

463300

2D to 3D: How to Make it Work for You

Kathryn Donald
Max Fordham LLP

Carlotta Mirri
Max Fordham LLP

Learning Objectives

- Learn how to create a road map for transitioning from delivering projects in 2D to producing 3D models with embedded data (BIM).
- Discover the importance of adequate resources for successfully delivering and maintaining the development that they do.
- Learn how to plan development for more efficient and consistent project delivery in Revit compared to using it “out of the box”.
- Learn how to avoid similar mistakes to those we made when we first started delivering projects in Revit.

Description

We deliver our projects differently from most building services companies. Our engineers generate project deliverables rather than CAD technicians. As such, the majority of engineers deliver projects in Revit software, creating intelligent models to meet clients' requirements.

We've been delivering projects in 3D for 10 years; however, only recently has the engineers' preference become working in Revit rather than AutoCAD software. This shift is a result of the work completed throughout the last few years; engineers now believe delivering projects in Revit is the simplest and quickest method. We will guide attendees through the work we have undertaken to achieve this, looking at the easiest wins before moving to the more ambitious, including the development of bespoke tools. We will look at how we can automate boring tasks, giving engineers more time to be creative. We will touch on the issues we have experienced, cover tips and tricks we have discovered, and show how to maintain tools and resources once they are out in the “wild”.

Speaker(s)

Kathryn Donald

Kathryn is a Partner at Max Fordham LLP, leading their transition to a fully digital design environment through Building Information Management (BIM) and digital engineering. Her digital design expertise has developed through her 10 years' experience as a building services engineer with the Practice.

As a project engineer on early BIM projects, Kathryn developed a real-world understanding of the opportunities and challenges of deploying digital design.

Kathryn and her Digital Design Team work closely with the engineering teams to develop bespoke digital tools, processes, content and training to improve the quality, efficiency and effectiveness of the Practice's engineering output.

Carlotta Mirri

Carlotta is passionate about applying technology in the AEC industry.

As a Digital Design Engineer at Max Fordham, Carlotta manages BIM model production for large scale projects and supports teams of engineers in optimizing and enforcing BIM strategies and effective collaboration.

She has been heavily involved in the development of BIM procedures, content and custom digital tools. Carlotta began exploring pyRevit as a way to interact with the Revit API using Python, for automating time consuming tasks in Revit and speeding up the production of information and surfacing model data for engineering calculations.

Introduction

During this Industry Talk we will set out the Max Fordham journey of our adoption of Revit and our subsequent transition from 2D to 3D project delivery. Having spent the first 6 or so years muddling through this transition, we will highlight the lessons we have learned and how, in hindsight, we would have planned out the roll out of Revit if we were to start the process over again.

Introduction to Max Fordham

To understand our approach to delivering projects, you need to understand the ethos at Max Fordham. We are a Building Services Engineering consultancy founded in 1966 by Max Fordham OBE on the premise of pushing the boundaries of sustainability, creativity and innovation. We are also a Limited Liability Partnership, with almost half of the current staff being a Partner of the Practice. The result is, that as a Practice, we have been raised to question everything while also being encouraged to actively voice our opinions on how the Practice is run. Implementing standardized processes, workflows and content in this environment is difficult; if users think they can do it better they will give it a go. Therefore, any standardization we implement needs to be robust and easy to use/implement.

In addition, we deliver a wide range of project types from high profile, complex projects to large commercial projects across most building sectors. These projects are delivered from our 5 UK offices by our 225 staff including 170 engineers. Our Digital Design approach needed to be flexible enough to cater for and accommodate all these differing requirements.

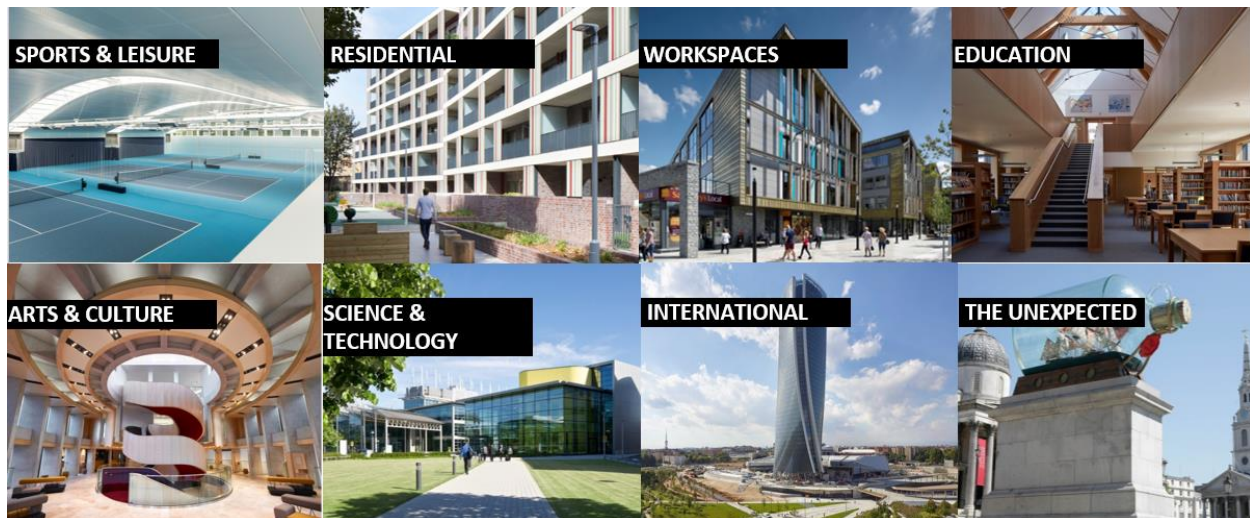


FIGURE 1: BUILDING SECTORS

Max has always believed that a key element to a creative engineering design process is for all engineers to know how to draw. The Practice was built on the principal of engineers delivering their own drawings; firstly, hand drawn drawings (with many having drawing boards as desks!) then subsequently moving on to using AutoCAD. We have kept this ethos through our transition to Revit, not employing any CAD technicians but training our engineers to deliver our projects in

using this software. Both transitions have been fraught, thank goodness we only have these types of changes every 2-3 decades!

A Difficult Start to 3D Delivery

When we first adopted Revit in 2010, we made several crucial mistakes that impacted our engineers' experience, our efficiency and the quality of our output. The main mistakes we made were:

- Reason for purchasing Revit - we purchased the software originally because our clients were starting to request the production of 3D models of their projects. We did not take the time to explore the software so didn't understand its complexity or have an idea of how the software could benefit our internal workflows.
- Minimal central development – due to our ignorance of the software, we didn't take the time to establish what central development was required to make it successful.
- Training – we brought in external companies to train small groups of engineers to begin with. We found that engineers needed specific training to be delivered right before they started the tasks in Revit. This is hard to achieve with an external, face-to-face training consultancy and it isn't flexible enough for when project dates slip (which they always do!). It also doesn't offer any on-going support and troubleshooting so the engineers are left to find answers to problems by Googling them and watching YouTube videos.
- Replicating output from AutoCAD – initially we tried to replicate the same type of output from AutoCAD. This proved to be extremely inefficient, causing those involved in the projects a large amount of stress.

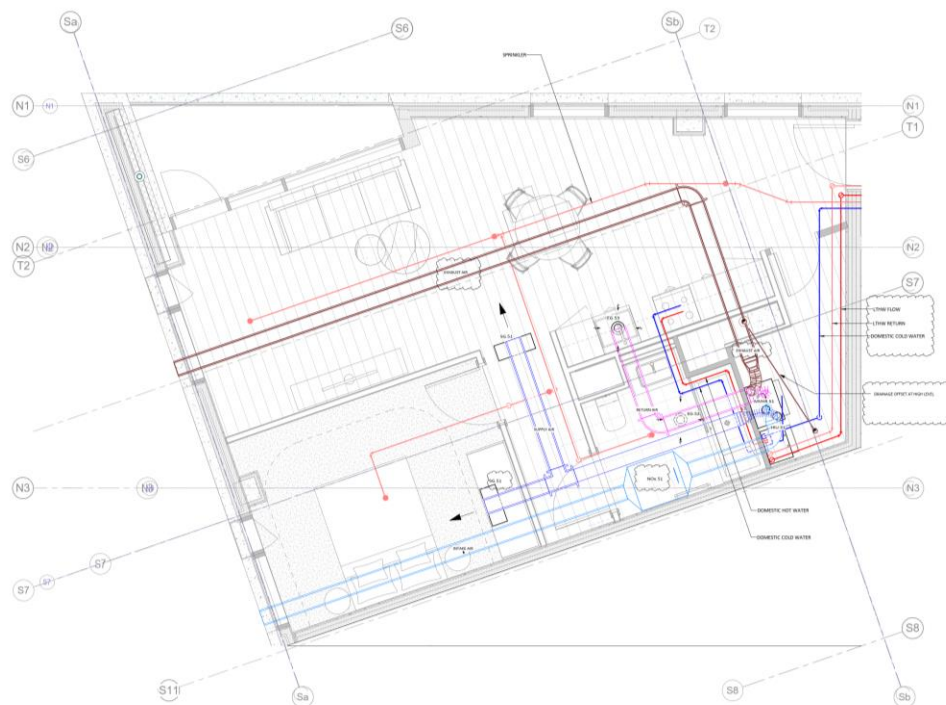


FIGURE 2: EXAMPLE DRAWING OUTPUT FROM 5 YEARS AGO

These mistakes led to our engineers who were working in Revit to become very frustrated and gave them a terrible first impression of the software. In hindsight, we should have taken the time to get to know the software, understand its capabilities and establish how best to deliver our projects. In the end, we left ourselves with an uphill battle trying to change engineers' impressions of Revit to the extent where it was their preferred delivery solution. The Industry Talk and Handout will summarize how we have gone about achieving this (with proof of this change in impression at the end), detailing the improvements we have made over the last four years.

Business Case

To implement any improvements, we required the backing of our Management Group. This was important for two main reasons: to agree that the proposed development work was worthwhile and worthy of redirecting resource, and that the development was to become the Practice standard. To gain this support we needed to sell our vision of what we wanted to achieve. As we already had the Revit licenses, we produced a light touch business case focusing on:

- What we wanted to achieve, including:
 - What the current issues were
 - The development proposed to address these issues
- What resource was required
- What benefits would be realized
- What the likely return on investment (ROI) would be

This approach achieved our goal and we were able to negotiate a yearly development budget and had the authority to implement this development as the new standard.

In hindsight, had we approached the acquisition of Revit in this way in the first place, we would have saved our engineers a lot of time and anxiety, saved a lot of money and attained a higher quality of output sooner. We have learned our lesson and now whenever we are considering a new piece of engineering software, we would produce a business case that details the points that need to be considered for that software covering:

- What is the implication of doing nothing?
- What is the benefit of introducing this type of software?
- What are the different software options available?
- What is the software cost?
- What are the costs for?
 - Any required plugins or associated software
 - Development
 - Ongoing maintenance
 - Training
- What is the likely return on investment (ROI)?

As well as helping to clarify our own requirements and preparation, we find that having a thorough business case gives both ourselves and our Management Group the confidence that we fully understand what is required to make the software a successful addition to the Practice. Therefore, we would be more likely to get the support to purchase and implement it.

What are you Trying to Achieve?

Having used Revit for several years, we were clear on what we wanted to achieve going forward. While we needed to be modelling in Revit to keep winning the type of work we wanted, we also wanted engineers to enjoy and want to use Revit. To do this, we needed to make it easier to deliver high quality output from Revit compared to AutoCAD. Our key objectives were:

- The quality and consistency of output
- The efficiency of modelling and drawing output
- BIM compliancy
- Happier engineers

This was essentially the brief for the rest of the work we undertook. To achieve these objectives, we had five key stages of delivery:

- Strategy and approach
- Better training and support
- Content Development
- Workflow Development
- Tool Development

Strategy and Approach

To enable the delivery of the following four steps listed above, we had to have a clear strategy of what we wanted to achieve, who was going to deliver this work and who was going to support the engineers in changing how we were to employ Revit on our projects.

We knew as well as upskilling our engineers to deliver projects in Revit, we needed people with a higher level of proficiency to deliver the central development while also supporting the engineers in the delivery of their projects. From this realisation, our Digital Design Team were born. Originally the concept was to have a central Digital Design Team; although this worked well for the central development, the training and support aspect didn't work so well. Instead, we now have members of the Digital Design Team embedded in the different engineering groups. This means that the Digital Design Engineers can develop a much closer relationships with those engineers they are charged with training and supporting.

The Digital Design Team is considered a specialist team within the Practice and is responsible for maintaining and improving the central resources. We meet on a regular basis to discuss and prioritize what improvements are to be made while also discussing issues that arise on projects.

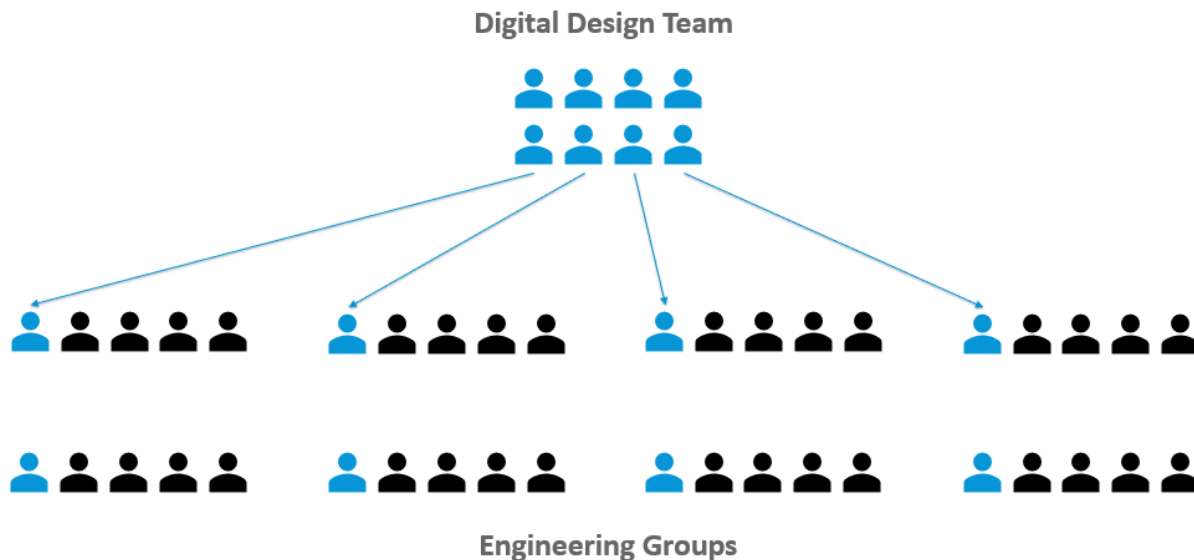


FIGURE 3: DIGITAL DESIGN TEAM STRUCTURE

Support and Development Resource

As Revit is quite a complex software, we knew we had to have experts that could support the engineers in delivering their projects, as well as delivering the central development. We considered two different approaches to this: having a small dedicated central group or having a larger group where members are embedded within the engineering groups. While a dedicated team would likely be more efficient, would avoid their focus being split and be easier to resource, we decided to go with a larger dispersed team with members embedded within the engineering groups. This makes resourcing the development a little more difficult, but we find that they are more accessible to the engineers and, as they are more involved in the delivery of projects, have a better idea of the most beneficial development work and how to prioritize it. Therefore, our specialist Digital Design Team was born.

To make this approach work, there needs to be an agreement on how much of the Digital Design Engineers' (DDEs) time should be set aside for development work. We have found that the DDEs are in high demand due to how well they can deliver projects so reserving their time can be difficult! However, as the engineering Team Leaders are aware of how important this development and support is, they are supportive of this arrangement. Some flexibility on both sides is required but generally this approach has worked well for us.

Planning of Delivery

Once you have the required resource, the focus is then on delivering the development and training. Our approach to introducing new software is to firstly focus on what is required to get the software and the people using the software to the stage where it can be used reasonably efficiently and competently. Internally we refer to this as the critical mass, the minimum amount of pre-work required to make the introduction of the software successful. This creates a stable foundation on which additional development can be built upon while the Practice can start benefiting from the software.

In the case of Revit, the critical mass for us was having a reasonably comprehensive project template, family library, clear modelling standards and competent Digital Design Engineers

within each group that could train and support the other engineers. Once these were in place, it was a lot more palatable for engineers to use Revit to deliver their projects rather than AutoCAD and we started to see a culture change start to happen. It was a much slower process than we would have liked, this was a result of having to change the initial impression the engineers had of Revit.

Once Revit started to be used more widely, our focus shifted to what additional improvements could be made to further increase the efficiency, consistency and quality of our work. This included:

- Additional content including the development required to produce schematics within Revit
- Exploring Dynamo and pyRevit to creating bespoke automation tools

We are now exploring how we can capitalize further on the structured data within the Revit models that we create. Access to this structured data gives us the opportunity to learn lessons from previous projects and to create benchmarks to inform future designs. This can be very effective in delivering projects more efficiently while hopefully achieving better designs as this information is available to inform the decisions being made by the engineers. This then gives the foundation for tools that utilise machine learning.

Training and Standards

Training and Support

As noted earlier, Revit is more complex than AutoCAD and requires a more structured training approach. Initially we arranged for an external company to give training to small groups of engineers. However, we have found that the training needs to be delivered as the engineer is starting their first project in Revit for it to be effective. It is also much more effective if the training is broken down into different modules and the modules undertaken are related to the tasks the engineer will be immediately carrying out. This is difficult to do with an external training company, so we decided to take a different approach. This led us to develop a group of engineers into what are now our Digital Design Engineers with the expectation that they would become expert Revit users and train the rest of the engineers in the Practice. We found that this approach worked well as the training could be much more targeted; engineers could be given the relevant training just as they were about to undertake tasks. The Digital Design Engineers were also available to support the engineers if they ran into any issues which was more efficient than engineers trying to troubleshoot by looking at forums and YouTube videos.

