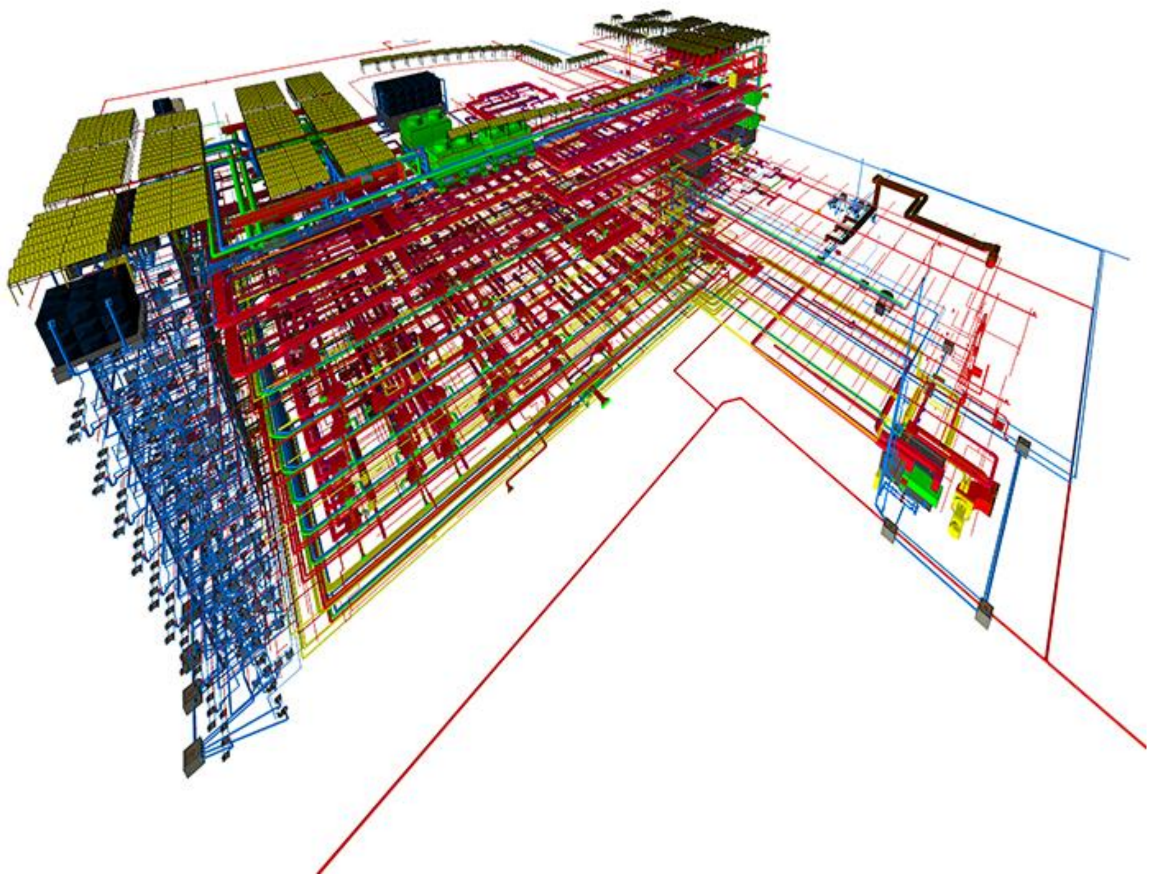
Building and Construction Authority

BIM Essential Guide

For MEP Consultants



BCA acknowledges the leadership provided by the BIM Steering Committee in support of the production of the BIM Essential Guides

The BIM Essential Guides have been drafted by the Centre for Construction IT on behalf of BCA and the BIM Steering Committee.

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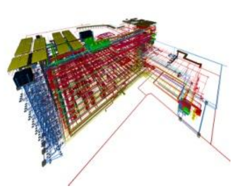

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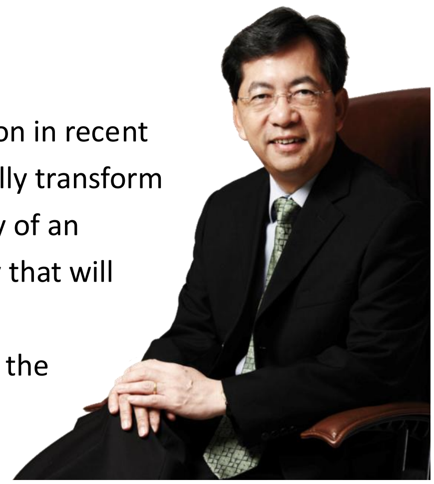
CEO's Message

Dear readers,



Building Information Modelling (BIM) has gained much traction in recent years as digital construction technology that will fundamentally transform the building and construction industry practice in the delivery of an excellent built environment. It is a game changing technology that will improve the construction productivity as well as the level of integration and collaboration across the various disciplines in the construction value chain. It is therefore important for the industry to embrace the technology with clarity.

The BIM Essential Guides are part of the industry's efforts to demystify BIM and to give clarity on the requirement of BIM usage at different stages of a project.

Under the leadership of the BIM Steering Committee chaired by Er Lee Chuan Seng, Emeritus Chairman, Beca Carter, and comprising of leaders in BIM, the BIM Managers Forum has contributed much time and effort to compile the various best practices to make this Guide possible over a short span of time. We would like to thank them for their contribution.

We hope that every BIM user can truly reap the benefits of BIM by integrating it into his/her day-to-day workflow – from feasibility study to facility management. We hope that BIM users can use these guides as a platform to jumpstart their BIM adoption, before they leap to greater heights, innovating and transforming their workflow.

BIM is a journey. We envisage that it will grow with time and will inspire more advanced and innovative use of BIM. I would like to encourage all BIM practitioners to join in this industry effort to grow this Guide into a wealth of BIM knowledge.

Dr John Keung

ACKNOWLEDGEMENTS

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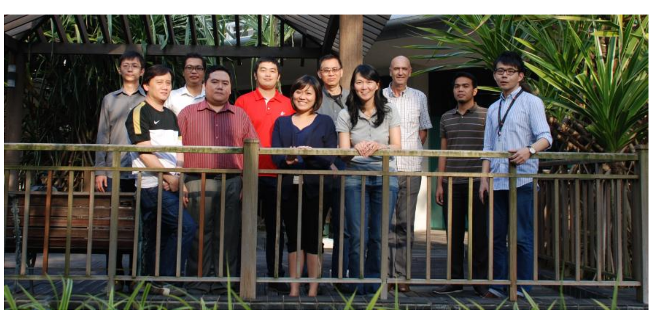


OBJECTIVES

The objective of this Guide is to assist MEP (Mechanical, Electrical and Plumbing) BIM users to develop BIM model(s) for new or and A&A project. It shows the possible use-cases of BIM at various design stages of the project.

This is a general document that covers a few typical buildings and is not an extensive document that covers all scenarios that might arise based on specific projects. Users are allowed to edit/change accordingly to suit their needs.

This document is not based on any specific software. This document does not cover the explanation and steps on how to use the software. For the steps and explanations of specific software, please refer to the software help or user manual.

Based on the project requirement, type and time line choose the BIM use and implement in the project.

Suggested Deliverables

STAGE	SUGGESTED DELIVERABLES (MEP ONLY)
1. Preparation & Conceptual Design	a. Understanding Client's Requirements b. BIM Execution Plan c. MEP Concept Report which includes simple schematic, relevant design codes and etc.
2. Schematic Design	a. Preliminary Model based on Architectural massing models b. MEP Schematic Design Report which includes design criteria and prelim design calculation. c. Schematic Drawings
3. Detailed Design	a. Detailed Design Drawing + Model b. MEP Detailed Design Report which includes updated design criteria and design calculation c. Clash detection & resolution report between MEP model and Architect & Structure models d. Detailed cost estimate, BOQ, tender documents
4. Construction	N/A
5. As Built	N/A
6. Facility Management	N/A

Note: Regulatory BIM e-submissions are excluded from the above list because the timing of submission may vary due to individual project requirements.

Preparation & Conceptual Design

UNDERSTANDING CLIENT'S REQUIREMENTS

- Identify project brief
- Identify sustainability aspirations

Both the client and project team should reach an understanding on the purpose of BIM to fulfil Client's Requirements.

Example questions to clarify the Client's Requirements.

- What are the overall goals in this BIM project?
- What are the specific goals that have to be achieved by BIM in this BIM project?
- What are the possible ways to achieve the specific BIM goals?
- Is the client aware and agreeable that the design team may use a different way to achieve the specific BIM goals?

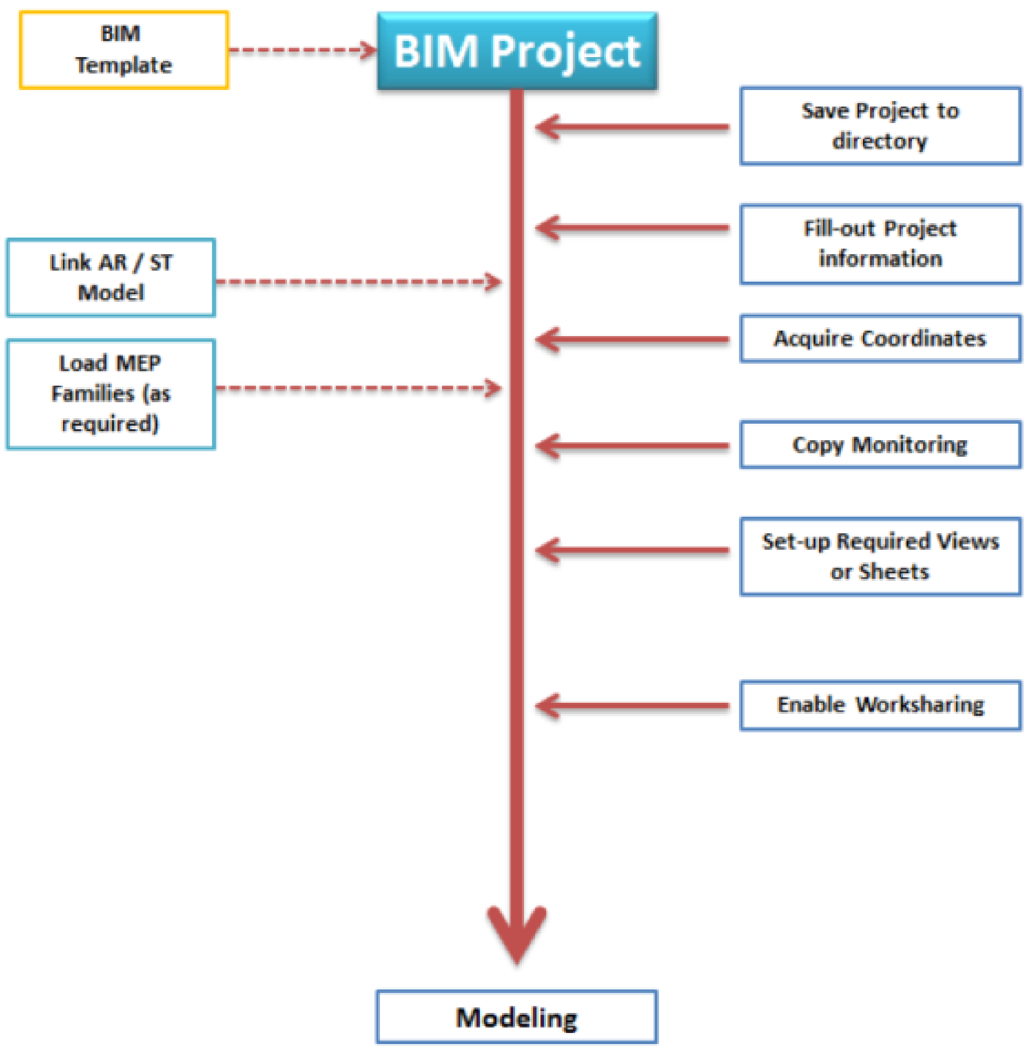
The preliminary BIM MEP Model can be created from the Architectural BIM model and serves as a preparation for the Detailed Design stage. Before starting the actual modelling, it is recommended to go through proper planning and preparation.

