Analyze > Schedule/Quantities) and show Material, Size and Length. Group as you see fit, and switch off “Itemize every instance” on the Sorting/Grouping tab.



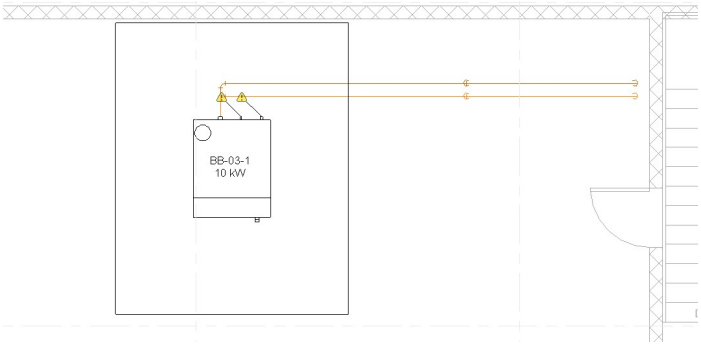
<500 - Pipe Schedule>

A	B	C
Material	Size	Length
Carbon Steel	15 mmø	205,130
Carbon Steel	32 mmø	54,134
Carbon Steel	65 mmø	9,839
Carbon Steel: 136		269,103
Copper	22 mmø	129,040
Copper	28 mmø	37,029
Copper: 48		166,069
Grand total: 184		435,171

Specify boiler duty from Revit system

One last thing to check – the boiler will inherit the flowrate from the connected system, so you can add a formula into the boiler to calculate heating duty based on a flow and return temperature.

In this case, there's also a tag that shows the heating output for the boiler. This is a quick and useful way of checking the total heat load for the system.



Outputs

So now you have the following deliverables complete in a timely fashion, and any changes that occur from now on are easy to incorporate into all of these deliverables…

1. A 3D model with spaces, heat emitters, pipework and main plant
2. Accurate embedded data and system sizing
3. Treatment plans
4. Room data sheets per room
5. Pipework layouts
6. Schematic and colour scheme layouts
7. Equipment schedules
8. Pipework bill of quantities