While this was effective, as the number of Revit projects grew, the time pressure on the Digital Design Engineers associated with training and support also grew. We wanted to explore options for how we could reduce this load while keeping the benefits realized. This gave us two options: create our own training content or purchase access to on-demand training resources. In the end we have gone for a mix of these two options using on-demand training resources for standard Revit training while we develop our own training for Max Fordham specific content, workflows and tools.

Content that we produce in-house is typically located on our internal Wiki platform. This platform is accessible by all and easily searchable. Unlike PDF documents, it allows us to embed short demo videos into the pages which can be much more effective than text and images for certain tasks. Our schematic drawing workflow guidance has been the most visited page on the Wiki while the queries asked of the Digital Design Engineers have been minimal, showing that it is proving to be effective.

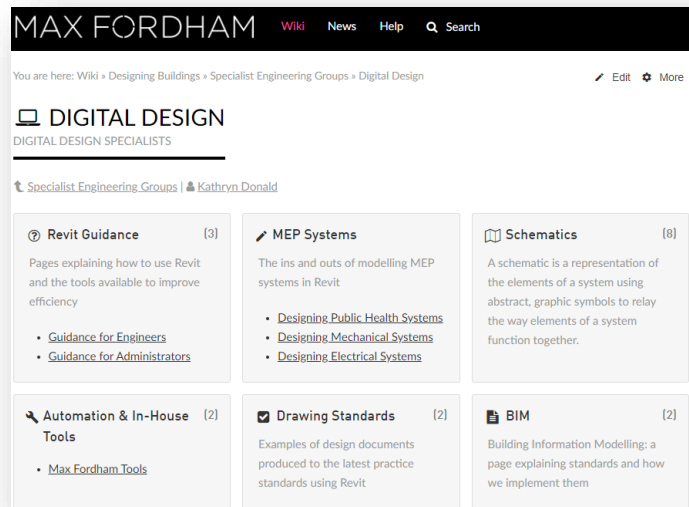


FIGURE 4: THE DIGITAL DESIGN PAGE OF OUR INTERNAL WIKI

We have found that creating single issue pages rather than creating long PDFs is much more effective when communicating standards to engineers and, going forward, we are intending to only have PDFs of documents that are needed for other reasons such as evidence when bidding for a new project.

For the standard content, we are in the process of introducing an online training platform called Global eTraining. The content on this platform is split into bitesize modules allowing us to create bespoke training workflows for different roles or for different tasks. For example, new Digital Design Engineers will undertake more of the training modules than the rest of the engineers.

We are currently reviewing the content to ensure it does not contradict any of the Max Fordham training content, so we have yet to implement the platform, but the review of the content has found it to be very well structured and thorough and we expect it will be a great addition to our training workflow.

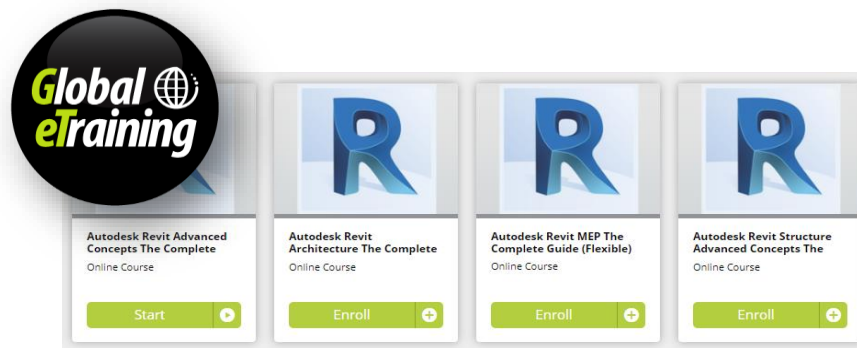


FIGURE 5: SNAPSHOT OF SOME OF THE COURSES AVAILABLE ON THE GLOBAL eTRAINING PLATFORM

Standards

In addition to training, we have also created standards that should be followed, increasing the consistency across the Practice. The suite of documents and content include:

- Model Production Standards
- BIM Standards
- Standard Drawings

Model Production Standards

Our Model Production Standards document sets out the modelling standards that those modelling are to follow. It sets out everything to be followed related to the modelling, from the colors to be used for each of the services, the line styles to be used, the annotation styles and sizes, etc.

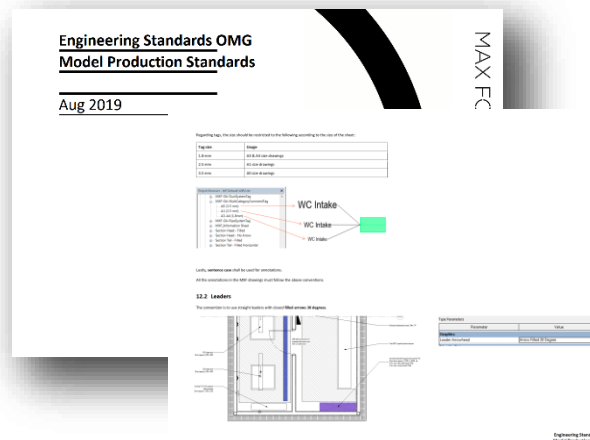


FIGURE 6: MODEL PRODUCTION STANDARDS DOCUMENT

Development Work

One of the key aspects of successful BIM delivery is the development and enforcement of consistent standards. We achieved this by developing content and workflows that allow a repeatable and predictable approach, reducing wasted or duplicated effort and repetitive tasks where possible.

In some cases, we customized some of the out of the box software tools to fit our way of working. Other times, we embraced new ways of delivering our information.

Content Development

We first focused on the Revit content that can be used across multiple projects (e.g. the project template and Revit families).

Starting every new project from a well-developed Project Template and family library allowed us to both save a lot of time and produce a consistent output across different projects.

Engineers with less experience in Revit were also able to immediately get started working in Revit, concentrating on the design rather than on Revit issues.

Project Template

Every new project is set up using a standard Max Fordham project template. This has been developed to facilitate navigation and pre-populated with content that is used on almost every project.

Project Browser Organization

The views in the project browser have been organized according to their intended use.

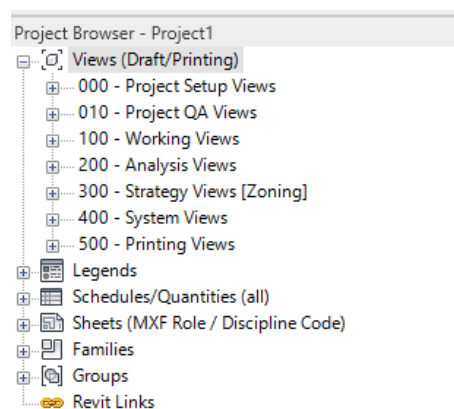


FIGURE 8: PROJECT BROWSER ORGANIZATION

In particular:

- “000 – Project Setup Views” are used when setting up the Revit model (e.g. copying the levels and grids from the architectural model or adjusting the project base and survey points) or to export the 3D model to other software (e.g. Navisworks).

- “010 – Project QA Views” are used to run visual quality checks, e.g. checking that pipes have been modelled using the correct materials.
- “100 – Working Views” are used when modelling MEP systems. The views are organized using the Uniclass 2015 classification system and show the commonly used MEP systems:

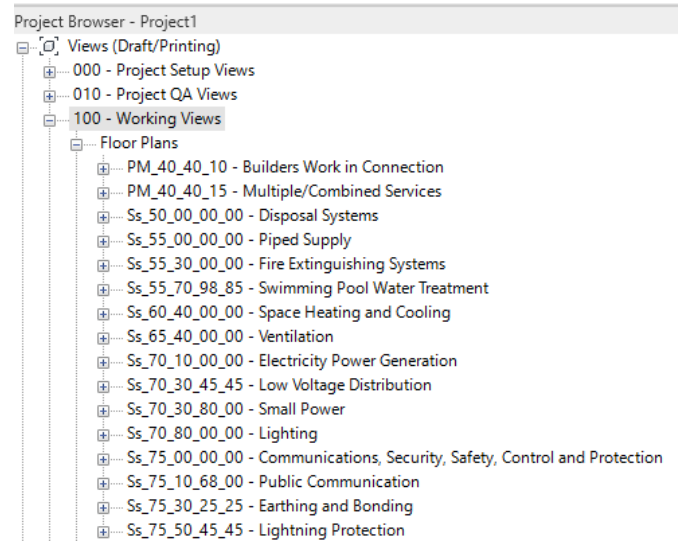


FIGURE 9 WORKING VIEWS

The system relative to a specific view will be color coded (e.g. drainage pipes in disposal system views) with the other systems shown greyed out in the background for clash avoidance.

We recommend working in a combination of 2D layout and 3D views to encourage better coordination.

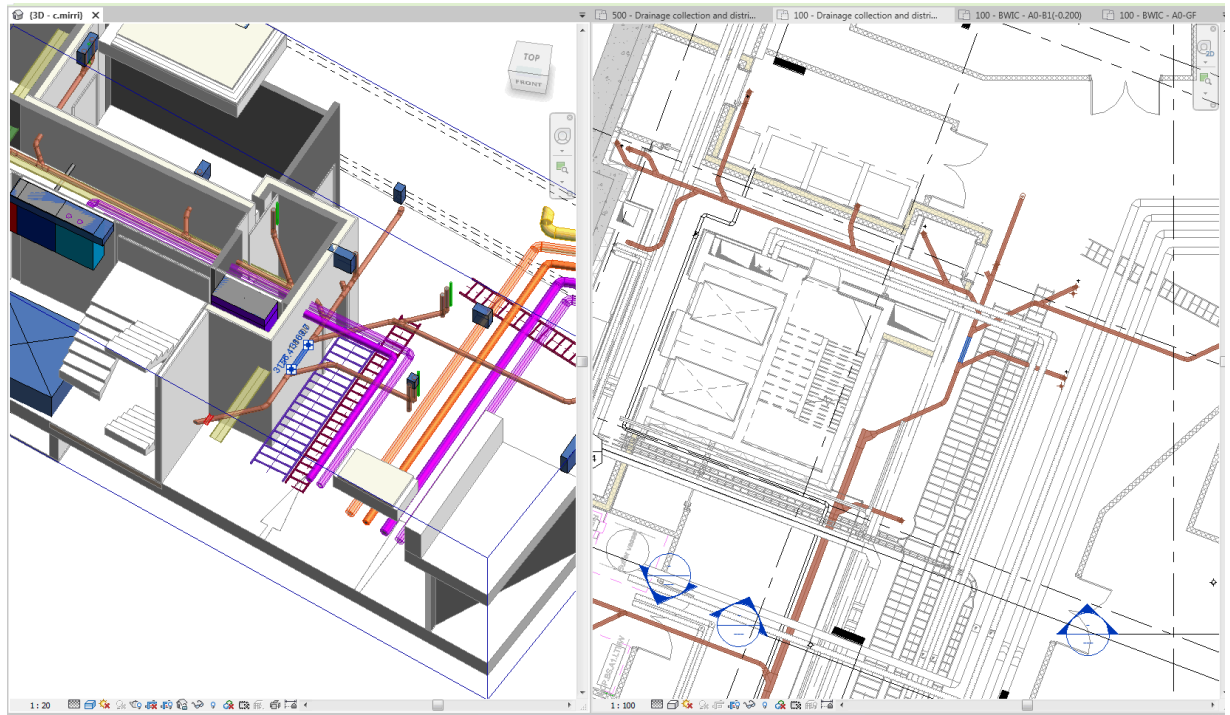


FIGURE 10 3D COMBINED SERVICES VIEW AND DISPOSAL SYSTEMS WORKING VIEW

- “200 – Analysis Views” show rooms or spaces. These views can be used to export data to modelling software such as IES Virtual Environment.
- “300 – Strategy Views [Zoning]” are designed to create colored strategy layout drawings using spaces.
We will talk in more detail about how these are used in the workflow development section.

- “400 – System Views” show each system for visual inspection. The image below shows the same area isolating a different system in each view for easier understanding:

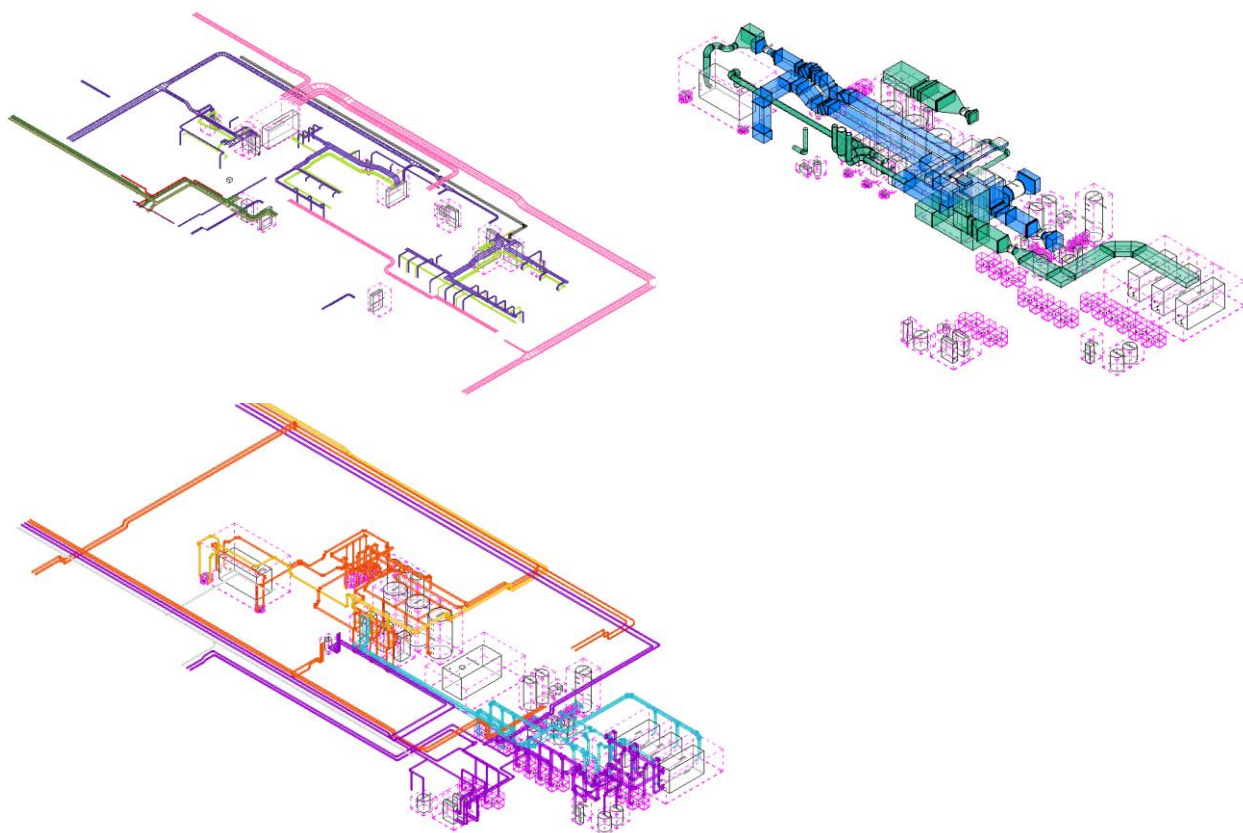


FIGURE 11 EXAMPLE SYSTEM VIEWS

- “500 – Printing Views” display the MEP systems as desired for the final detailed layout drawing production, i.e. these are the views that will be placed on sheets.

Annotations and tags are added to these views rather than the working views. The line weights and colors for these views have been optimized for PDFing.

Contrary to what was happening in the past when using AutoCAD, we now use a lot of sections and 3D views to better communicate the design intent and the distribution of services, as shown in the example plantroom drawings below:

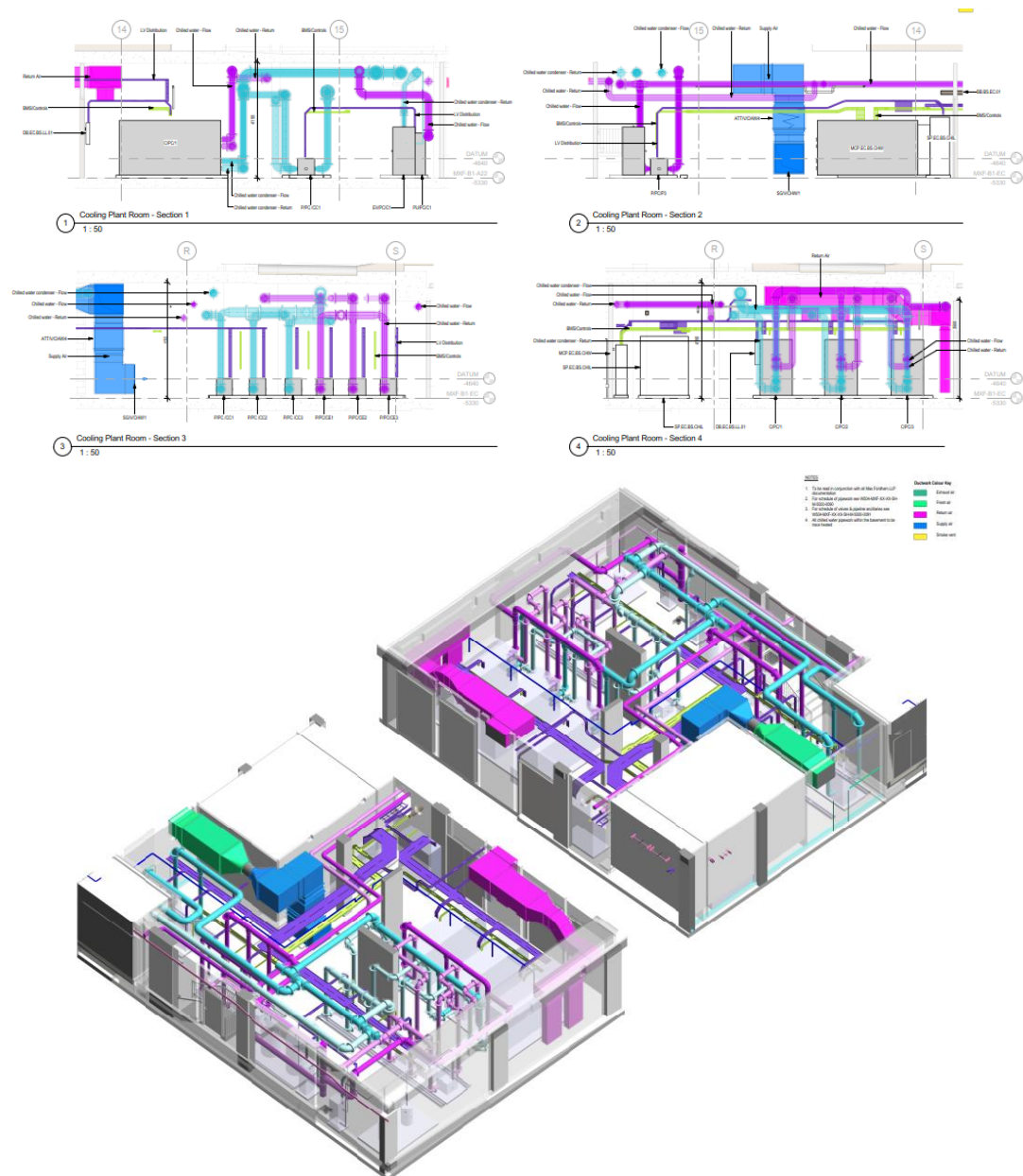


FIGURE 12 COOLING PLANTROOM PRINTING VIEWS

View Templates

View templates are a collection of view properties and they are used to apply standard settings to views (e.g. they control how objects appear on a view, how views are organized in the project browser, etc.). For this reason, view templates are essential to ensure adherence to office standards and achieve consistency across design document sets.