PROJECT SET-UP

Factors to be considered before starting a BIM Project:

- Client's requirements as stated in the BIM execution plan
- Agreed software platform and version for the project

Typical Project Set-up Workflow



Legend: AR – Architectural Model

ST – Structural Model

Load Template

Load MEP BIM Template before the start of a new project. The template should include company standards from the following 4 MEP sub-disciplines:

- Air-Conditioning and Mechanical Ventilation ACMV (Services)
- Plumbing and Sanitary Services
- Fire Protection Services
- Electrical Services

Project Information

Each project file should include the following project information:

- Project Status
- Client Name
- Project Address
- Project Name
- Project Number
- Project location
- Other optional project information: e.g. Design Engineer etc.

Building Services Additional Data:

- Building Services type (i.e. VAV – Single Duct)
- Building Construction (Defines default Building Construction)
- Building Infiltration Class (Defines Building Construction leakage)
- Report Type (Defines type of Analysis report generated)
- Ground Plan (Project level associated to Site Ground level)
- Project Phase (Defines what phase of the project is being analyzed)
- Sliver Space Tolerance (Defines riser and shaft tolerances for the space)

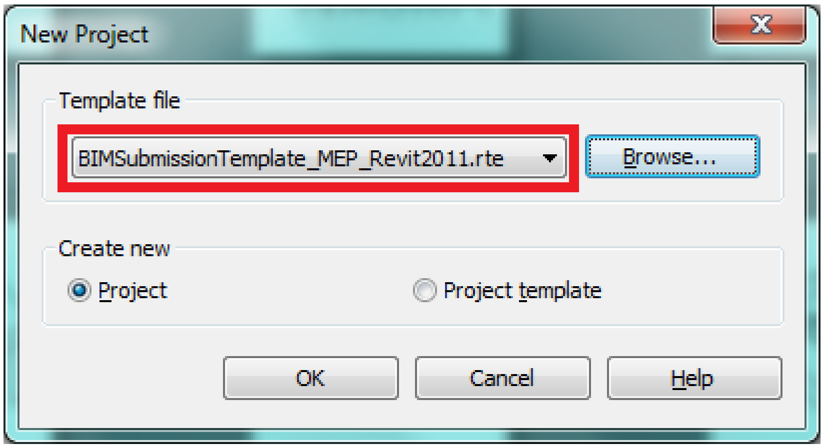
ARCHITECTURAL MODEL VALIDATION

Check the coordinate of the Architectural model. Make sure both MEP and Architectural models has the same coordinate before linking. The basic elements required from the Architectural model are as follows:

- Raised Floor
- False Ceiling
- Grids
- Levels
- Plumbing Fixtures
- Slab
- Wall
- Services, Risers
- The elements should be placed realistically on the architectural plan for proper modelling of required MEP systems

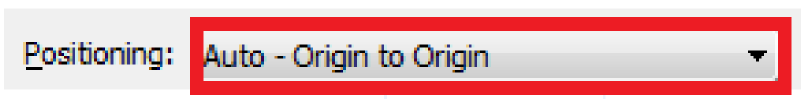
Example for Revit MEP BIM Users

1) Load project template



An example of MEP template can be found at http://bimsg.wordpress.com/singapore-guide/e-submission/ . It is designed for MEP BIM e-submission.

2) Link architectural model



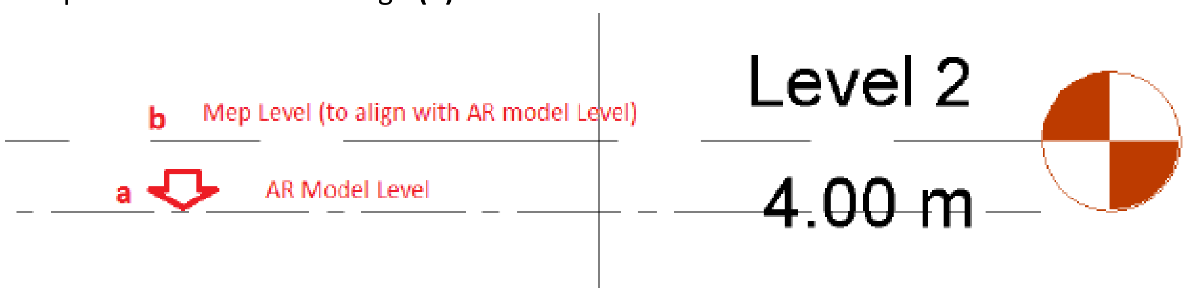
Note: Using Origin to Origin Positioning option to place MEP model at the same position as the Architectural model

Preparing MEP Model

Make sure that the MEP and Architectural levels are aligned. This can be done through the following steps for Revit MEP users.

a. Open one of the elevation views of the model by right–clicking and select **Go to Elevation View**

b. Open the **Modify Tab** of the select **Align tool**. Pick the Architectural model level **(a)** first, then pick the MEP Level to align **(b)**. See below.



c. **Lock** the MEP level to the AR level by clicking the Lock Icon that appears in the view. This is to monitor any future changes to the floor height of the project

Sheets Set-up

Basic title blocks and sheets are already created as part of BCA MEP e-Submission Template. New sheets can be created through the following steps:

a. Go to **View** Tab and select **Sheet**

b. Choose the right **Title Block** to be used for the new sheet

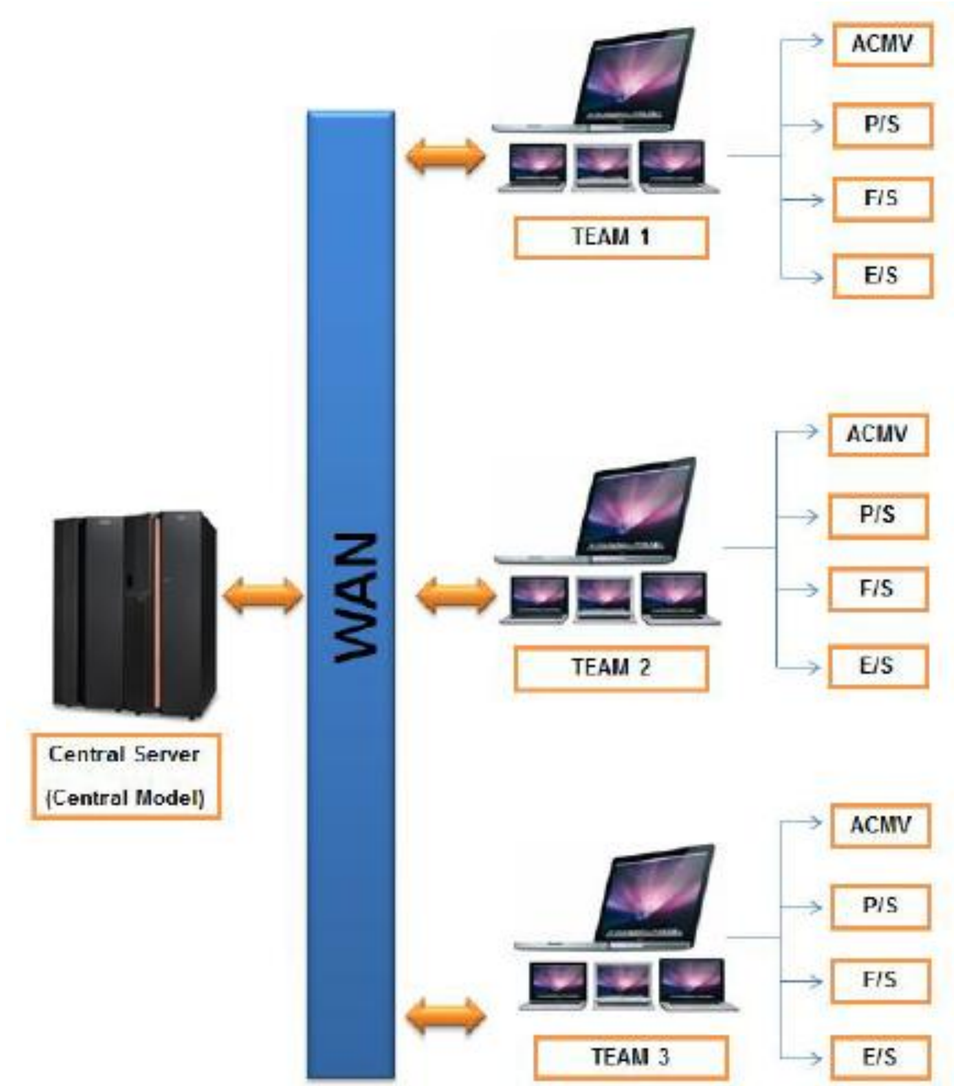
Modelling Plan

A project model should be carefully divided into manageable sizes based on the project complexity or size. This can be done through **Worksharing** and **Linking Models** for Revit Users.

Worksharing

This is applicable for bigger projects that need to be done by more than one BIM modeller. The Worksharing function must be enabled.

Work Sharing Workflow



Members could name the file they are working on with the following naming convention.

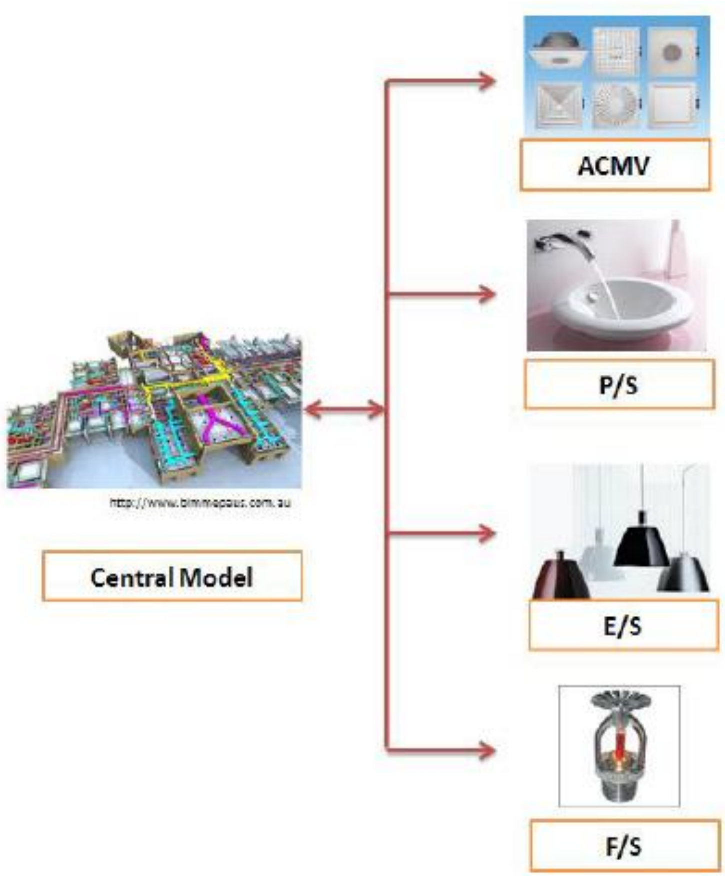
WORKSET NAME ELEMENTS ASSIGNED TO WORKSET

ES	Electrical sub-discipline elements	**SN**	Sanitary sub-discipline elements
FP	Fire sub-discipline elements	**PL**	Plumbing sub-discipline elements
ACMV	Mechanical sub-discipline elements	**PF**	Plumbing Fixture sub-discipline elements
GAS	Gas sub-discipline elements		

Linking Models

This is the most common method for projects where the individual models of each sub-discipline in a project are created. This is more applicable for smaller projects where tasks can be done without too much coordination effort. Elements will be placed in the model and can be coordinated within the sub-discipline itself. Models will then be linked for coordination with other sub-disciplines within the central file.

Linking Model Workflow



STARTING THE MODEL

Once the project set-up has been done, file will copied for each sub-discipline.

Coordinating MEP Elements Using Link

Individual sub-discipline models will be linked one by one to a Central File. The linked models cannot be edited inside the Central File. They need to be edited in the original authoring tool. Relinking of the files using Mange Link is needed to reflect the latest update back in the Central File.

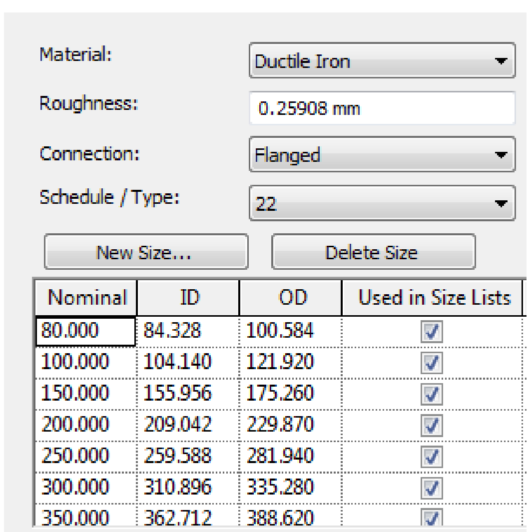
Specifying Pipe/Duct Settings

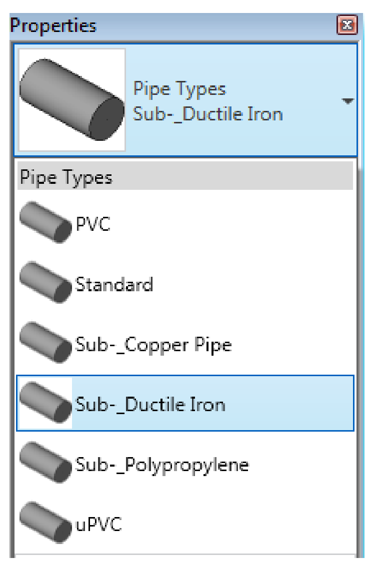
Create a new pipe/duct type. Configure conversion settings that will be used when creating a pipe to physically connect the elements. Types of pipes/ducts to be created will be based on the requirements of the project.

Pipe settings to be done are shown (but not limited to) below:

a. Pipe Types (Materials, Fittings and other accessories, etc.)
b. Pipe Sizes
c. Systems

Pipe types Setting





Schematic Design

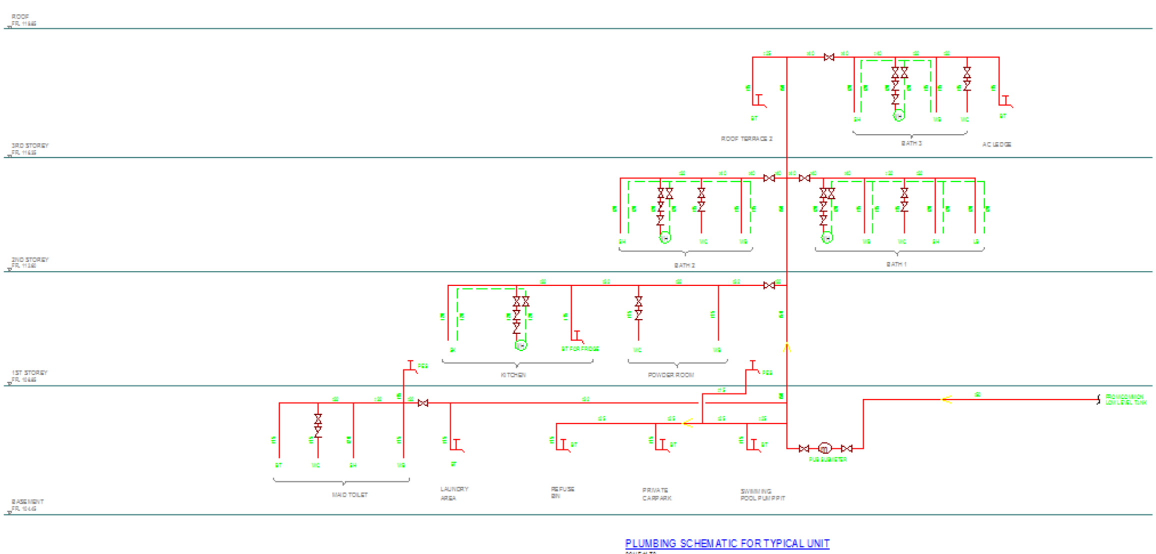
SCHEMATIC DIAGRAMS

The Schematic Design Stage for Mechanical, Electrical and Plumbing covers the steps required for creating schematic diagrams. BIM modelling is not required.

Most BIM authoring tools do not have the capability to generate Schematic Diagrams automatically from the model at this moment. It is recommended to follow either one of the options below to generate Schematic Diagrams

1. Create Schematic Diagrams using traditional 2D methods in a CAD environment
2. Create Schematic Diagrams using BIM authoring tools

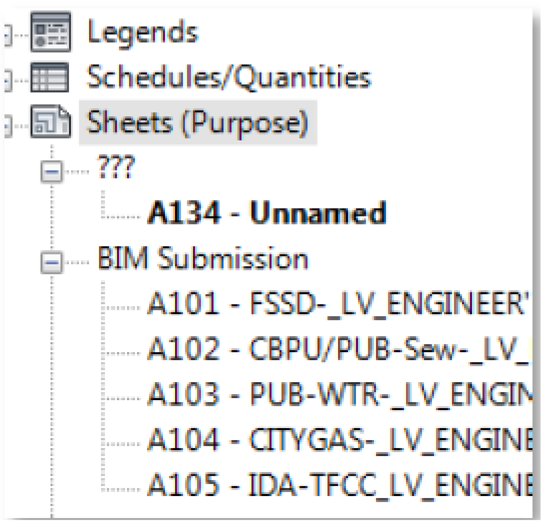
Sample Plumbing Services Schematic Diagram

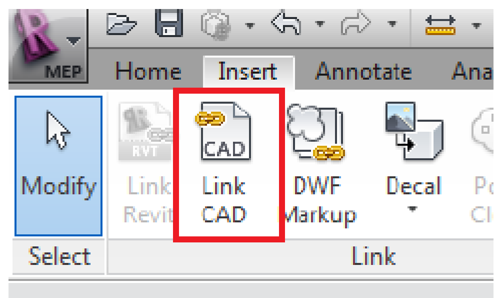


TRADITIONAL 2D METHOD USING CAD TOOLS

Schematic diagram created in CAD tool can be loaded directly into BIM tools through the following steps

1. Create a new sheet from the View Tab of BIM Authoring Tools
2. Select the tile block based on the system from the list of the title blocks shown in the New Sheet dialog box.
3. The created new sheet for the schematic diagram will be placed under the non category views on the project browser. Right click on the created sheet and rename it based on the purpose of the model.

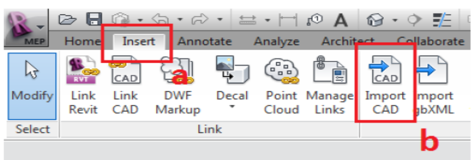


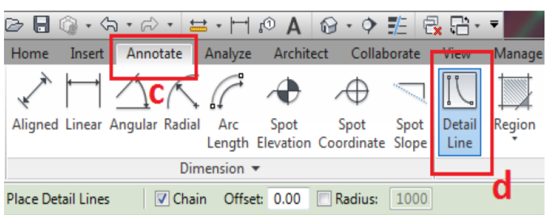


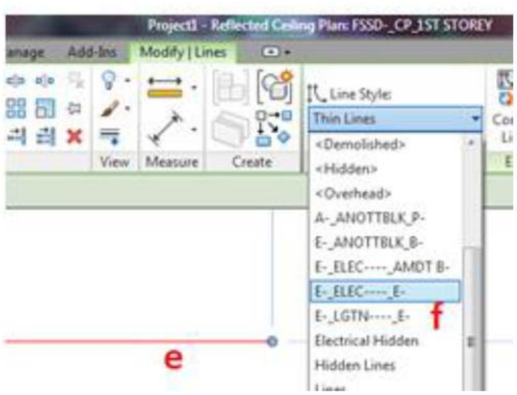
4. Insert the pre-created 2D CAD drawing through **Insert Tab** – Link CAD then choose the intended file as show in the image on below

BIM METHOD

It is advisable to import the symbols and typical details that are already created in CAD. This is to save time in creating the schematic diagrams. Below are steps needed to create the schematics in BIM.







1. Creating a new Drafting View from the View Tab.
   View > Drafting View
2. Import 2D Symbols through **Insert Tab > Import CAD** (**a** and **b** from the figure on the left)
3. Place the imported 2D Symbols into the drawing and connect it. Using the Detail Lines.
   Use Annotate Tab **c** and use Detail Line tool **d** to do.