Our Project Template contains an extensive set of default view templates that should not be edited by our engineers. We have one view template for each deliverable.

All view templates follow a naming convention to allow easier navigation and better understanding of their intended use, as shown in the table below:

View group number	View type	Output	Role and discipline code	Classification Number	Classification Description
000	Ex <i>Export/Setup</i>	2DP <i>2D plan</i>	PXX <i>Public Health</i>	Uniclass 2015	Uniclass 2015
000	Fx <i>Fix</i>	2DS <i>2D Section</i>	MXX <i>Mechanical</i>		
010	QA <i>Quality Check</i>	3DV <i>3D View</i>	EXX <i>Electrical</i>		
100	Wo <i>Working</i>	SCH <i>Schematics</i>	JXX <i>Combined Services</i>		
200	An <i>Analysis</i>				
300	St <i>Strategy</i>				
400	Sy <i>System</i>				
500	Pr <i>Printing</i>				

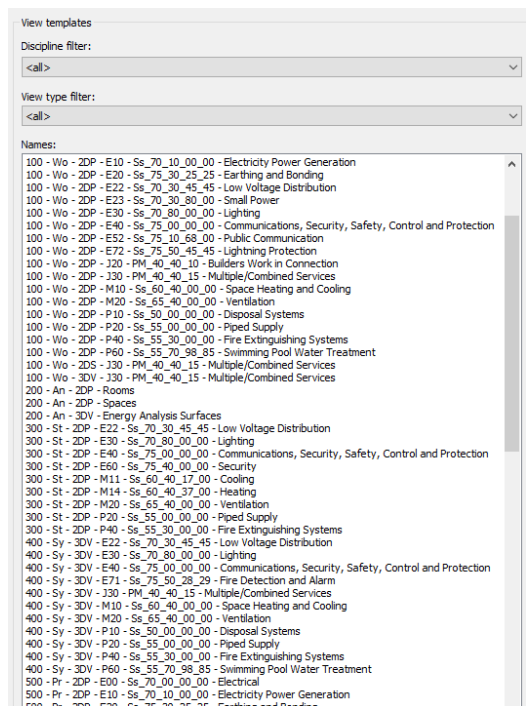


FIGURE 13 VIEW TEMPLATES NAMING CONVENTION

Legends

Template legends are available in the Project Template and can be adjusted to suit project specific needs. In this way engineers do not have to create them from scratch for every project.

NOTES

1. This drawing is to be read in conjunction with all other Max Fordham LLP drawings, specifications and schedules.
2. This drawing should be printed in colour.
3. Refer to the architects and structural engineers information for additional details.
4. This drawing should be printed in colour.
5. All components installed within the domestic water service installation are to be WRAS approved suitable for use on a potable water system and be in accordance with the requirements of the local water company. Sanitaryware specified by others.
6. Not all valves are shown on the layouts. Valves only shown where they need to be coordinated with the locations of accessible ceilings.
7. All external pipework to be trace heated to protect it from freezing.

KEY

	CAT 5 Irrigation
	Domestic Boosted Cold Water
	Domestic Hot Water Flow
	Domestic Hot Water Return
	Mains Cold Water
	Pool Filtration - Flow
	Pool Filtration - Return
	Fire Protection - Deluge
	Fire Protection - Deluge
	Fire Protection - Sprinklers
	Fire Protection - Wet Riser
	Fuel
	Gas
	Harvesting - Grey Water
	Harvesting - Rainwater
FA	From Above
TB	To Below
—	Pipework at Low Level
- - -	Pipework at High Level

NOTES

1. This drawing shows the design intent and is to be completed by the Fire alarm specialist to the satisfaction of the Fire Officer.
2. Fire alarm system to be compliant with BS EN 54, BS 5839-1 & BS 9999. Refer to Fire Engineers information for system grading and additional information.
3. All electrical works are to be designed installed and tested to BS 7671 : 2018 (18th Edition of the Wiring Regulations). Combined detectors / sounders / beacons are to be used wherever possible.
4. All fire alarm cabling is to be FP200 gold in dedicated closed trunking.
5. General setting out of all fire alarm components and ancillary items to be by the Architect.

KEY












	Aspirator
	Beam Detector - Receiver
	Beam Detector - Transmitter
	Carbon Dioxide Detector
	Concealed Area Smoke Detector
	Door Lock or Hold Open Device
	Fire Alarm Interface
	Fire Alarm Panel
	Fire Alarm Repeater Panel
	Fireman's Switch
	Flashing Beacon
	Flashing Beacon & Sounder
	Heat & Beacon Alarm
	Heat Detector
	Heat Sounder & Beacon Alarm
	Heat Sounder and Detector
	Manual Call Point
	Smoke & Beacon Alarm
	Smoke Detector
	Smoke Sounder & Beacon Alarm
	Smoke Sounder & Detector
	Sounder Alarm

FIGURE 14 TEMPLATE LEGENDS

Line Styles, Filled Regions and Annotations

We also standardized the 2D elements in the Project Template. In particular, we created a set of default filled regions (mainly used in legends), line styles (used in schematics and detail drawings) and annotations.

All these elements follow a standard naming convention to make it easier for the user to find what they require.

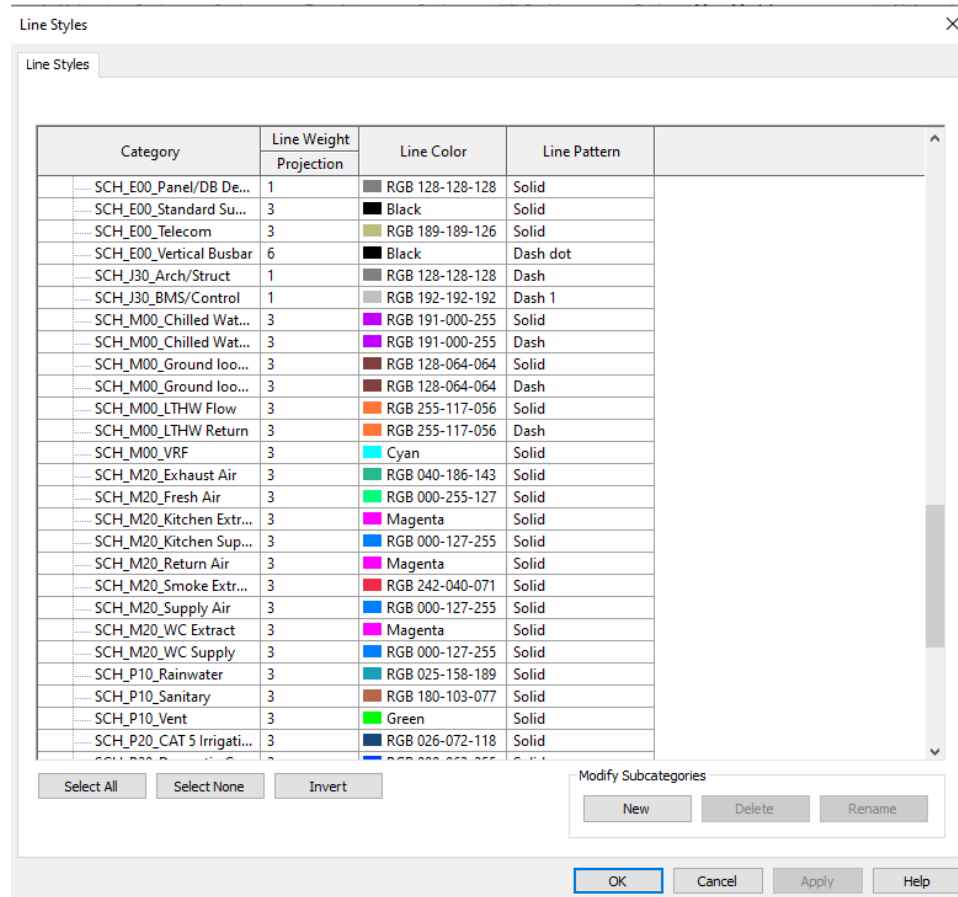


FIGURE 15 LINE STYLES NAMING CONVENTION

All the annotations (text boxes, tags, dimensions, etc) are set up with Max Fordham standard font and sizes so the annotated drawings look consistent across projects.

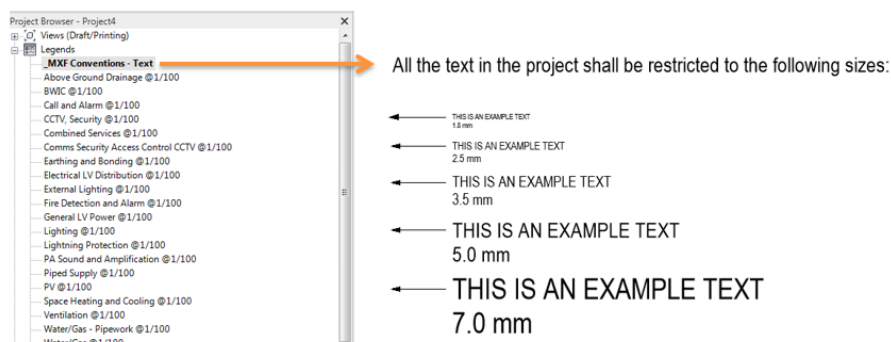


FIGURE 16 STANDARD TEXT FONT AND SIZES

Families

Family Template

We have implemented a Family Template that can be adjusted to create a variety of different 3D families. The Family Template uses three basic components: clearance, body and connections.

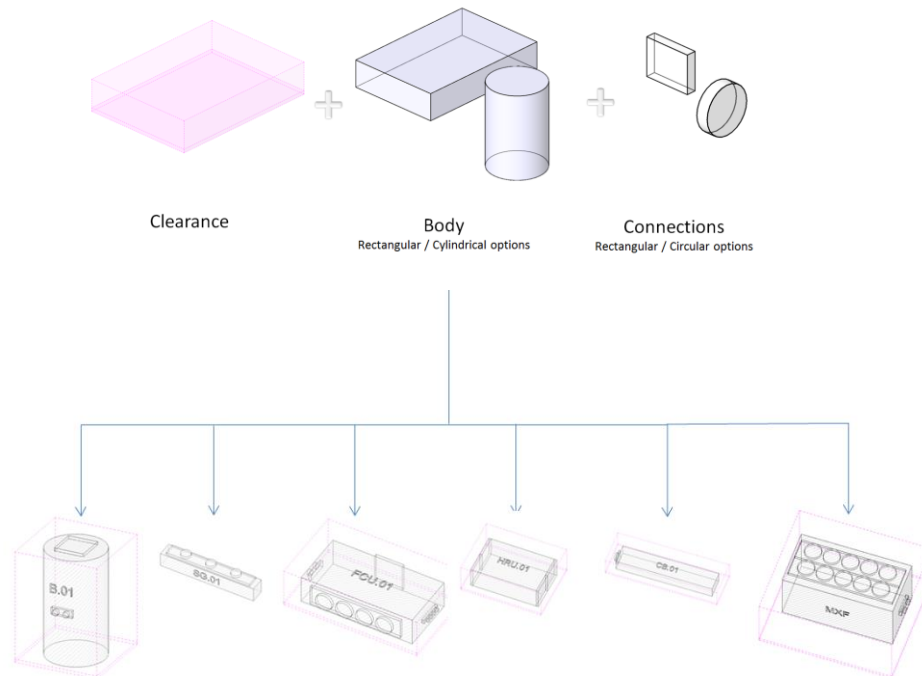


FIGURE 17 TEMPLATE FAMILY AND POSSIBLE OUTPUTS

Using this Family Template, we have developed hundreds of families that form our in-house Family Library. We decided to create our own families to guarantee consistency between every object in a project and an appropriate level of detail and information for each project stage.

Manufacturers' families tend to be overdetailed and often miss out access zones and connections. Therefore, we tend to prefer our own families to ensure that the 2D output is consistent, equipment appears on the correct drawings and to limit the file size.

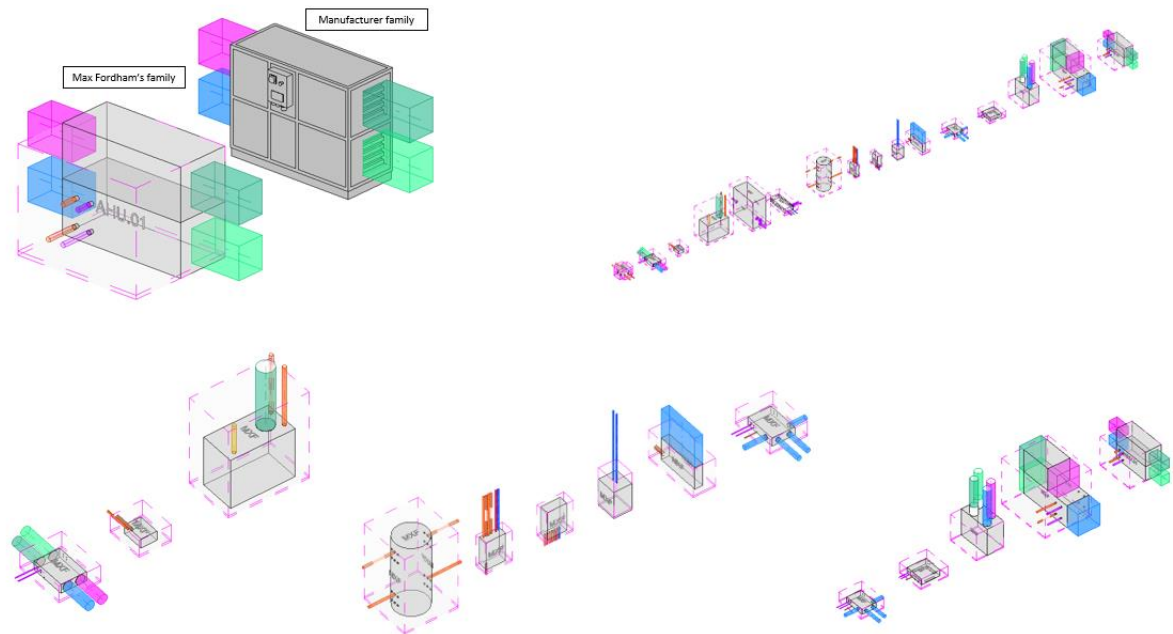


FIGURE 18 FAMILY LIBRARY

We have also developed 3D electrical families that have multiple types with different symbols associated to them. In this way objects show as 2D symbols on the layouts and their reserved space in 3D.

For example, the family in the example below includes different security devices. Depending on where the 3D family is placed in the model, the symbol might overlap with architectural elements which could appear unclear. To address this, we added offset parameters that allow the symbol to move independently from the 3D object.