4. Select the lines **e** from the figure on left) that were created and change the line style properties to its representing system. **f**

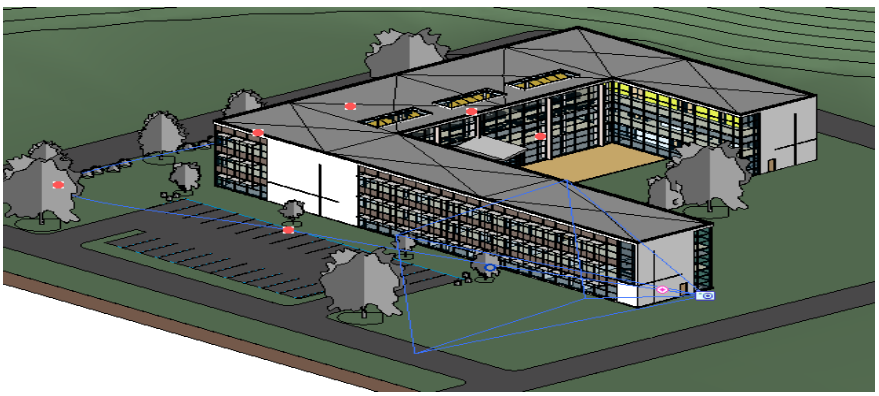
Analysis

PREPARING BIM MODEL FOR ENERGY ANALYSIS

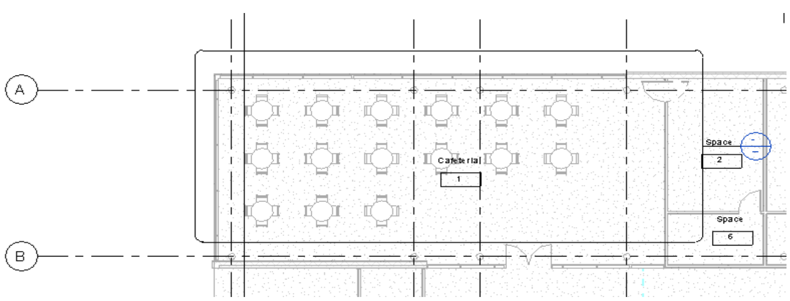
Visualization

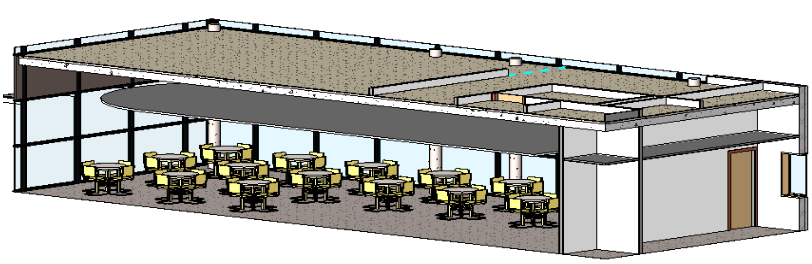
Survey the model to determine the best method of installing MEP systems.

- Perform walkthrough



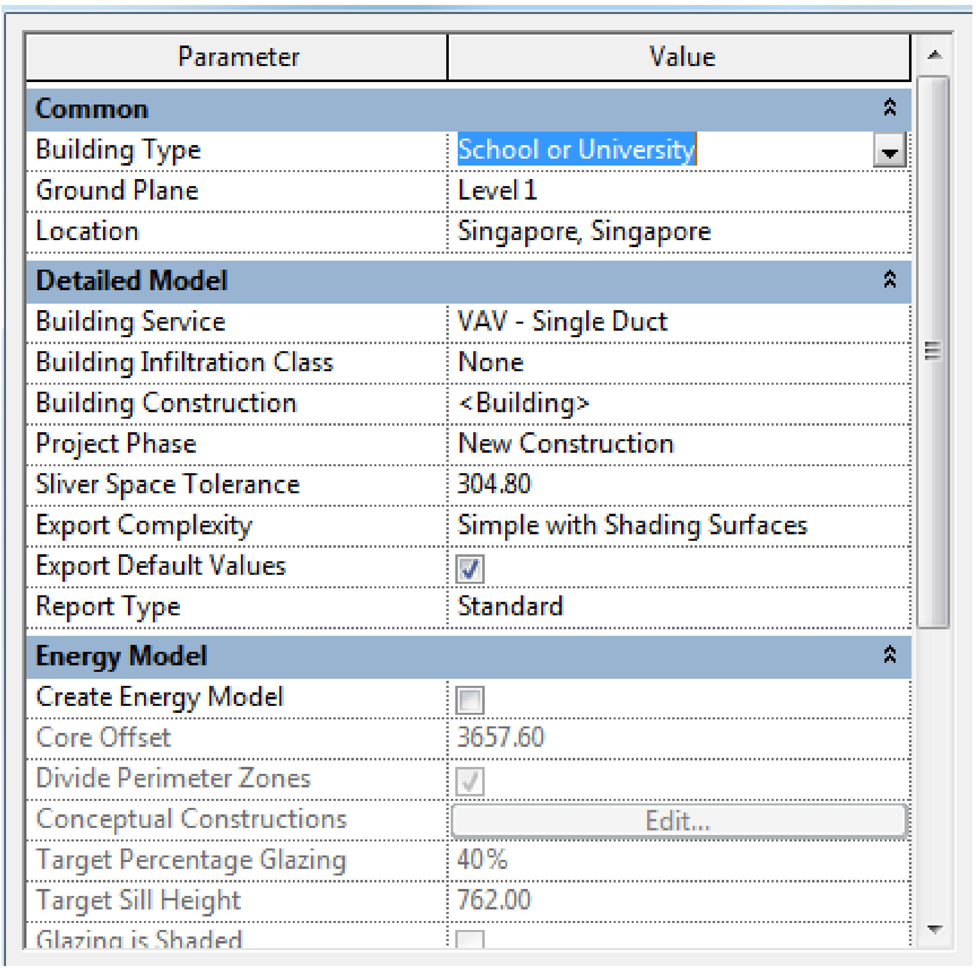
- Cut Sections (2D / 3D)





Setting Project and Zone Information

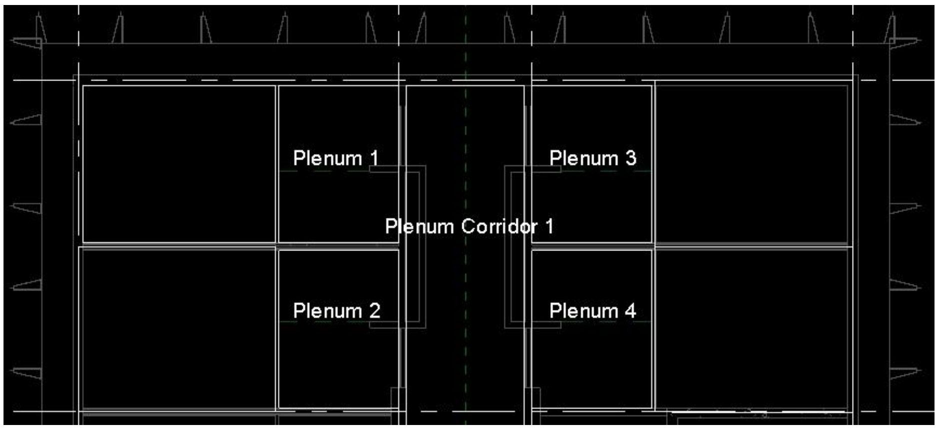
Set a data that is universal to the project, including building types, location, weather, building construction type, and window type data.

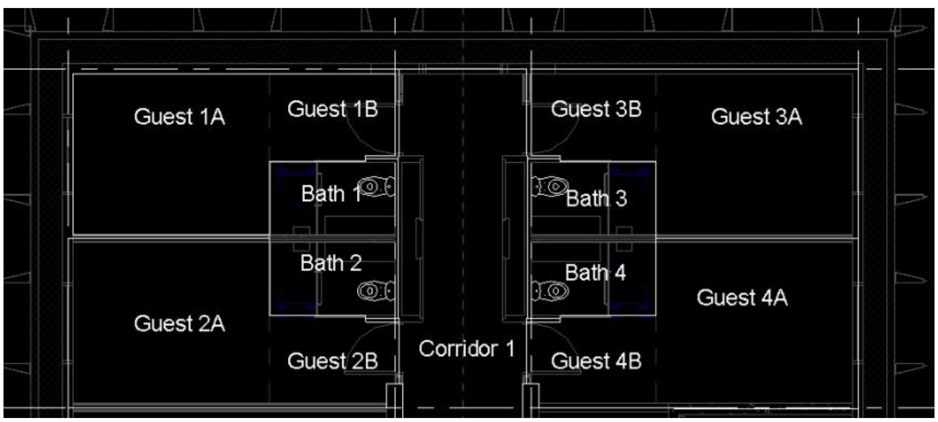


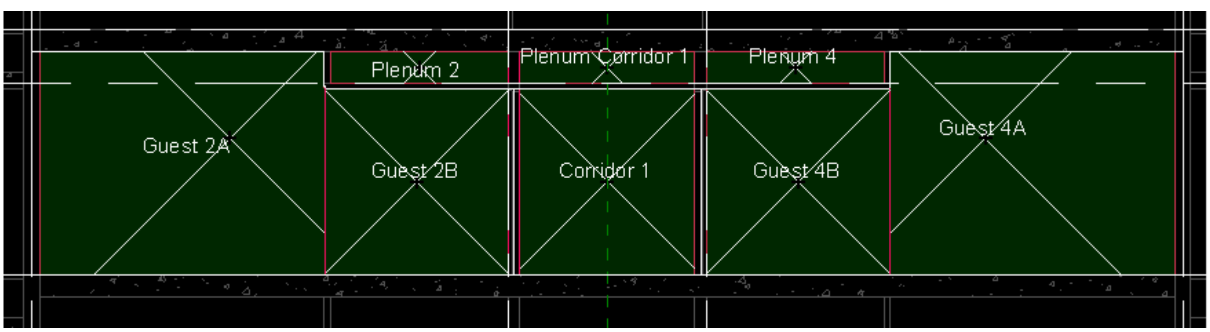
Parameter	Value
Common	
Building Type	School or University
Ground Plane	Level 1
Location	Singapore, Singapore
Detailed Model	
Building Service	VAV - Single Duct
Building Infiltration Class	None
Building Construction	<Building>
Project Phase	New Construction
Sliver Space Tolerance	304.80
Export Complexity	Simple with Shading Surfaces
Export Default Values	☑
Report Type	Standard
Energy Model	
Create Energy Model	☐
Core Offset	3657.60
Divide Perimeter Zones	☑
Conceptual Constructions	Edit...
Target Percentage Glazing	40%
Target Sill Height	762.00
Glazing is Shaded	☐

Creating and Defining Rooms or Spaces

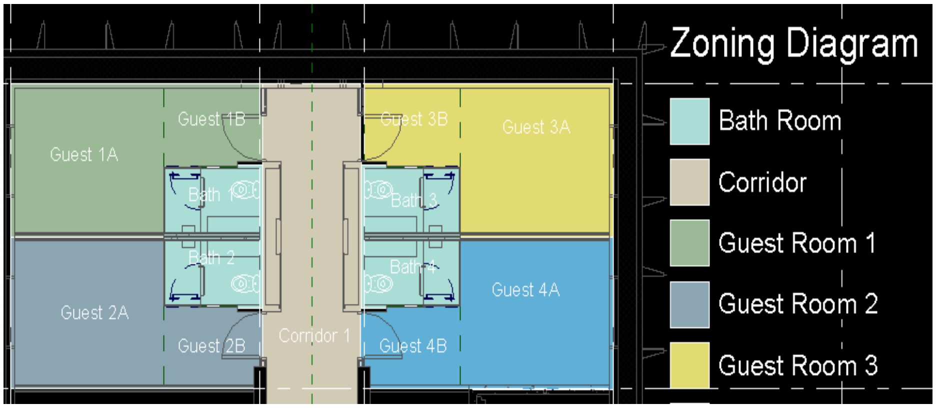
Assign spaces to the linked Architectural model and make sure that all spaces are properly assigned including unoccupied spaces such as plenums and shafts.





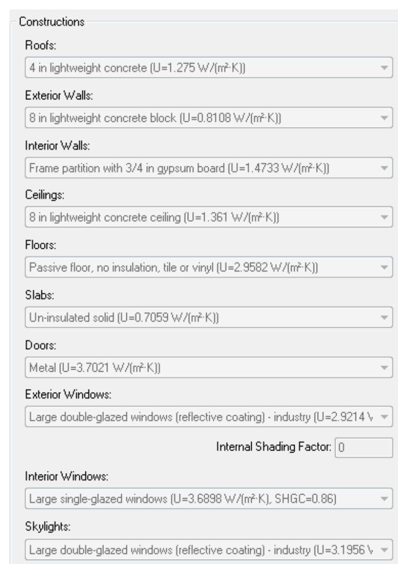


Form ACMV Zones to group spaces created earlier

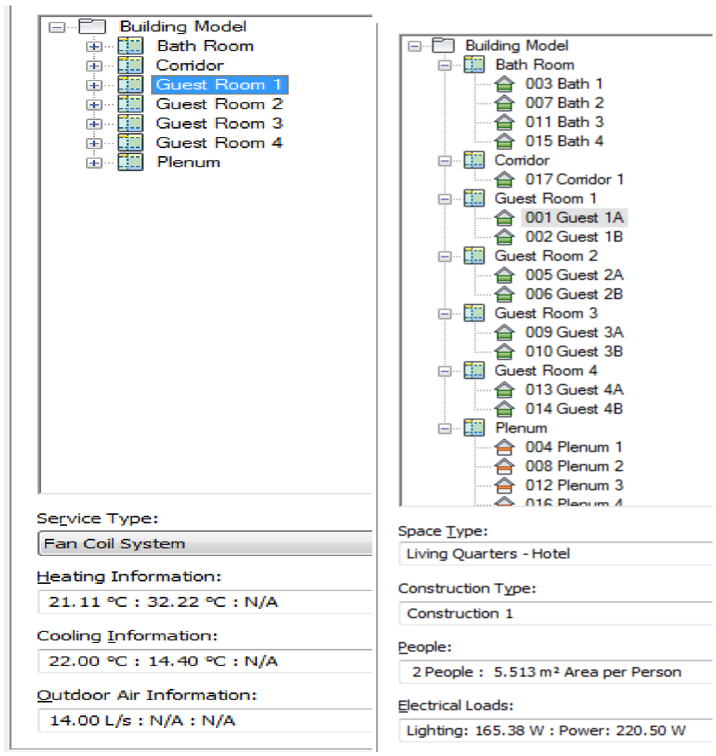


Input spaces' detail information by using either property palette or space schedule and make sure all the spaces are correctly defined. All spaces need to be defined even unconditioned spaces like plenums and shafts

Parameter	Value
Energy Analysis	
Area per Person	1.429 m^2
Sensible Heat Gain per person	80.59 W
Latent Heat Gain per person	80.59 W
Lighting Load Density	9.69 W/m^2
Power Load Density	5.81 W/m^2
Plenum Lighting Contribution	20.0000%
Occupancy Schedule	Restaurant Occupancy - Lunc
Lighting Schedule	Retail Lighting - 7 AM to 8 PM
Power Schedule	Retail Lighting - 7 AM to 8 PM

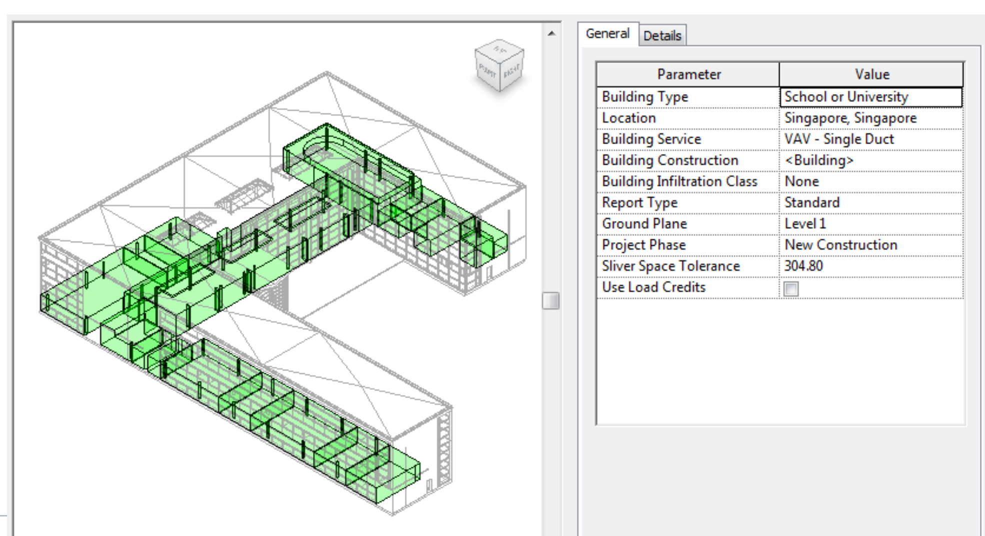


Enter detail information for zones and spaces. Make sure that all spacing errors and warning are solved before proceeding to next step. Any error or warning left unsolved may affect the accuracy of the analysis.



Loads Calculation

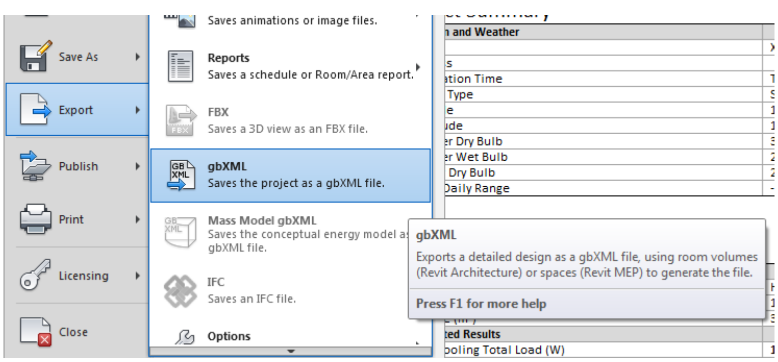
Cooling load calculation results can be produced in three types: Simple, Standard and Detail. The report can be accessed in the Project Browser under reports

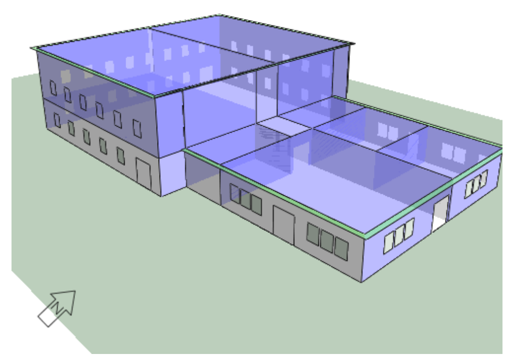


- Analyze the reports

Space Name	Area (m²)	Volume (m³)	Peak Cooling Load (W)	Cooling Airflow (L/s)	Peak Heating Load (W)	Heating Airflow (L/s)
1 Cafeteria	146.961	431.42	19,882	828.7	-651	0.0
1 Office	22.209	57.74	1,748	95.5	-77	0.0
2 Office	41.502	107.90	4,669	266.7	-139	0.0
4 Office	15.359	39.93	1,851	104.7	-73	0.0
5 Office	9.7	34.29	583	32.9	-18	0.0
6 Space	8.463	22.00	591	34.2	-21	0.0
7 HALL	327.189	1,174.32	72,957	4,178.2	-870	0.0
8 LECTURE ROOM 1	48.559	126.25	8,018	463.9	-191	0.0
9 Space	31.567	82.08	4,072	234.4	-127	0.0
10 Space	126.698	329.42	17,186	1,011.2	-631	0.0
11 Space	38.487	118.49	3,249	191.0	-113	0.0
12 Space	13.688	35.59	1,014	59.7	-43	0.0
13 Space	13.122	34.12	965	56.8	-41	0.0
14 Space	89.465	232.61	10,920	642.6	-357	0.0
15 Space	47.99	124.77	5,886	346.3	-191	0.0
16 Space	97.118	252.51	11,821	695.6	-382	0.0
17 Space	47.99	124.77	5,885	346.3	-191	0.0
18 Space	47.169	122.64	4,308	253.5	-219	0.0

In order to further perform energy analysis by using other energy analysis software, export gbXML file from BIM modelling authoring tools.



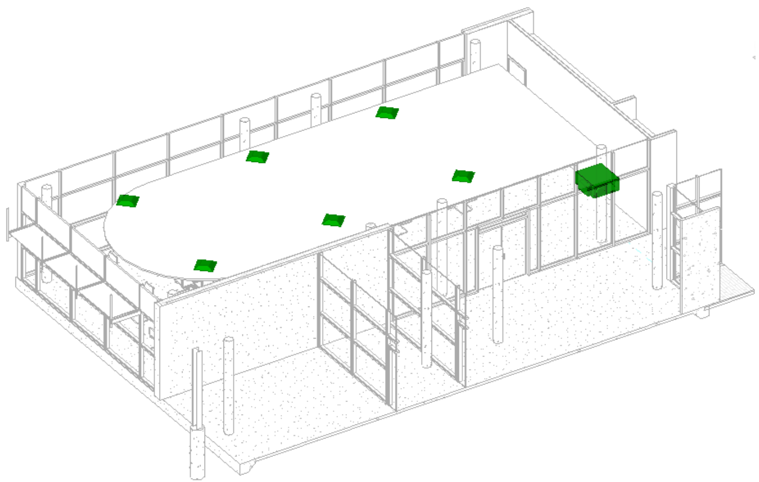


SIZING MEP ELEMENTS

Creating Diffusers and Mechanical Equipment

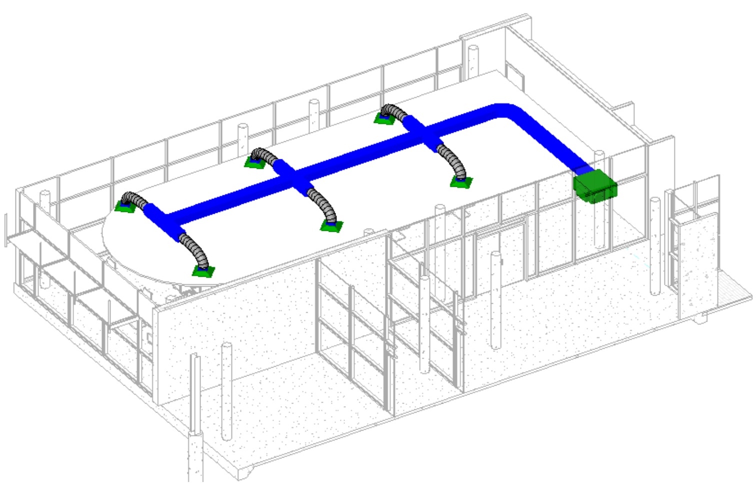
Choose the right diffusers and equipment based on the design requirements

Place the diffusers and equipment in the model.