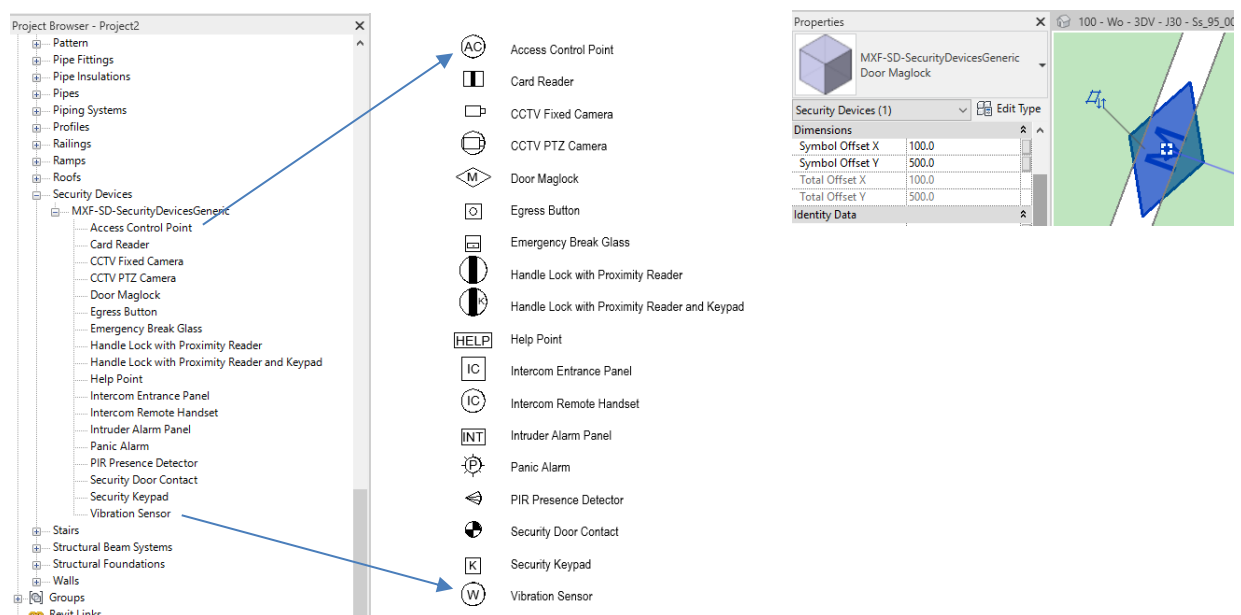


FIGURE 19 SECURITY DEVICES FAMILY

Family Naming convention

All our families follow the naming convention defined by the British Standard 8541-1:2012. Naming the families in a consistent manner is a requirement of the BIM Execution Plan. Having an agreed naming convention allows you to:

- More easily search for the family you need (e.g. using keywords)
- Understand what the family is without opening the file (e.g. Revit category)
- Know who the author of an object is when the BIM models are federated

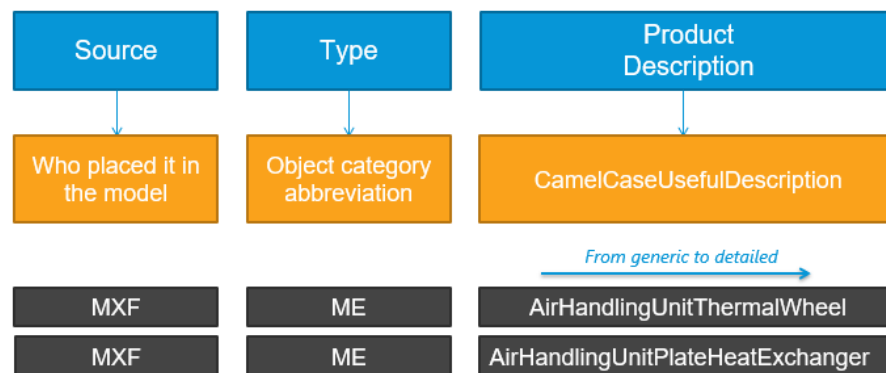


FIGURE 20 FAMILY NAMING CONVENTION

Family QA workflow

The Family Template is very easy to use and allows less experienced Revit users to create their own content. Thanks to a large pool of contributors, we have managed to grow our in-house Family Library quickly and currently have more than 750 families.

It is very important to have a QA process in place to make sure that the families that are saved in the Family Library are free from errors. To achieve this, we ask our engineers to save their objects in a Sandbox folder that is checked regularly by expert Revit users. The families in the Sandbox that pass the QA check are then moved to the Family Library for everyone to use. The Family Library folder is read-only to avoid any adaptations on projects overwriting the original.

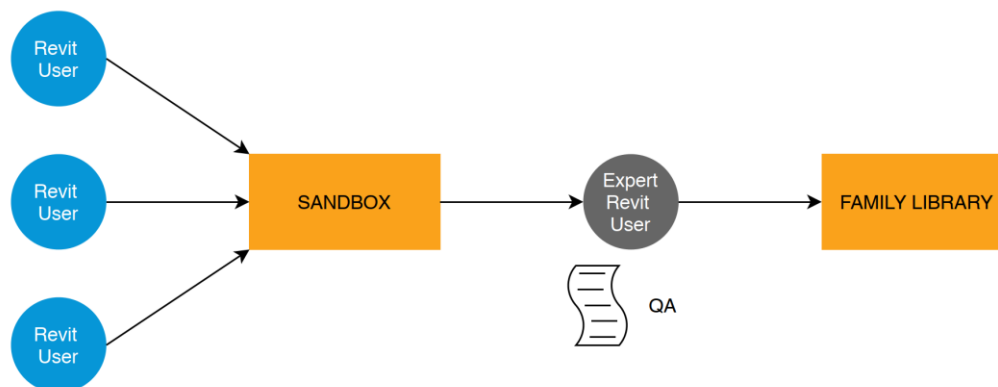


FIGURE 21 FAMILY QA WORKFLOW

We also developed 2D libraries for typical schematics (or single line diagrams) and details. As with the 3D typical arrangements, the 2D library saves engineers time and acts as an engineering training tool.

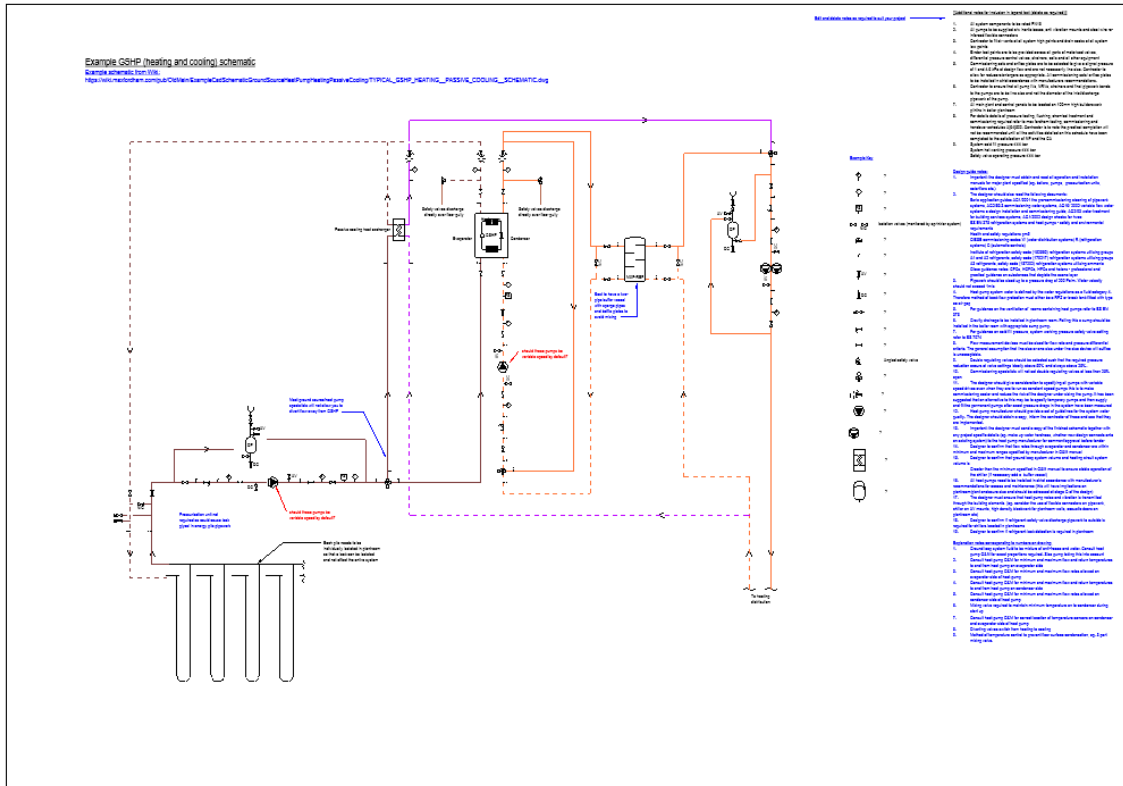


FIGURE 23 EXAMPLE HEATING AND COOLING PLANT ROOM SCHEMATIC

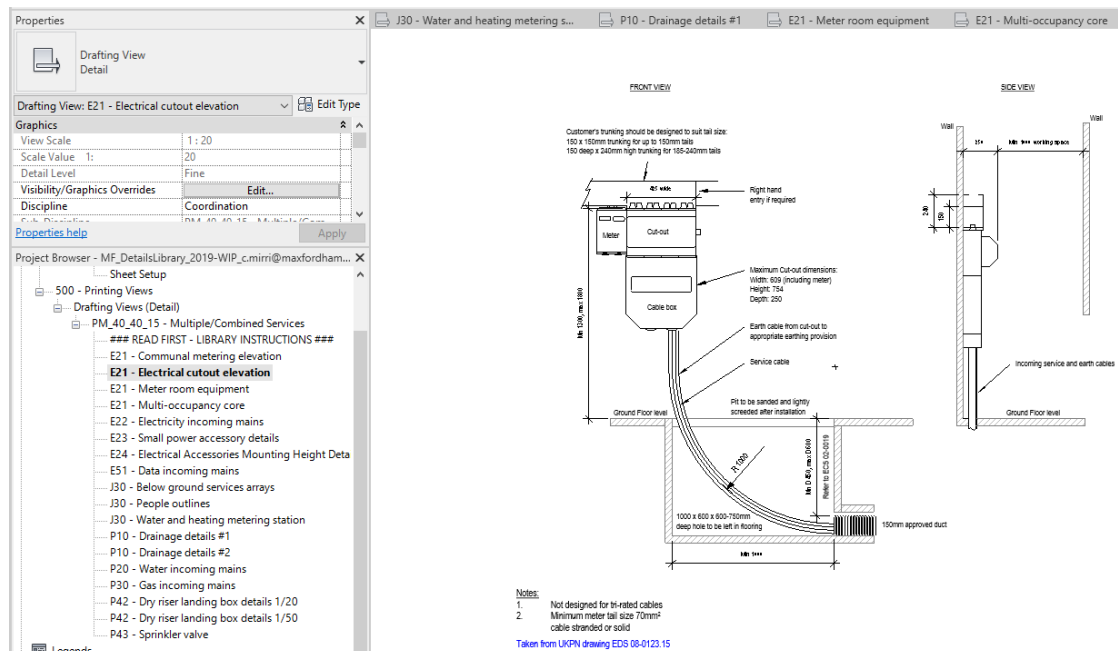


FIGURE 24 EXAMPLE ELECTRICAL CUT-OUT ELEVATION

Shared Parameters

We have a central Shared Parameter File that is saved on our internal network and maintained by the Digital Design Team.

One mistake we made in the past was to allow any Revit user to add shared parameters to this list when they couldn't find what they needed. This caused the file to quickly develop in an unstructured way – all parameters were grouped under “exported parameters” and some of them had the same name but different Globally Unique Identifiers (GUIDs). This caused problems down the line as tags were not reading the correct parameters and were not showing the expected information.

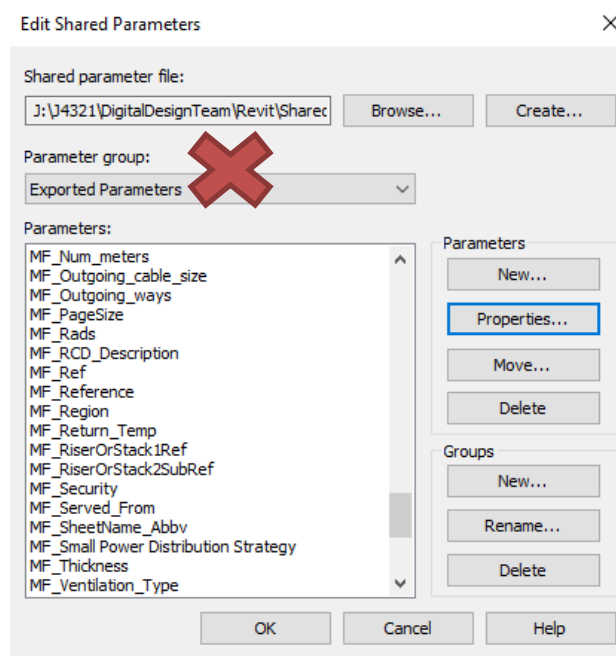


FIGURE 25 SHARED PARAMETERS FILE

We recommend that a separate shared parameter file is created if the definition of new shared parameters is required for a project. The main shared parameters file should only contain those parameters that are used on all projects.

The Project Template defines a set of default properties for each space that can be filled in with values according to the strategy drawing you want to produce. If the space shape changes following a change in the associated room, the MEP values assigned to the space will be retained.

Another advantage is that legends are created automatically. In fact, a Color Fill Legend can be placed on the view and it will automatically show the properties of each space according to the strategy view you are in (this is controlled by the view template).

The strategy view below shows the electrical distribution strategy. By assigning a value to the “MF Electrical Strategy” parameter of a selected space, a new entry will appear in the legend and a new color will be associated to the strategy.

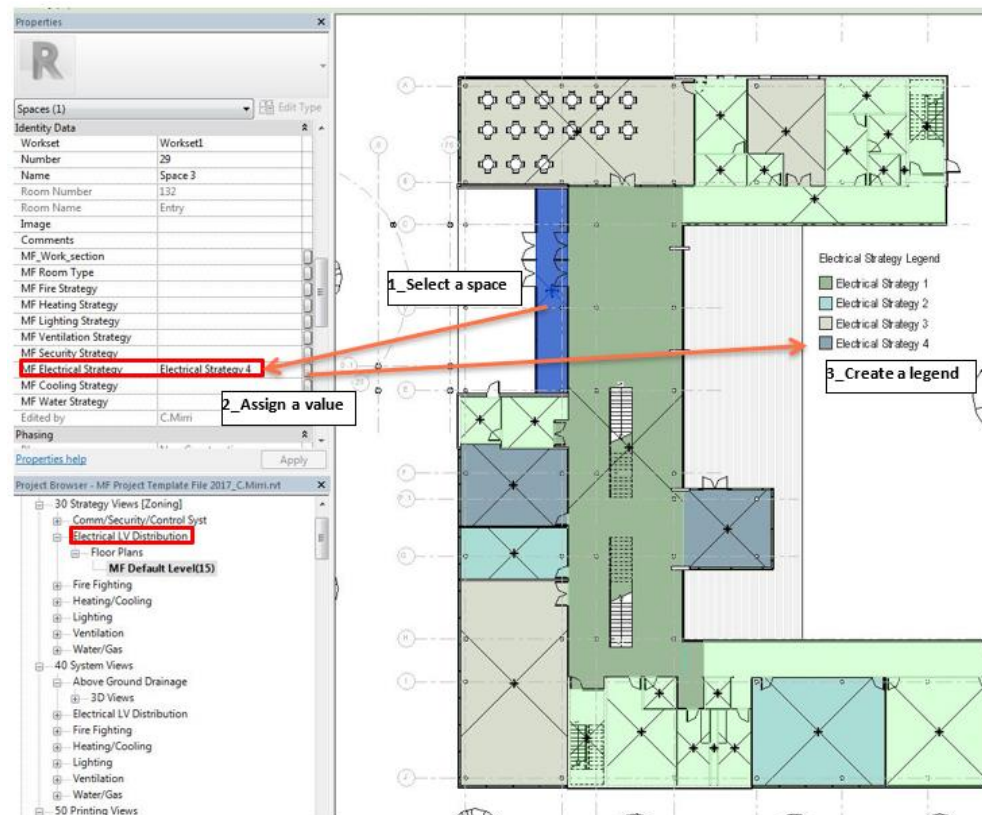
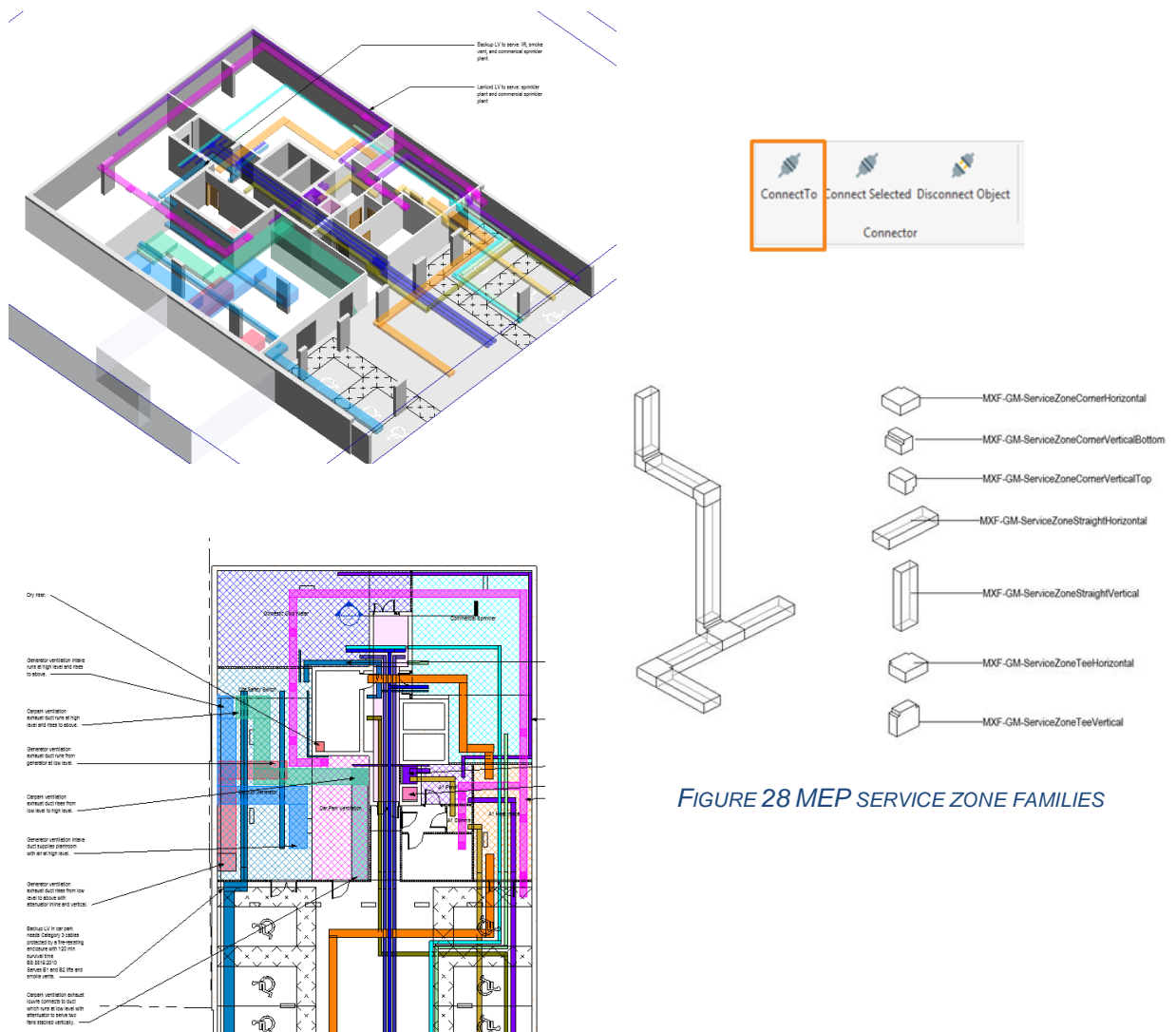


FIGURE 27 STRATEGY DRAWING WORKFLOW

MEP service zones

At early design stage, we have to define and communicate the space requirements for MEP services. Revit doesn't provide a tool to represent MEP service zones. In the past we used ducts and duct fittings to represent them. This was misleading as what we intended as space allocation for MEP services was confused for actual ductwork. We also tried using masses and spaces but neither of them fitted with our intended use (e.g. spaces were not visible in 3D, masses are cumbersome to edit).