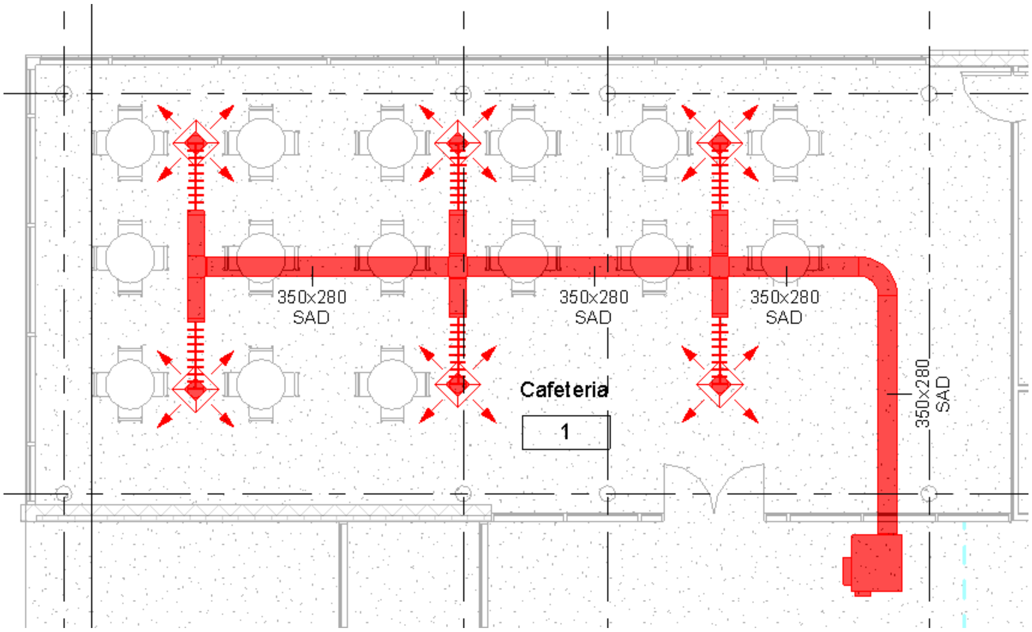


Duct Layout

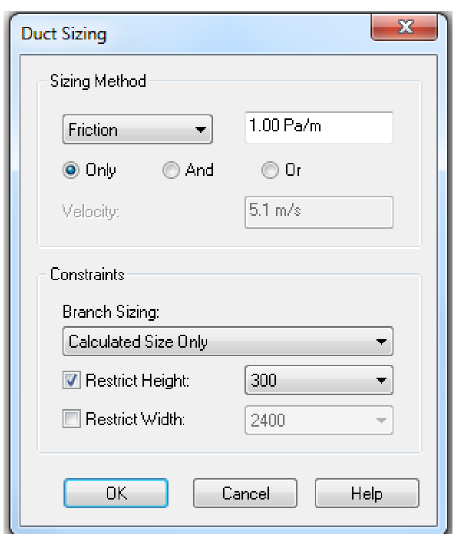
Complete the ACMV systems with ducts.



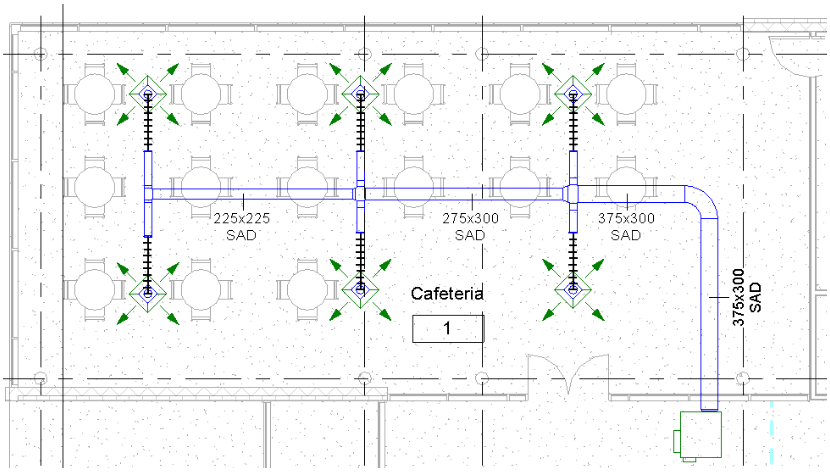
- Select the system to be sized.



- Set the friction loss rate.
- Set the duct height restriction if necessary for some factors e.g. ceiling space limitation.



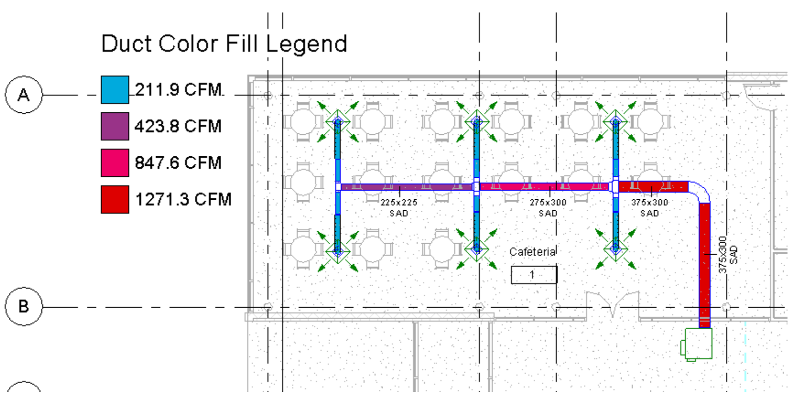
- Run Duct Sizing



- Generate and analyze the duct pressure loss report.

Detail Information of Straight Segment by Sections								
Section	Element ID	Flow	Size	Velocity	Velocity Pressure	Length	Pressure Loss	Total Pressure Loss
2	563683	211.9 CFM	190.0	3.5 m/s	7.5 Pa	1459.64	1.3 Pa	1.3 Pa
3	563677	211.9 CFM	175x175	3.3 m/s	6.4 Pa	750.29	0.7 Pa	0.7 Pa
5	563674	423.8 CFM	225x225	4.0 m/s	9.4 Pa	4514.64	4.1 Pa	4.1 Pa
7	563675	847.6 CFM	275x300	4.8 m/s	14.1 Pa	4454.29	4.3 Pa	4.3 Pa
9	563671	1271.3 CFM	375x300	5.3 m/s	17.1 Pa	4305.11	4.1 Pa	6.5 Pa
	563672	1271.3 CFM	375x300	5.3 m/s	17.1 Pa	2401.99	2.3 Pa	
12	563693	211.9 CFM	190.0	3.5 m/s	7.5 Pa	1459.64	1.3 Pa	1.3 Pa
13	563687	211.9 CFM	175x175	3.3 m/s	6.4 Pa	750.29	0.7 Pa	0.7 Pa
16	563703	211.9 CFM	190.0	3.5 m/s	7.5 Pa	1459.64	1.3 Pa	1.3 Pa
17	563697	211.9 CFM	175x175	3.3 m/s	6.4 Pa	634.76	0.6 Pa	0.6 Pa
20	563713	211.9 CFM	190.0	3.5 m/s	7.5 Pa	1459.64	1.3 Pa	1.3 Pa
21	563707	211.9 CFM	175x175	3.3 m/s	6.4 Pa	584.76	0.5 Pa	0.5 Pa
24	563723	211.9 CFM	190.0	3.5 m/s	7.5 Pa	1459.64	1.3 Pa	1.3 Pa
25	563717	211.9 CFM	175x175	3.3 m/s	6.4 Pa	546.26	0.5 Pa	0.5 Pa
28	563733	211.9 CFM	190.0	3.5 m/s	7.5 Pa	1459.64	1.3 Pa	1.3 Pa
29	563727	211.9 CFM	175x175	3.3 m/s	6.4 Pa	496.26	0.4 Pa	0.4 Pa

- Do some changes to the model if necessary.



Detailed Design

In the Detailed Design stage, the preliminary design model will be further developed with more accurate BIM elements. Additional BIM elements need to be added to complete the model. Refer to Appendix A for a list of typical BIM elements with attributes that need to be modelled. Elements should come with an accurate dimensions, shape and location. Necessary attributes should be provided.

Deliverables:

1. Tender model with drawings
   Content:
   - Site Plans
   - Floor Plans
   - Schematic Diagrams
   - Typical detail Plans
   - BIM model

2. Submission BIM model for Regulatory Approval
   Please refer to BIM MEP e-submission guides for specific requirements from the Agencies

The sub-chapter will be divided into different services namely:

- Mechanical Services
- Electrical Services
- Plumbing & Sanitary Services and
- Fire Protection Services

MODELLING MEP SERVICES

In this section, it is assume that the file has already been prepared and the modelling plan to be used by the team has already been decided.

Copy Monitoring Elements of the Architecture Model

Copy Monitor is a tool to ensure the changes in the model between different disciplines are properly communicated.

Note: Coordinates are to be acquired from the Architectural model first before doing copy and monitor.

Revit elements which can be copied / monitored

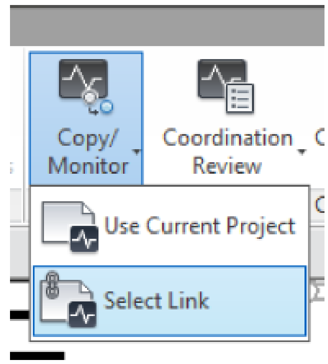
ELEMENTS	REVIT MEP
Grids	Yes
Levels	Yes
Columns	Yes *
Floors incl. openings	Yes *
Walls incl. openings	Yes *
Air Terminals	Yes **
Lighting Fixtures	Yes **
Plumbing Fixtures	Yes **

* Unless there is a specific project deliverable, this function should not need to be used in Revit MEP

** If the element is created in the Architectural Model

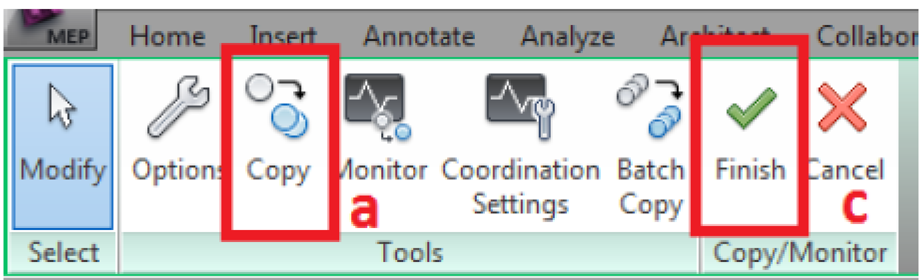
Copy monitoring can be done through the following steps:

a. On the plan view of the model, go to the **Collaborate** Tab and select **Copy/Monitor tool**



b. From the pull down menu, choose **Select Link**

c. Hover the cursor to the architecture link model and pick it. Copy monitor tab will be activated.