Instead, we decided to develop a dedicated set of Revit families that can be linked together to form a connected system using a pyRevit tool (we will talk more about pyRevit tools later on in this document). This allowed us to produce RIBA Stage 2 models that show service space allocations in 3D and contain the correct data.



Schematics (or Single Line Diagrams)

In order to create our schematics in Revit we developed a library of 2D schematic symbols. These are pre-loaded in the Project Template.

We set up drafting views in the Project Template which contain a workplane grid that can be used as a reference when drawing schematics.

Some advantages of drawing schematics in Revit is that lines automatically adjust when a symbol is moved, symbols snap to the grid, etc.

We also have a script that automatically places the drafting views on sheets and renames them according to our naming convention.

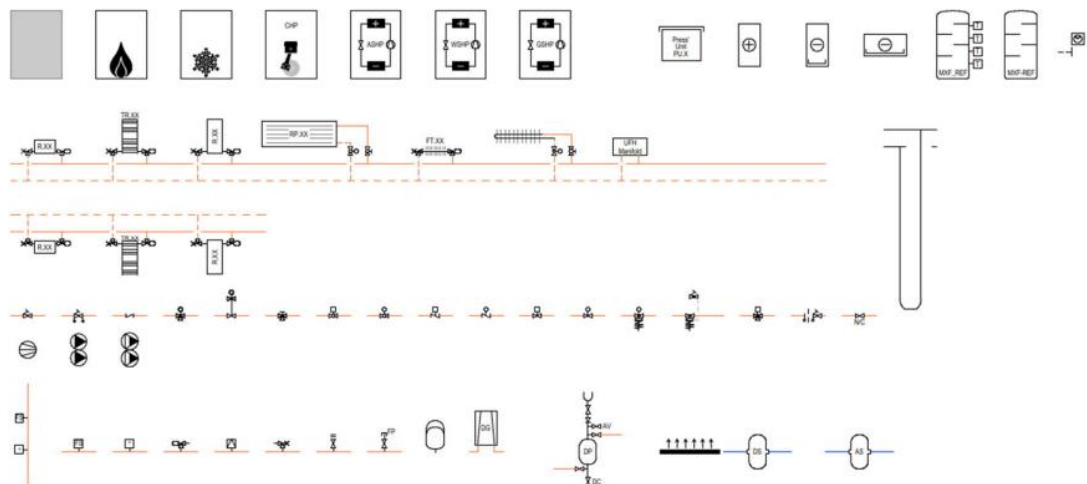
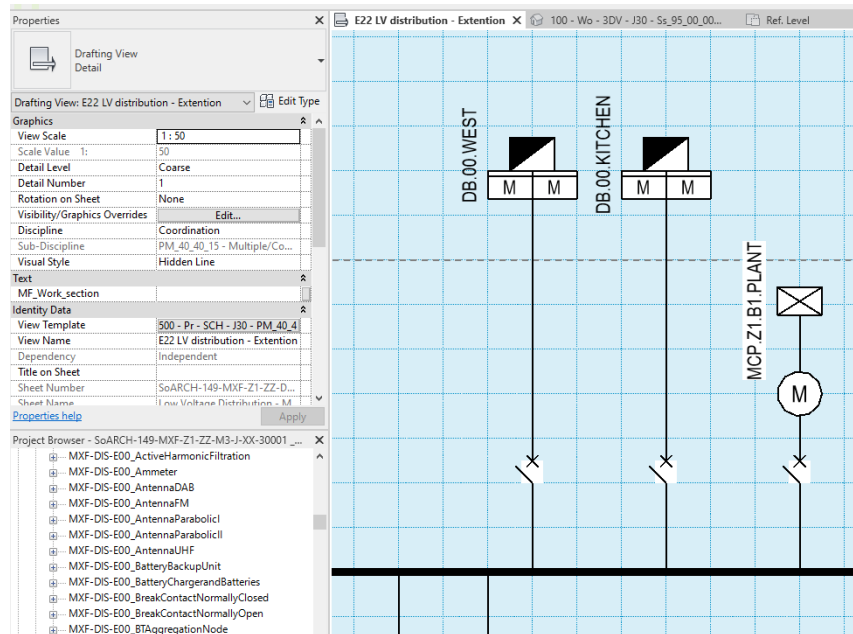


FIGURE 30 EXAMPLE SCHEMATIC SYMBOL FAMILIES

Health and safety

Previously we communicated health and safety risks on our projects through notes on relevant drawings and a summary schedule produced in Word. Other than the Word schedule template, we did not have a consistent approach to how these risks were communicated. Different engineers would add different types of notes with differing information to the drawings. Revit gave us an opportunity to standardize the way risks are depicted on our drawings and link the data on the drawings to the data in the schedule. This provides consistency across our projects while omitting the duplication of data and therefore minimizing the risk of contradictory information being provided.

POTENTIAL HAZARDS / RISKS SPECIFIC TO THE PROJECT

Notes:

1. This schedule includes information about aspects of the services work covered under this contract that may affect the health and safety of persons involved in the construction, operation, maintenance or demolition of the work, or affected by it. It is provided in accordance with the Construction (Design and Management) Regulations 2015.
2. The possible actions are broadly indicative and are for general guidance. The contractor shall inform the CDM co-ordinator of the general approach and specific action he/ she intends to take to deal with each health and safety matter identified.
3. This schedule should be read in conjunction with the Hazard/Access/Maintenance notes on drawings, and all other contract documents.
4. This schedule is only intended to highlight significant risks associated with the design that are i) not likely to be obvious to a competent contractor, ii) unusual, or iii) likely to be difficult to manage effectively. Contractors, or persons carrying out the works, are expected to identify and assess all other risks associated with the work.

WORK SECTION	TASK	DESCRIPTION OF HAZARD	SUGGESTED ACTION REQUIRED	HAZARD CATEGORY (refer to key 2)	PERSONS AT RISK (refer to key 3)
Z-10	Site services	Contract involves working around existing site services to be retained, modified or diverted.	Refer to MF existing site services drawings and all available record and survey information for approximate locations of services. Conduct further surveys as deemed necessary to determine extent of services by means of electromagnetic (CAT) techniques, trial pits or slit trenches. Agree scope of survey works with engineer prior to carrying out work. Mark and protect services as necessary to ensure safe work in this area.	F, L, M	C, S, M
Z-10	Roof top plant	Installation, maintenance and replacement of plant at height	Refer to MF plant replacement strategy drawing UOP-MXF-XX-XX-DR-Z-10-100. Maintain landing areas clear for plant replacement off the roof into/from both roof top plant spaces using cranes for large items of equipment. Carry out installation out of hours	A, B, D	C, M, (S, V, P, E)
Z-10	Roof top access to clean roof lights, gutters or PV panels	Potential risk of falls from height at the edges of roof or through glazed roof lights in the sports hall or pool hall. General activity on the roof is contained within the plant enclosure areas	Restrict access to roof area with permit to work required with method statement for work. Barrier to areas outside of roof plant enclosure and to pool hall rooflights to prevent fall. Apply a fall prevention system for access where required	A, C	C, M

FIGURE 31:EXAMPLE OF WORD HAZARD/RISK SCHEDULE

We now integrate Health and Safety information into our BIM models in accordance with UK BIM Framework. This can be achieved by adding families to the project that contain hazards and risks information.

The Revit project template contains a “hazard family” that can be placed in the areas within the project where a hazard might occur.

The hazard family is a 3D object with four default types: compulsory action, prohibited action, residual risk warning, and significant information. A symbol is associated to each of these types in accordance with BSRIA document BG55/2018.

Every time that a hazard is identified the family should be placed in the model and populated with all the relevant information (e.g. the description of the hazard, the suggested action required, etc.).

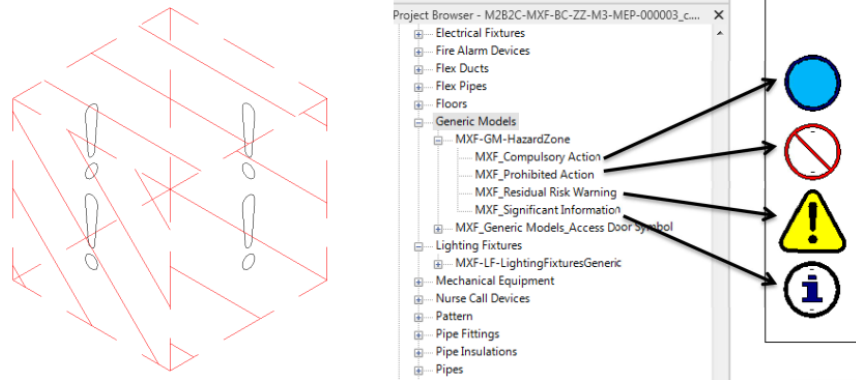


FIGURE 32 REVIT HAZARD FAMILY

The view templates in the Project Template are designed to show the hazard symbols only on the relevant views. For example, the hazard symbol only displays on the water layouts if the hazard is related to something happening in the water plantroom (as shown in the image below).

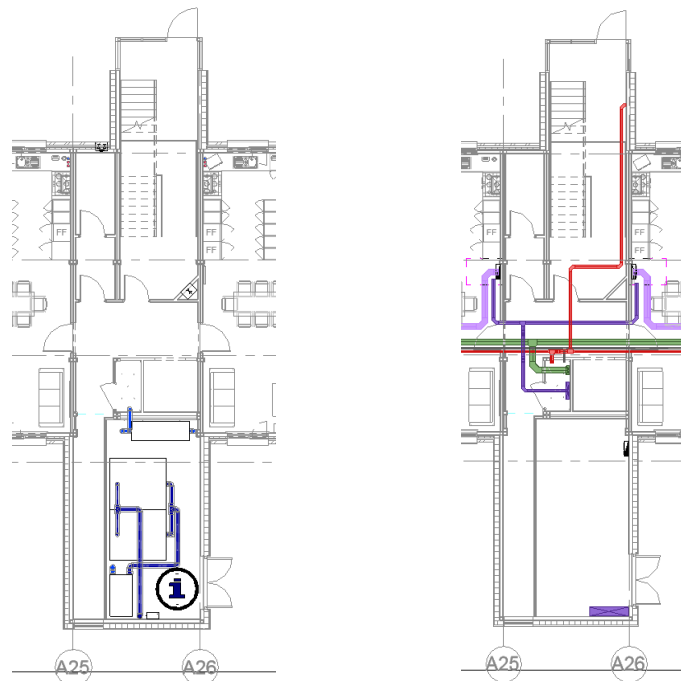


FIGURE 33 EXAMPLE HAZARD SYMBOL ON LAYOUTS

The Project Template also contains a Residual Risk schedule that can be exported once all the hazards have been specified on the drawings.

<000 - PM_80_60_70 - Residual Risk Schedule>								
Notes: 1.This schedule includes information about aspects of the services work covered under this contract that may affect the health and safety of persons involved in the construction, operation, maintenance or demolition of the work, or affected by it. It is provided in accordance with the Construction (Design and Management) Regulations 2015. 2.The possible actions are broadly indicative and are for general guidance. The relevant contractor shall inform the Principal Contractor of the general approach and specific action he/she intends to take to deal with each health and safety matter identified. Where the specific action proposed involves further design work, the relevant contractor shall also inform the Principal Designer. 3.This schedule should be read in conjunction with the Hazard/Access/Maintenance notes on drawings, and all other contract documents. 4.This schedule is only intended to highlight significant risks associated with the design that are i) not likely to be obvious to a competent contractor, ii) unusual, or iii) likely to be difficult to manage effectively. Contractors, or persons carrying out the works, are expected to identify and assess all other risks associated with the work.								
A	B	C	D	E	F	G	H	I
Type	Mark	Level	Space Name	Hazard Description	Hazard Category	Target Group	Suggested Action	Responsible Party
Compulsory Action								
CA	CA01	ZA_LGF_Lower	Car Park Plantroom	Flooding to car park	Electricity	Car park operator, public	Isolate power prior to flooding event	Car park operator
CA	CA02	ZA_LGF_Lower	LOWER GROUND PARKING - CO	Exposed gas pipework at high level	Harmful substances	Contractor, car park operator, public	Install to IGM UP2 including natural ventilation and welded joints. Isolate and inert gas fill, for tenant to	Contractor
CA	CA03	Z0_GF_Ground		Remote connection to Fire Alarm	Fire	Student accommodation operators	Fire alarm in Energy Centre and Student Refuse to be linked to B6 main building fire alarm system, as t	Contractor
CA	CA04	Z0_GF_Ground		Remote connection to Fire Alarm	Fire	Commercial operator	Fire alarm in Commercial Refuse and Covered Service Yard to be linked to B6 Management Suite whic	Contractor
Residual Risk Warning								
RRW	RRW06	ZA_RD_Road_D		Unconfirmed flow and pressure to new hydrant co	Fire	Fire fighters, operators, occupants	Schedule flow and pressure test with Water authority and for approval of fire officer	
Significant Information								
SI	SI01	ZH_03_Third_Fls	Corridor	Soil vents to atmosphere would be too close to ope	Disease and Health	Occupants	Use of air admittance valves at top of risers at grids B12 and C12	Contractor
SI	SI02	ZH_03_Third_Fls	Corridor	Soil vents to atmosphere would be too close to ope	Disease and Health	Occupants	Use of air admittance valves at top of risers at grids T12 and U12	Contractor
SI	SI03	ZA_LGF_Lower	LOWER GROUND PARKING - CO	Electric Vehicle Charging Point. Potential to flood	Electricity	Car park operator, public	Charging point to rear wall, where they are mounted high. Isolator at high level to allow isolation prior t	Contractor
SI	SI04	B6_GF_Ground	RETAIL C10	No fire strategy yet in place for phased occupation	Fire	Commercial Tenant, Student Accomodatio	Fire Engineer advises: The commercial units and the resi have independent escape. Their alarms do n	Client
SI	SI05	B6_GF_Ground	RETAIL C11	No fire strategy yet in place for phased occupation	Fire	Commercial Tenant, Student Accomodatio	Fire Engineer advises: The commercial units and the resi have independent escape. Their alarms do n	Client
SI	SI06	B6_GF_Ground	RETAIL C12	No fire strategy yet in place for phased occupation	Fire	Commercial Tenant, Student Accomodatio	Fire Engineer advises: The commercial units and the resi have independent escape. Their alarms do n	Client

FIGURE 34 RESIDUAL RISK SCHEDULE

Product Specification Schedules

One of the advantages of using a BIM software like Revit is the opportunity to exchange data with the model.

Schedules in Revit are a tabular display of information extracted from the properties of the elements in a project. Schedules can be placed on sheets and issued as part of your deliverables.

In the past we used to produce our product specification schedules in separate Word documents. The data contained in these documents was not structured and not easy to access. It was also more likely to have discrepancies as data was added to different documents and models and we didn't have a "single source of truth". With the introduction of Revit, we first started to manually add parameters to every object in the model and create schedules in Revit. This workflow was very time consuming and senior engineers were finding it difficult to check and modify product data within Revit. Also, there was a lot of wasted effort to create customized data sets on different projects.

We then decided to look at standard Product Data Templates (PDTs) that are available through the BIMHawk platform developed by CIBSE (Chartered Institution of Building Services Engineers). PDTs are lists of standard properties for each equipment type. We are currently collaborating with CIBSE to further develop the existing available PDTs.



Product Data Template

Pumps

Template Category	Pumps			
Template Version	v1			
Category Description	Devices for moving fluid to serve (or serving) a building services system			
Classification System				
Classification	Value			
Suitability for Use	Approved			
Template Custodian	CIBSE			
Information Category	Parameter Name	Value	Units	Notes
Manufacturer Data				
Specifications	Manufacturer		Text	
Specifications	Manufacturer Website		URL	
Specifications	Product Range		Text	
Specifications	Product Model Number		Text	or code
Specifications	CE Approval		Text	number, yes, no
Specifications	Approvals		Text	e.g. WRAS number
Specifications	Product Literature		URL	
Specifications	Features		Text	Free text to describe product
Construction Data				
Specifications	Application		Text	e.g. LTHV, CHV, etc.
Specifications	Pump Type		Text	e.g. End Suction, inline, Glandless, Vertical multistage etc.
Specifications	Configuration		Text	e.g. close coupled, long coupled, split coupled etc.
Specifications	Drive Type		Text	e.g. Direct, Belt, Integrated drive
Specifications	Casing Material		Text	e.g. cast iron, ductile iron, bronze etc.
Specifications	Impeller Material		Text	e.g. bronze, plastic etc.
Specifications	Shaft Material		Text	e.g. Stainless steel, brass etc.
Specifications	Shaft Seal Type		Text	e.g. carbon, silicon carbide etc.
Specifications	PN Rating		Text	e.g. as per ISO 7005
Specifications	Colour		Text	e.g. RAL Colour
Specifications	Finish		Text	e.g. polished, matt, gloss etc.
Specifications	Connection Type		Text	e.g. flanged, screwed etc.
Dimensional Data				
Specifications	Impeller diameter		mm	to be a range, user input
Specifications	Number of Impellers		Number	
Specifications	Suction Connection diameter		mm	

FIGURE 35 EXAMPLE CIBSE PRODUCT DATA TEMPLATE (PDT)

Once the PDTs are populated with the correct information, the data contained in the PDTs can then be pushed back into the Revit model.