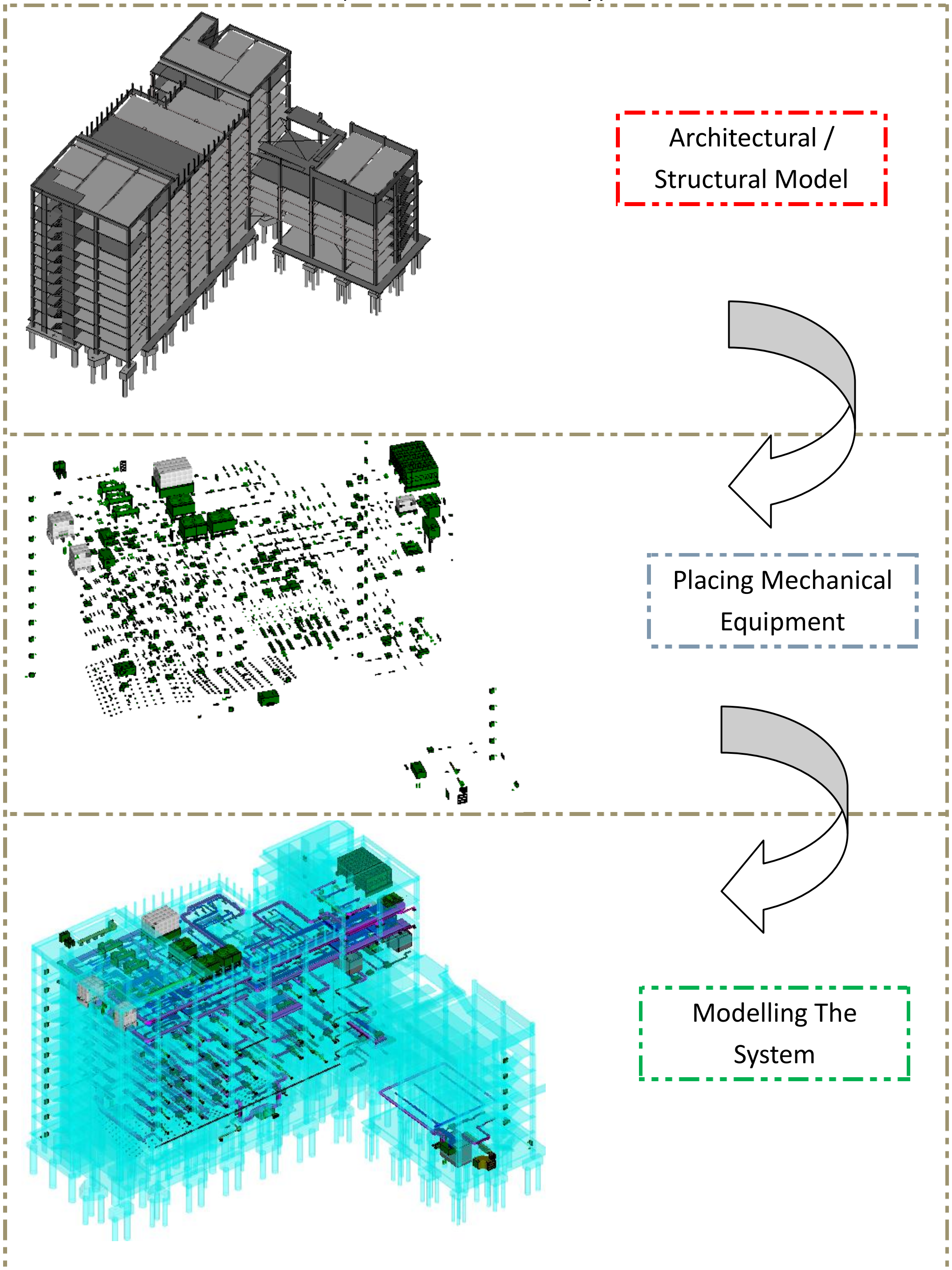
d. Select **Copy** from the ribbon then select the elements intended to copy and monitor on the project **(a).**

e. Click Finish **(c)** once done
Additional MEP elements will be created on the same position of the copied architectural model.

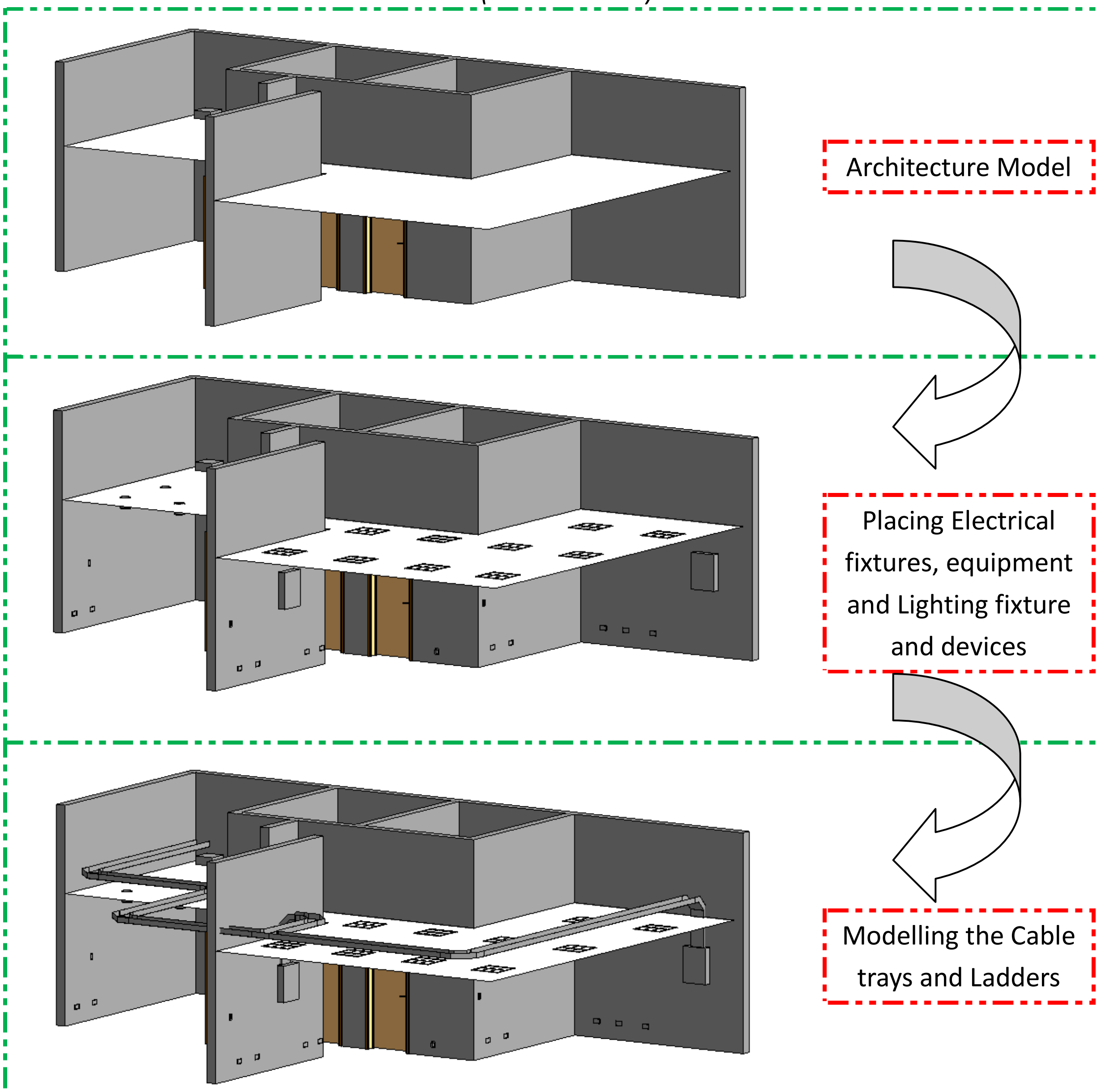
Note: If there is a change in the updated Architectural Model affecting the elements that have been copied and monitored, a warning will appear on the screen once the updated Architectural Model is being reloaded.

After the project has been set up, the mechanical services can be modelled in the manner illustrated in the following pages.

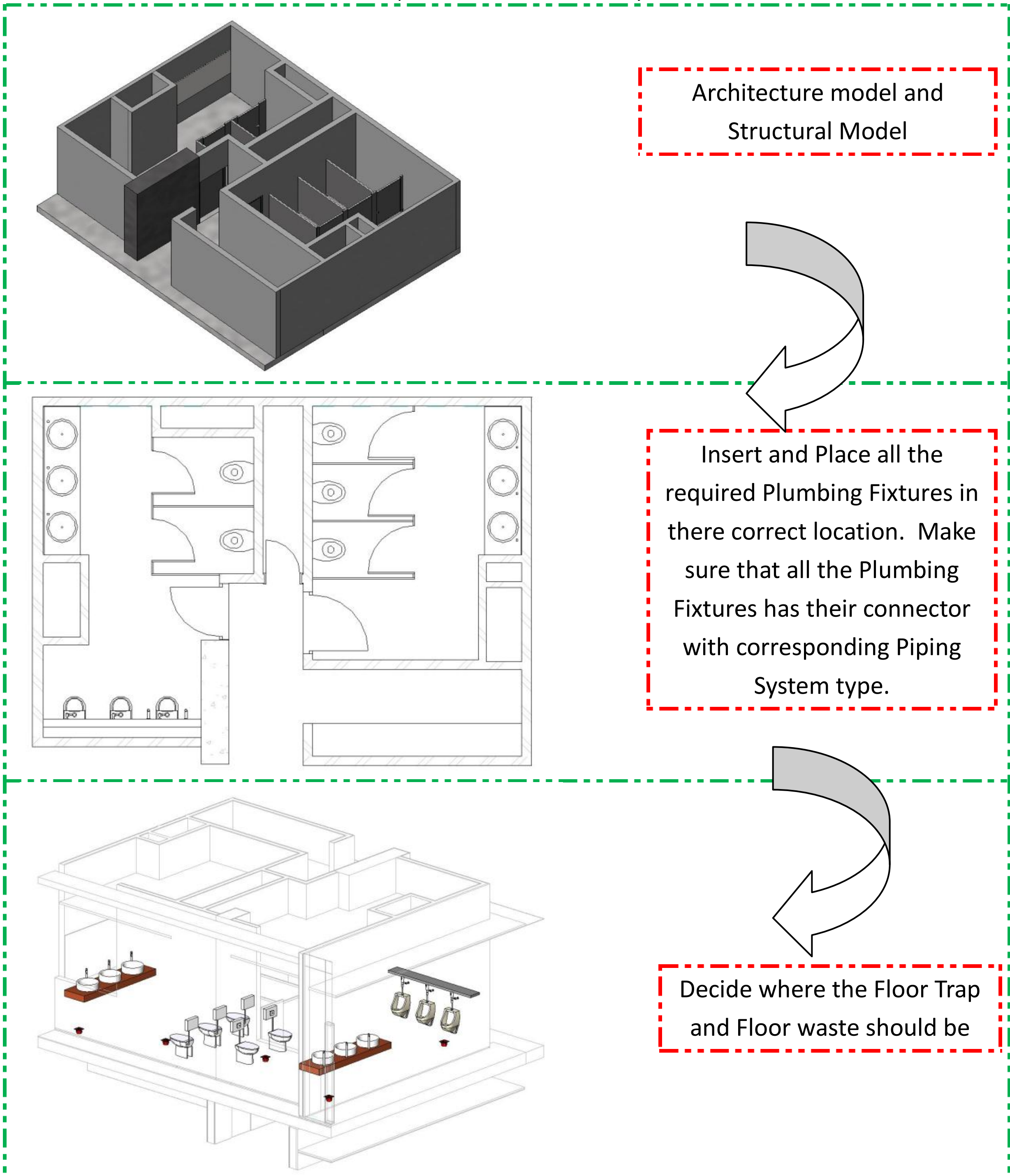
Modelling Mechanical Services
(Source: BCA Academy)