We have an “import/export PDTs” tool that allows the user to select a family in Revit and the associated PDT so that the parameters can be transferred between the two.

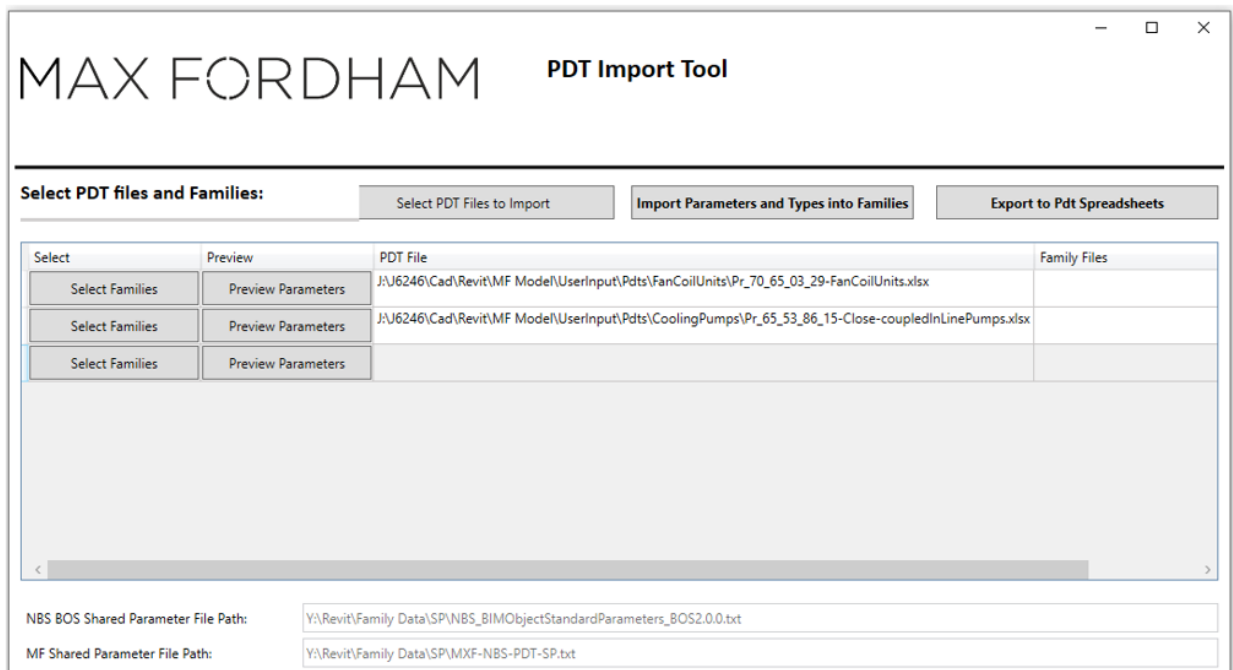

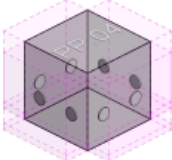


FIGURE 36 MAX FORDHAM IN-HOUSE TOOL FOR PDTs IMPORT/EXPORT

As we wanted to create schedules that are 'on brand' we have developed a second tool that allows us to export the schedules in a more customizable manner than Revit 'out of the box allows'. A version of this schedule output is shown below.

<h2>PP</h2>		<h3>TECHNICALDATA</h3>		<h3>TECHNICALDATA</h3>		<h3>TECHNICALDATA</h3>	
<h4>IDENTITYDATA</h4>		Hydraulic Performance Required Flow At The Guarantee Point TBC		Expected Noise Levels At The Guarantee PointTBC DB At1M		Operating Speed At Maximum Flow sdfasdf asdf sda	
TypeId	6963963	Hydraulic Performance Net Positive Inlet Pressure Available At The Guarantee Point TBC		Hydraulic Performance Net Positive Inlet Pressure Available TBC		Valves TBC	
MF_ElementId	7004020	Mode Of Operation TBC		Hydraulic Performance Overall Efficiency At The Minimum Flow TBC		Valves Adjustable Response To Hydraulic Fluctuations TBC	
Spaces	["109-Lounge";"3";" [unresolved space]";"1"]	Ancillary Connections Drain TBC		Hydraulic Performance Inlet Pressure At The Guarantee Point TBC		Utilisation TBC	
Type Mark	PP	Hydraulic Performance Differential Pressure At The Guarantee Point TBC		Drive System Rating Of Hydraulic Power Unit TBC		Operating Speed At Minimum Flow 1000 rpm	
<h4>DESCRIPTION</h4>		Standard TBC		Pump Unit Application LTHW System		Hydraulic Performance Required Flow Minimum TBC	
Manufacturer	Grundfos	Valves Material Copper		Ancillary Connections Inlet And Outlet Pressure Gauges TBC		Pump Body And Casing Material Aluminium	
Reference	PP.01	Diaphragm Material TBC		Drive System Type Of Mechanical Drive System TBC		Valves Double Inlet And Outlet Valves TBC	
Family	MXF-ME-Pump	Process Connection Details Inlet Connection TBC		Drive System asdfas dfasdf		Operating Speed 1800 rpm	
Model	HYDRO E Multi	Valves Type Of Valve TBC		Hydraulic Performance Outlet Pressure Minimum TBC		Process Connection Details Outlet Connection Nominal Bore TBC	
Type	Generic Pump	Drive System Type Of Drive System TBC		Hydraulic Performance Inlet Pressure Minimum TBC		Durability TBC	
Description	LTHW Pump	Process Connection Details Outlet Connection Flange Rating TBC		Drive System Adjustable Crank Stroke Facility TBC		Hydraulic Performance Net Positive Inlet Pressure Available At The Maximum Flow TBC	
<h4>Image</h4>		Ancillary Connections Vent TBC		Ancillary Connections TBC		Valves Quick Release Covers TBC	
		Process Connection Details TBC		Hydraulic Performance Overall Efficiency TBC		Hydraulic Performance Outlet Pressure Maximum TBC	
<h4>Model Image</h4>		Hydraulic Performance Required Flow Maximum TBC		Diameter Of Solid Sphere Required To Be Passed By The Pump Maximum TBC		<h4>NOTES</h4>	
		Operating Speed At The Guarantee Point TBC		Diaphragm Failure Protection Facilities TBC		MF_Instance_Notes	
		Hydraulic Performance Outlet Pressure At The Guarantee Point TBC		System Name LTHW F 22,LTHW R 24		Positioned close to the wall Care to be taken to allow access / maintenance	
		Process Connection Details Outlet Connection TBC		Process Connection Details Inlet Connection Flange Rating TBC		MF_Type_Notes	
				Vibration Requirements Isolation Mounting		Multi Stage LTHW Pump	
				Hydraulic Performance TBC			
				Drive System Method Of Oil Cooling TBC			
				Hydraulic Performance Inlet Pressure Maximum TBC			

Schedule Title: Pumps	Uniclass System: Ss_60_40 Space heating and cooling systems	MAX FORDHAM
Project Name: *EDIT IN PROJECT INFORMATION*		
Uniclass Product: Pr_65_53 Pump products		

FIGURE 37 EXAMPLE SCHEDULE OUTPUT

Clash Detection

When drawing in 2D, it is often taken for granted that some elements will be coordinated at a later stage. This is against the spirit of BIM because it postpones the coordination exercise until later, when it is generally more difficult and more expensive to fix.

When working in a 3D environment, clash avoidance needs to start before modelling in Revit. In fact, a clash **avoidance** strategy should be defined before a clash detection one. The coordination strategy of the MEP services should be agreed with the rest of the design team at the beginning of each project.

A common mistake is to start modelling without considering the Z dimension and thinking that MEP services can be easily moved at a later stage, thus resulting in several clashes.

Navisworks Manage

We use Navisworks Manage to evaluate our MEP model for clashes between MEP services themselves or with the architectural and structural models.

In order to run the clash detection on several projects in a more efficient way we produced some standard templates for Navisworks. In particular, we have clash tests and search sets templates that can be imported into different projects to avoid setting them up every time.

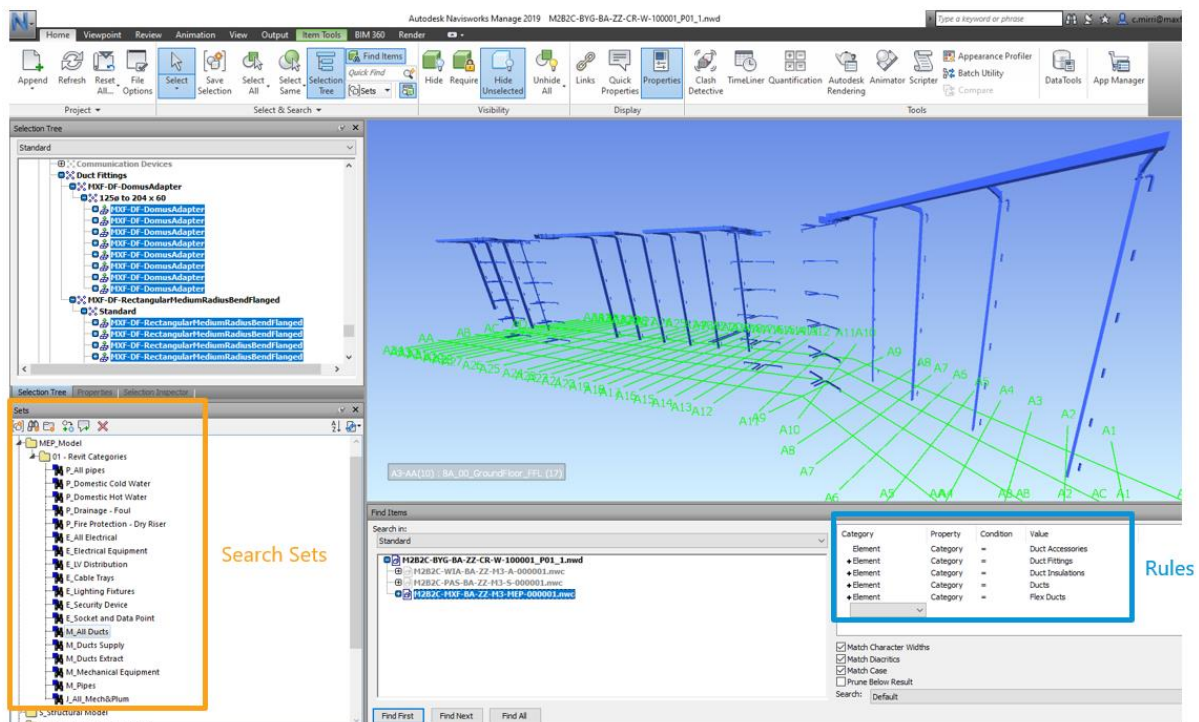


FIGURE 38 NAVISWORKS SEARCH SETS TEMPLATE

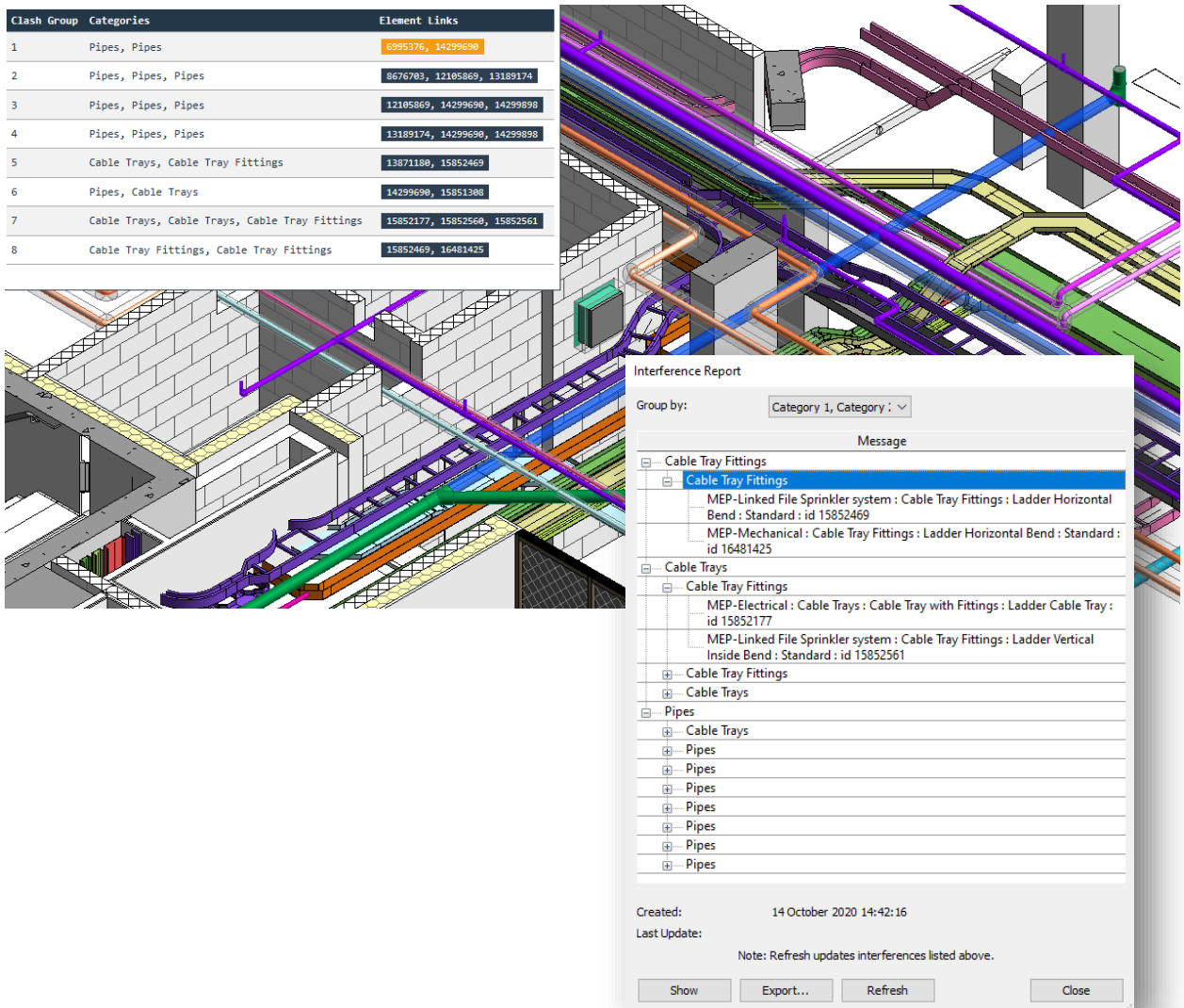
In-house Max Fordham Clash Finder Tool

We also developed an in-house pyRevit tool that allows engineers to run a quick clash detection within Revit without the need of exporting to external tools.

Our Clash Finder tool uses the Interference Check Report created in Revit to highlight the clashing element into clickable links for isolation in a view.

In the Interference Check Report, clashes can be counted multiple times because one element (e.g. a pipe) can clash with multiple other elements. The Clash Finder tool instead shows the clashes grouped by the items involved.

Clash Group	Categories	Element Links
1	Pipes, Pipes	6995376, 14299898
2	Pipes, Pipes, Pipes	8676783, 12185869, 13189174
3	Pipes, Pipes, Pipes	12185869, 14299690, 14299898
4	Pipes, Pipes, Pipes	13189174, 14299690, 14299898
5	Cable Trays, Cable Tray Fittings	13871180, 15852469
6	Pipes, Cable Trays	14299690, 15851388
7	Cable Trays, Cable Trays, Cable Tray Fittings	15852177, 15852568, 15852561
8	Cable Tray Fittings, Cable Tray Fittings	15852469, 16481425



Interference Report

Group by: Category 1, Category : ▾

Message

- [-] Cable Tray Fittings
 - [+] Cable Tray Fittings
 - MEP-Linked File Sprinkler system : Cable Tray Fittings : Ladder Horizontal Bend : Standard : id 15852469
 - MEP-Mechanical : Cable Tray Fittings : Ladder Horizontal Bend : Standard : id 16481425
- [-] Cable Trays
 - [+] Cable Tray Fittings
 - MEP-Electrical : Cable Trays : Cable Tray with Fittings : Ladder Cable Tray : id 15852177
 - MEP-Linked File Sprinkler system : Cable Tray Fittings : Ladder Vertical Inside Bend : Standard : id 15852561
 - [-] Cable Tray Fittings
 - [-] Cable Trays
- [-] Pipes
 - [-] Cable Trays
 - [-] Pipes
 - [-] Pipes
 - [-] Pipes
 - [-] Pipes
 - [-] Pipes
 - [-] Pipes
 - [-] Pipes

Created: 14 October 2020 14:42:16

Last Update:

Note: Refresh updates interferences listed above.

Show Export... Refresh Close

FIGURE 39 IN-HOUSE MAX FORDHAM CLASH FINDER TOOL

BIM Model QA Check

Everyone working on a project is responsible for performing quality control checks of their project information (BIM models) prior to sharing and issuing deliverables.

We were initially inspecting the BIM models manually by going through a checklist to assess, for example, if objects were assigned to the correct workset, if there were unplaced spaces or unresolved warnings, etc. Doing this manually was very time consuming and easily subject to errors.

We then decided to use a free tool available in the Autodesk BIM Interoperability Tools: the Autodesk Model Checker for Revit. This tool can automatically check your Revit model based on a set of BIM requirements and generate a compliance report.

The add-in comes with some default checksets that you can run. We implemented our own checklist file that includes some custom checks. This template file is saved on our internal network and can be used on all Max Fordham's projects with little modification.

We highly recommend implementing a QA process to avoid your BIM model being QA rejected once shared on a CDE platform.

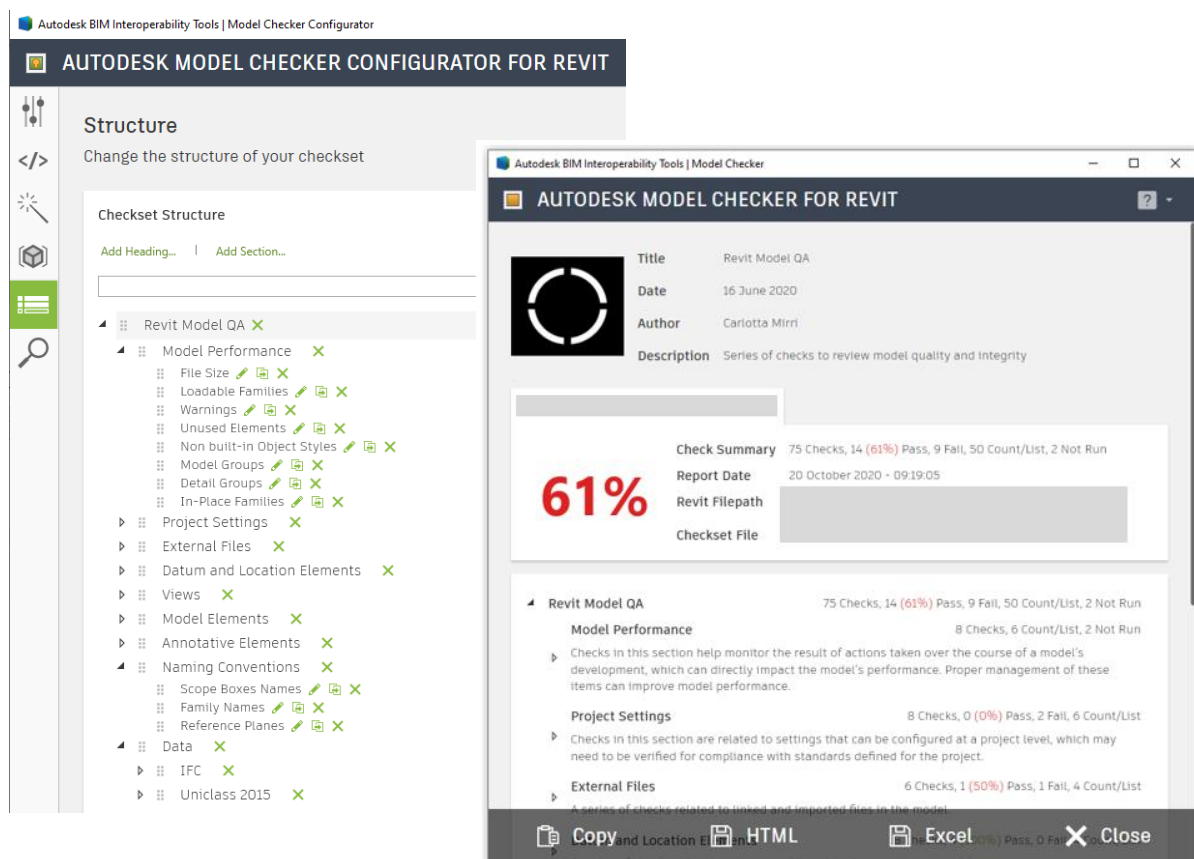


FIGURE 40 AUTODESK MODEL CHECKER

Tool Development

While delivering projects in Revit we identified a series of tasks that were repetitive and frequently subject to errors. We realized that automating these tasks would have improved our productivity and reduced mistakes.

In particular, the development of in-house tools allowed us to:

- Enhance the basic Revit tools and get the most out of them
- Automate boring and tedious tasks
- Reduce human error
- Increase efficiency

Since we have a lot of engineers working in Revit it wouldn't be economically feasible for us to give everyone access to third party tools. We also follow bespoke workflows that these third-party tools don't suit. Hence, the decision to develop in-house tools that replicate in-part the functionalities of third-party tools without locking us into their ecosystem.

At the beginning we used both Dynamo and pyRevit to develop our scripts. While Dynamo is a visual programming language, pyRevit is an open source add-in for Revit that allows Python scripts to access Revit functions and data.

More recently, we have been focusing on developing tools with pyRevit for two main reasons:

- We found Dynamo more difficult to deploy to such a large number of users
- We liked the idea that pyRevit allows you to create Python scripts and add them directly to a Ribbon in Revit.

Max Fordham In-House Toolbar (MF Tools)

We currently have more than 70 tools that form our Max Fordham toolbars.

These are organized in 3 tabs according to their intended use: data management tools, automated modelling tools and document management tools.

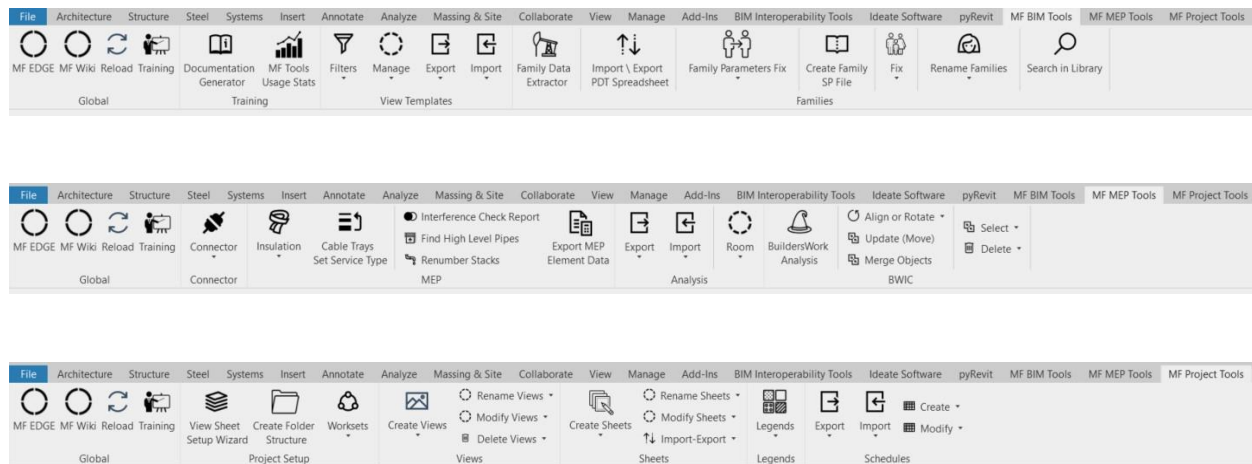


FIGURE 41 MAX FORDHAM IN-HOUSE TOOLBAR

Model management tools

We created a set of tools to help manage data in families and view templates. These tools allow you, for example, to copy parameters across families, remove unwanted parameters, export families and view templates properties, rename families according to our naming convention, etc

The example below shows how the view template properties can be exported to an Excel file for checking. The Excel file can then be re-imported in Revit to update the view template properties:

View Template ID	View Template Name	Filter ID	Filter Name	Categories	Visibility	HalfTone	Line Weight	Line Colour	Fill Colour	Fill Pattern	Transparency	Filter Rules
1	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	513355	Ventilation - General Supply	Duct Placeholders ,	TRUE	FALSE	-1	125 0 255	0 125 255	1		40 [Duct Placeholder
2	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	513356	Ventilation - General Extract	Duct Placeholders ,	TRUE	FALSE	-1	255 0 255	255 0 255	1		40 [Duct Placeholder
3	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	513357	Ventilation - General Exhaust	Duct Placeholders ,	TRUE	FALSE	-1	125 125 125	125 125 125	1		40 [Duct Placeholder
4	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	513361	Piped Service - Domestic Boosted Cold Water	Pipe Placeholders ,	TRUE	FALSE	-1	0 63 255	0 63 255	1		20 [Pipe Placeholder
5	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	513362	Piped Service - Domestic Hot Water Flow	Pipe Placeholders ,	TRUE	FALSE	-1	255 0 40	255 0 40	1		20 [Pipe Placeholder
6	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	718753	Ventilation - Kitchen Extract	Duct Placeholders ,	TRUE	FALSE	-1	255 0 255	255 0 255	1		40 [Duct Placeholder
7	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	718764	Electrical - Fire	Center line , Center	TRUE	FALSE	-1	255 16 16	255 16 16	1		20 [Center line , Ce
8	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	718765	Electrical - Telecom	Center line , Center	TRUE	FALSE	-1	125 125 125	125 125 125	1		20 [Center line , Ce
9	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	719111	Piped Service - Drainage Foul	Pipe Placeholders ,	TRUE	FALSE	-1	125 125 125	125 125 125	1		20 [Pipe Placeholder
10	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	719114	Piped Service - Fire Protection Wet Riser	Pipe Placeholders ,	TRUE	FALSE	-1	125 0 91	125 0 91	1		20 [Pipe Placeholder
11	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	719118	Piped Service - Gas	Pipe Placeholders ,	TRUE	FALSE	-1	255 0 255	255 0 255	1		20 [Pipe Placeholder
12	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	719120	Piped Service - CAT 5 Irrigation	Pipe Placeholders ,	TRUE	FALSE	-1	125 51 84	125 51 84	1		20 [Pipe Placeholder
13	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	719135	Piped Service - Chilled Water Flow	Pipe Placeholders ,	TRUE	FALSE	-1	125 0 255	125 0 255	1		20 [Pipe Placeholder
14	500 - Pr - ZDP - J30 - Ss_95_00_00_00 - Combined Services	719136	Piped Service - Chilled Water Return	Pipe Placeholders ,	TRUE	FALSE	-1	125 0 255	125 0 255	1		80 [Pipe Placeholder

FIGURE 42 VIEW TEMPLATE PROPERTIES EXPORT TOOL

Automated Modelling Tools

In the MEP tab of our Max Fordham toolbar there are a set of tools to automate time consuming modelling tasks.

The “insulation tool”, for example, allows you to automatically add the insulation to all the pipework/ductwork in your project. The user specifies the building type, pipe system, pipe and insulation materials and the script defines the correct insulation thickness for each pipe based on a database. The database can be modified on a project-by-project basis.

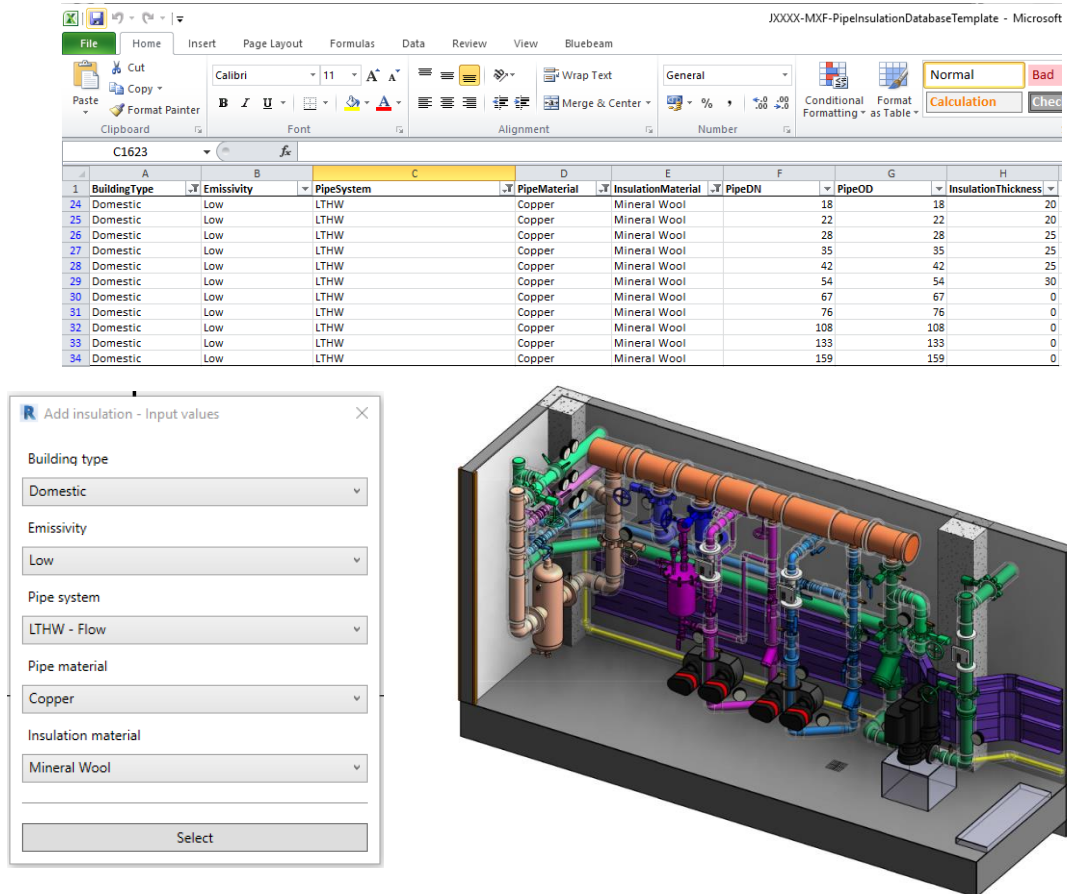


FIGURE 43 INSULATION TOOL

In the MEP tab we also have a set of tools for placing builder's work holes (BWIC). The user can automatically add the builder's work holes to all MEP elements in the model or to a selection of elements only. The builder's work holes will be sized based on the size of the pipe/duct/cable tray, the thickness of the insulation (if applicable) plus a margin. Each BWIC is colored to identify the different services passing through them. If an MEP object is moved, the relative BWIC will move accordingly.

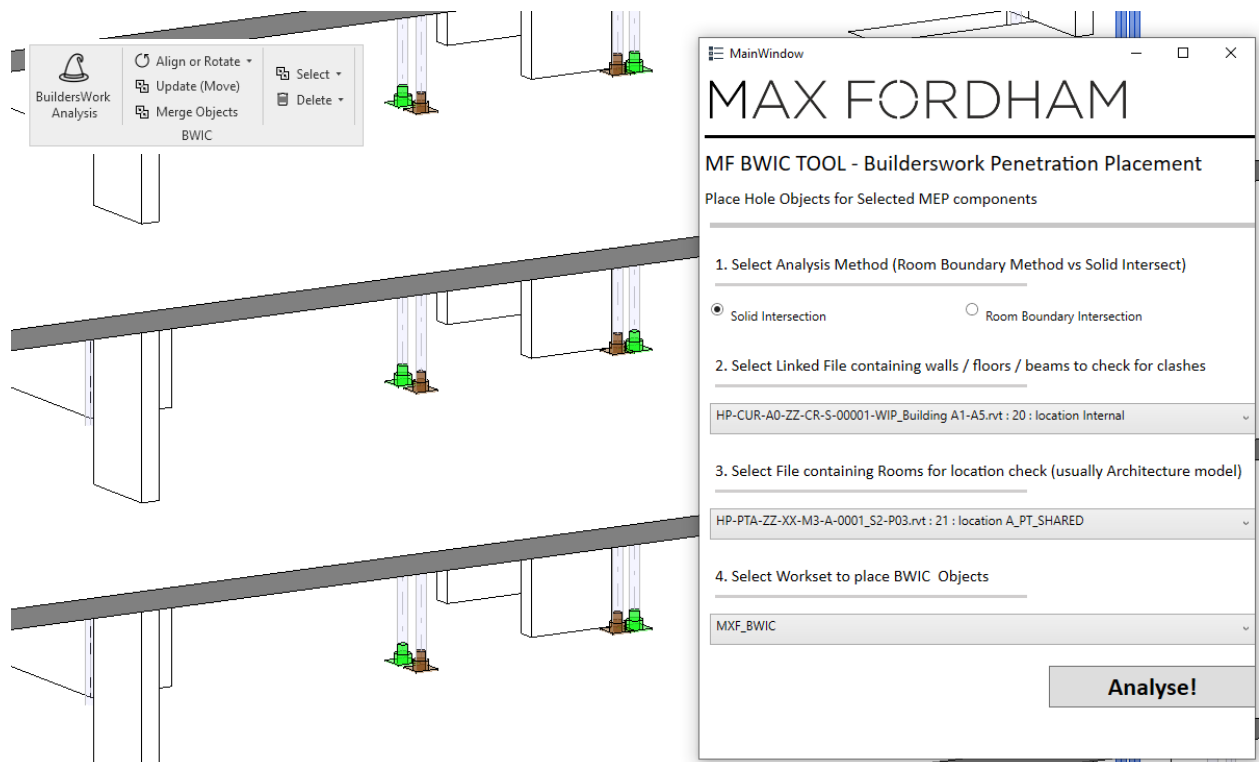
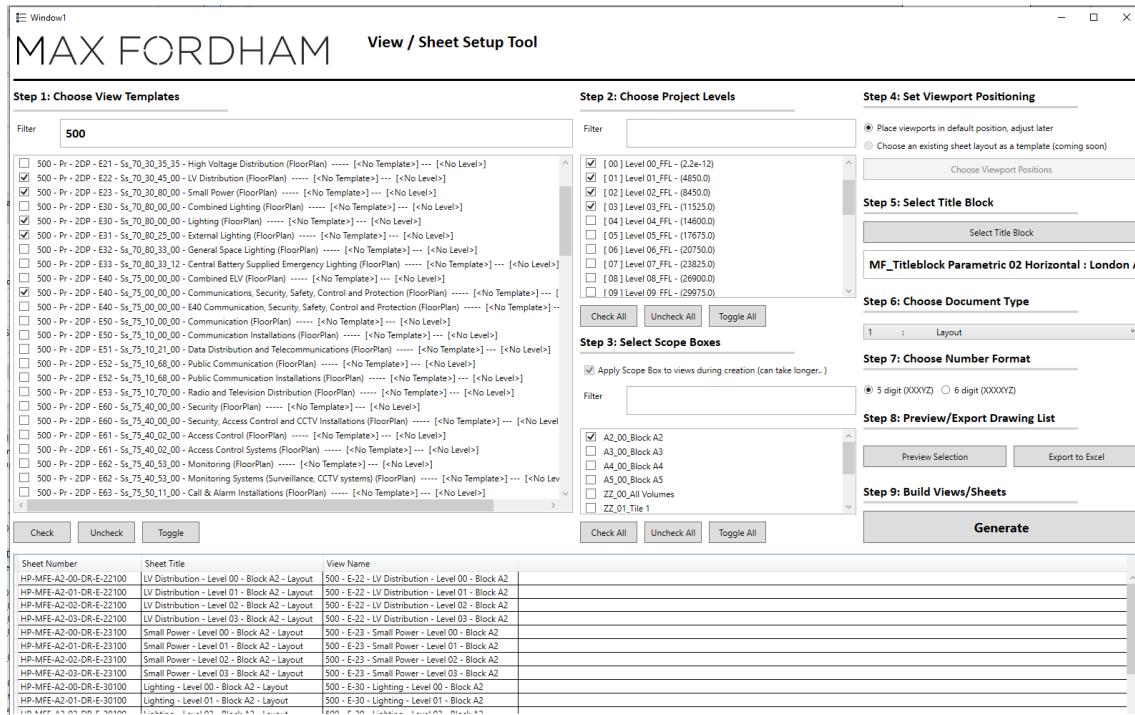


FIGURE 44 BUILDER'S WORK HOLE TOOL

Document Management Tools

We have several tools to aid with the management of views, sheets and legends.

In particular, our “View / Sheet Setup Wizard” tool is designed to create a set of views and sheets in bulk. The views created are automatically placed on the sheets and both views and sheets are named according to our naming convention that follows the ISO 19650-2 National Annex standard.



MAX FORDHAM View / Sheet Setup Tool

Step 1: Choose View Templates

Filter: 500

☐ 500 - Pr - ZDP - E21 - Ss_70_30_35_35 - High Voltage Distribution (FloorPlan) ----- [No Template] --- [No Level]

☒ 500 - Pr - ZDP - E22 - Ss_70_30_45_00 - LV Distribution (FloorPlan) ----- [No Template] --- [No Level]

☒ 500 - Pr - ZDP - E23 - Ss_70_30_80_00 - Small Power (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E30 - Ss_70_80_00_00 - Combined Lighting (FloorPlan) ----- [No Template] --- [No Level]

☒ 500 - Pr - ZDP - E30 - Ss_70_80_00_00 - Lighting (FloorPlan) ----- [No Template] --- [No Level]

☒ 500 - Pr - ZDP - E31 - Ss_70_80_25_00 - External Lighting (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E32 - Ss_70_80_33_00 - General Space Lighting (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E33 - Ss_70_80_33_12 - Central Battery Supplied Emergency Lighting (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E40 - Ss_75_00_00_00 - Combined ELV (FloorPlan) ----- [No Template] --- [No Level]

☒ 500 - Pr - ZDP - E40 - Ss_75_00_00_00 - Communications, Security, Safety, Control and Protection (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E50 - Ss_75_10_00_00 - Communication (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E50 - Ss_75_10_00_00 - Communication Installations (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E51 - Ss_75_10_21_00 - Data Distribution and Telecommunications (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E52 - Ss_75_10_68_00 - Public Communication (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E52 - Ss_75_10_68_00 - Public Communication Installations (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E53 - Ss_75_10_70_00 - Radio and Television Distribution (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E60 - Ss_75_40_00_00 - Security (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E60 - Ss_75_40_00_00 - Security, Access Control and CCTV Installations (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E61 - Ss_75_40_02_00 - Access Control (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E61 - Ss_75_40_02_00 - Access Control Systems (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E62 - Ss_75_40_53_00 - Monitoring (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E62 - Ss_75_40_53_00 - Monitoring Systems (Surveillance, CCTV systems) (FloorPlan) ----- [No Template] --- [No Level]

☐ 500 - Pr - ZDP - E63 - Ss_75_50_11_00 - Call & Alarm Installations (FloorPlan) ----- [No Template] --- [No Level]

Step 2: Choose Project Levels

Filter:

☒ [00] Level 00_FFL - (22e-12)

☒ [01] Level 01_FFL - (4850.0)

☒ [02] Level 02_FFL - (4850.0)

☒ [03] Level 03_FFL - (11525.0)

☐ [04] Level 04_FFL - (114600.0)

☐ [05] Level 05_FFL - (17675.0)

☐ [06] Level 06_FFL - (20750.0)

☐ [07] Level 07_FFL - (23825.0)

☐ [08] Level 08_FFL - (26900.0)

☐ [09] Level 09_FFL - (29975.0)

Step 3: Select Scope Boxes

☒ Apply Scope Box to views during creation (can take longer.)

Filter:

☒ A2_00_Block A2

☐ A3_00_Block A3

☐ A4_00_Block A4

☐ A5_00_Block A5

☐ ZZ_00_All Volumes

☐ ZZ_01_Title 1

Step 4: Set Viewport Positioning

☒ Place viewports in default position, adjust later

☐ Choose an existing sheet layout as a template (coming soon)

Step 5: Select Title Block

Select Title Block

MF_Titleblock Parametric 02 Horizontal : London

Step 6: Choose Document Type

1 : Layout

Step 7: Choose Number Format

☒ 5 digit (0000Y2) ☐ 6 digit (0000Y2)

Step 8: Preview/Export Drawing List

Preview Selection Export to Excel

Step 9: Build Views/Sheets

Generate

Sheet Number	Sheet Title	View Name
HP-MFE-A2-00-DR-E-22100	LV Distribution - Level 00 - Block A2 - Layout	500 - E-22 - LV Distribution - Level 00 - Block A2
HP-MFE-A2-01-DR-E-22100	LV Distribution - Level 01 - Block A2 - Layout	500 - E-22 - LV Distribution - Level 01 - Block A2
HP-MFE-A2-02-DR-E-22100	LV Distribution - Level 02 - Block A2 - Layout	500 - E-22 - LV Distribution - Level 02 - Block A2
HP-MFE-A2-03-DR-E-22100	LV Distribution - Level 03 - Block A2 - Layout	500 - E-22 - LV Distribution - Level 03 - Block A2
HP-MFE-A2-00-DR-E-23100	Small Power - Level 00 - Block A2 - Layout	500 - E-23 - Small Power - Level 00 - Block A2
HP-MFE-A2-01-DR-E-23100	Small Power - Level 01 - Block A2 - Layout	500 - E-23 - Small Power - Level 01 - Block A2
HP-MFE-A2-02-DR-E-23100	Small Power - Level 02 - Block A2 - Layout	500 - E-23 - Small Power - Level 02 - Block A2
HP-MFE-A2-03-DR-E-23100	Small Power - Level 03 - Block A2 - Layout	500 - E-23 - Small Power - Level 03 - Block A2
HP-MFE-A2-00-DR-E-30100	Lighting - Level 00 - Block A2 - Layout	500 - E-30 - Lighting - Level 00 - Block A2
HP-MFE-A2-01-DR-E-30100	Lighting - Level 01 - Block A2 - Layout	500 - E-30 - Lighting - Level 01 - Block A2

FIGURE 45 VIEW / SHEET SETUP WIZARD TOOL

This tool is not only automating a very time-consuming task, but it also ensures that the information produced complies with the BIM standards. The data used to compose the sheet number and name string is taken from the information contained in the view template, levels and scope boxes as shown in the image below.

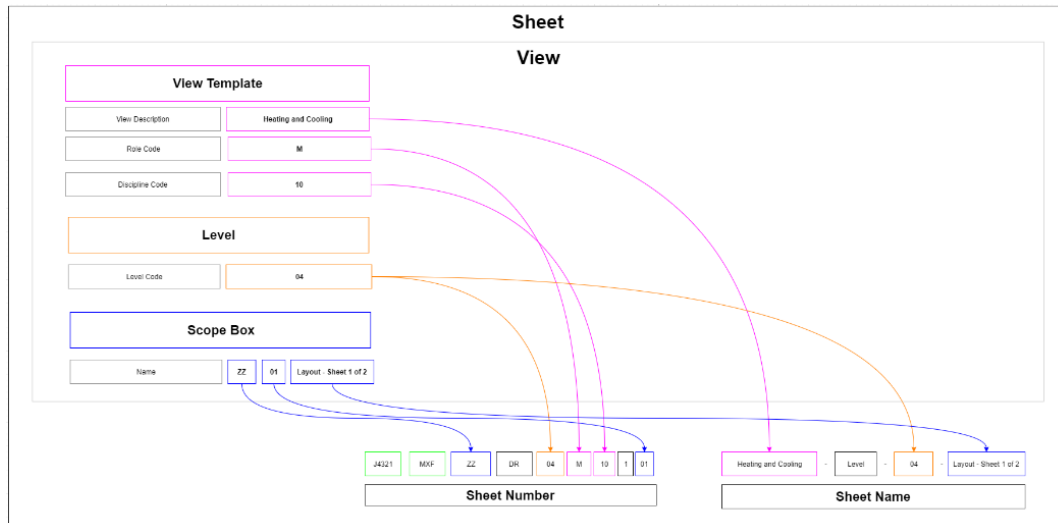


FIGURE 46 SHEET NUMBER AND NAME COMPOSITION

last five years. The number of current projects each year has increased from around 30% to 75%. When we restrict this to the top 100 projects by fee earned in the latest year, this percentage increases again to over 80% as it excludes all feasibility studies and other projects where we don't produce drawings.

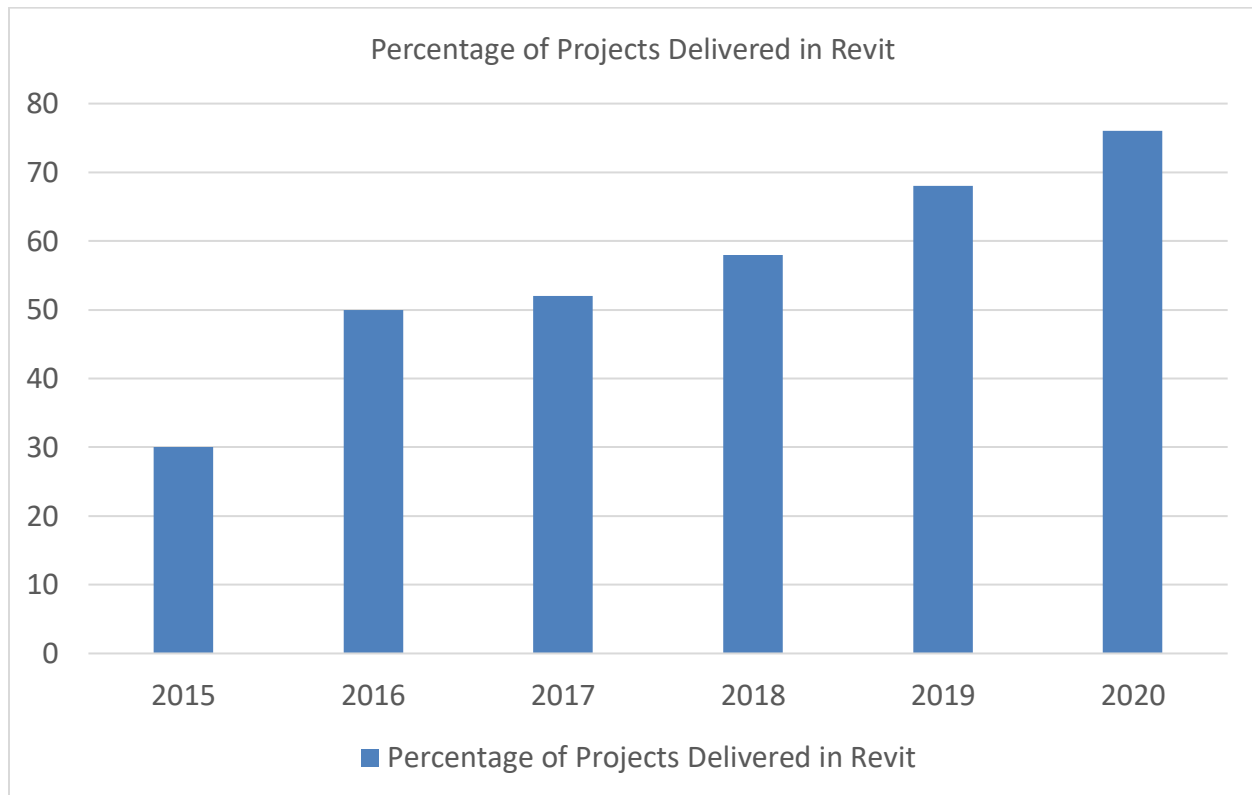


FIGURE 48: PERCENTAGE OF PROJECTS DELIVERED IN REVIT BY YEAR

Along with the central content developed, the pyRevit tools have had a big impact on the Revit experience. While we have estimated the cost of creating these tools to be in the region of £35k and have an ongoing annual maintenance and improvement cost of £10k (which will only increase as we produce additional tools), the usage data we have for the tools shows that they have been used over 9000 times in the last year. We estimate this is a saving of over 14,000 engineering hours equating to a cost saving of £250 - £300k.

The efficiency achieved through the better support and training, the improved central development and the automation tools has been reflected in the increase in the turnover achieved per engineer. Since 2015, the turnover per engineer has increased by around 23%. While not all of this increase in productivity can be attributed to the Revit development, it has been a major contributing factor.

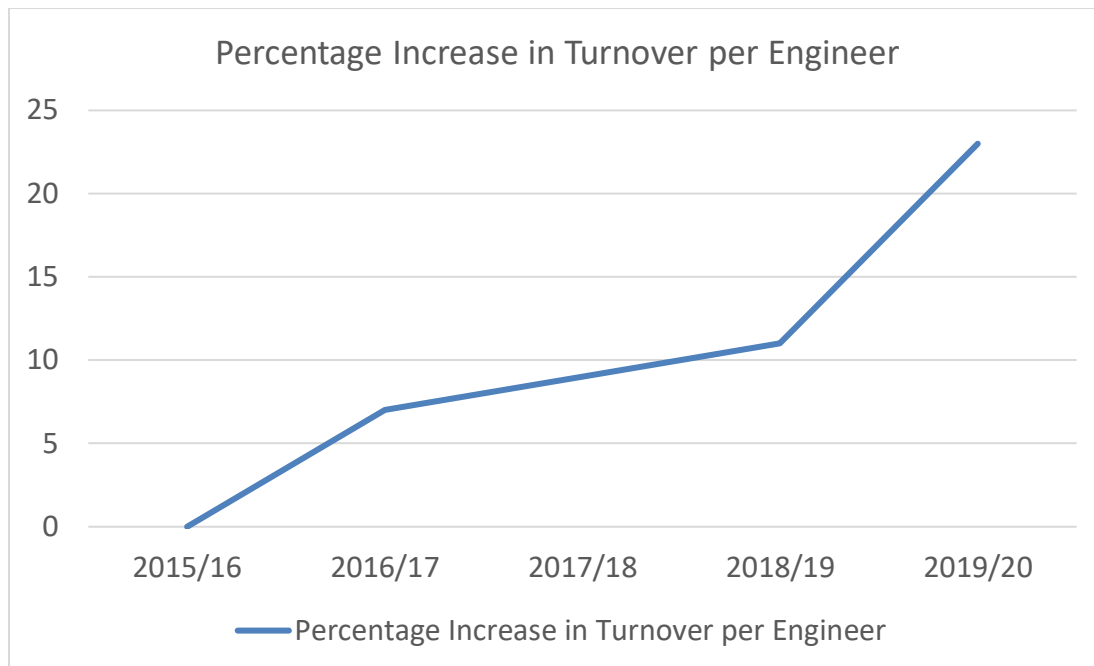


FIGURE 49: PERCENTAGE INCREASE IN TURNOVER PER ENGINEER SINCE THE FINANCIAL YEAR 2015/16

Future Developments

Licensing Arrangements

Up to now we have relied on multiuser licenses to enable us to have the volume of Revit users within the Practice. We currently have we need a ratio of approximately 1:4 between licenses and users. With the changes Autodesk have made to their licensing options (removing the multiuser option) we are currently exploring how we can keep the delivery ethos we currently have without doubling the cost of our Autodesk licenses. We haven't fully worked through what this will look like going forward, but we expect it will be a combination of some different workflows and potentially some other technology for those without access to Revit to better interact with the model.

Further Improved Workflows

With the change in licensing mentioned above, over the next few months we will be looking at how we can adapt our workflows to enable us to deliver our projects with fewer engineers having access to Revit.

We also want to improve workflows between ourselves, clients and collaborators. For example, we are keen to develop our workflows around room data sheets and integrating the acoustic, sustainability and net zero carbon requirements/targets in such a way that it allows for easier and better tracked communication with everyone involved in the project.

Further Central Content

We are always looking at how we can extend our content libraries. Our focus in the near future is going to be on extending our 3D arrangement library.

Improved Workflows

Again, we are always assessing how we can achieve further efficiencies and quality gains through improved workflows. One area of workflows we would like to improve is those around our collaboration with other design team members.

Further Automation

We are always looking at new ways in which we can automate our processes. We want to explore whether it is possible to automate the placement of equipment families within spaces for example, based on the data inputted to space parameters, i.e. the number of power sockets noted within the room data sheet parameter is linked to the number of that family placed in the space.

Data Analytics

One of the biggest areas we will be focusing on developing is the use of data. Now that we are starting to collate structured data, we want to look at how we can aggregate and use this data to inform future design decisions and, automate processes such as reviewing technical submittals supplied by the subcontractors (through the structured PDTs).

Summary

In summary, the key messages that we have taken away from the last 10 years are:

- Revit is complex but offers lots of functionality and opportunities. There is a higher barrier to adoption than with something like AutoCAD but the benefits far outweigh this if you invest in your transition and adoption.
- We would recommend gradually building up your content and templates – every little helps
- We have spent relatively small amounts of money developing this content compared with the multinational companies. We have done this by learning from others and developing those areas where we will get the largest benefit.
- Those in the industry are more than happy to talk about their journey and help out where possible. There are also lots of webinars and tips and tricks available to learn from on the internet.
- Don't worry too much about making mistakes; don't allow yourself to become crippled with fear!
- Planning out a strategy that works best with your brief is key while also taking the time to plan out the standards to be followed for your development.
- Look at ways in which you can provide targeted and ongoing training and support.

We hope this handout along with the Industry Talk have been helpful. We would love to answer any questions you have along with hear any feedback you have, please get in touch! Otherwise, happy Reviting!