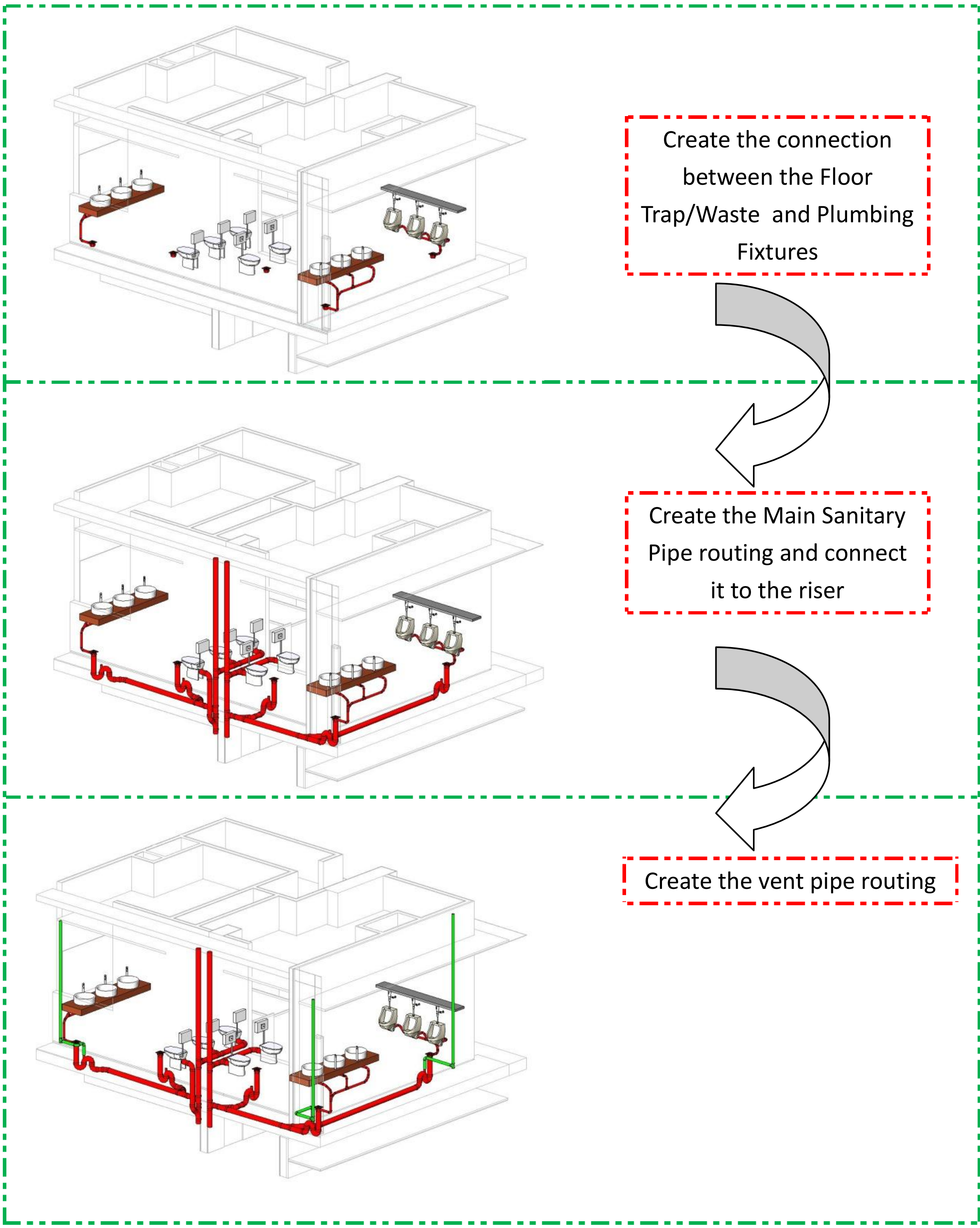


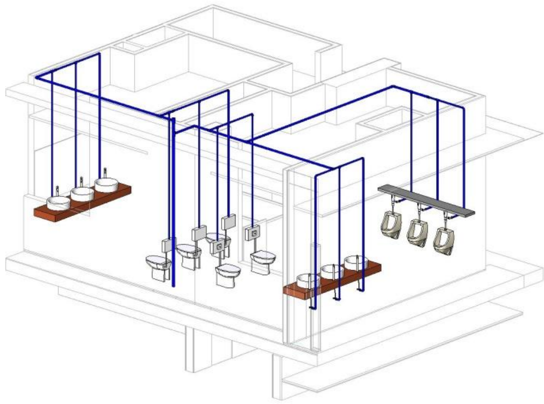
Modelling Electrical Services
(Source: ST AE)



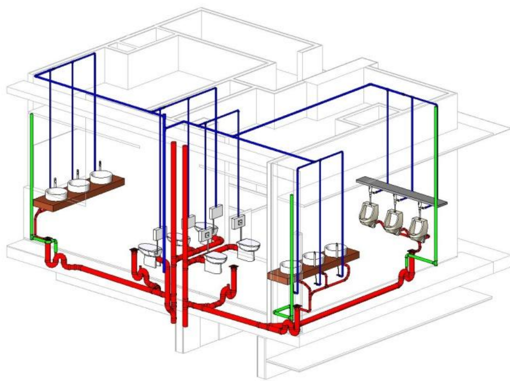
Modelling Plumbing and Sanitary Services
(Source: Rankine & Hill)



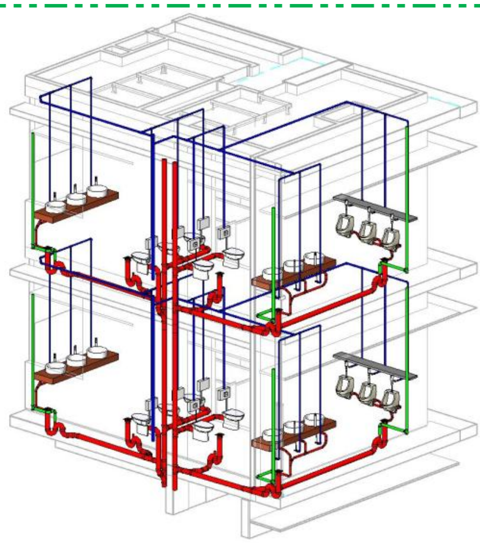

Create the connection between the Floor Trap/Waste and Plumbing Fixtures
Create the Main Sanitary Pipe routing and connect it to the riser
Create the vent pipe routing



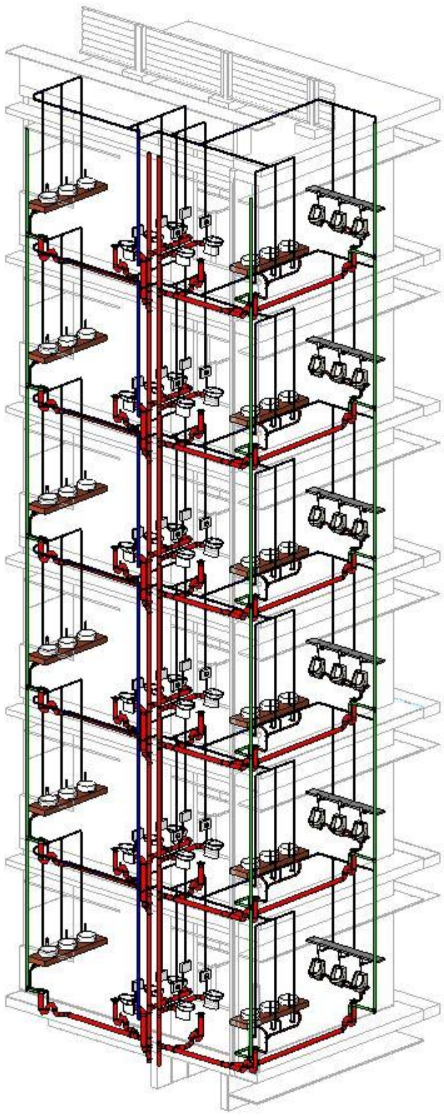
Create Plumbing pipe routing



Check if there are clashes between two Piping Systems.

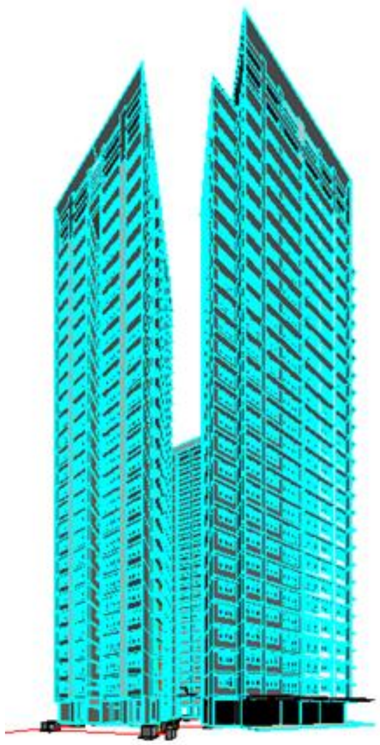


Typical Floor, Copy Plumbing & Sanitary routing to above level for further coordination.

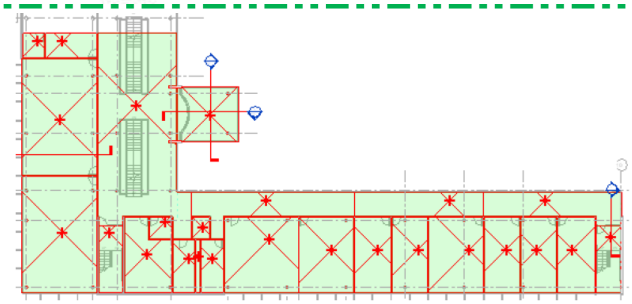


After Coordination, Copy the typical plumbing & sanitary routing to other typical floors and connect the riser to each other for it to become one connected piping system.

Modelling Fire Protection Services
(Source: xx)



Hide all unnecessary elements from Architecture model.



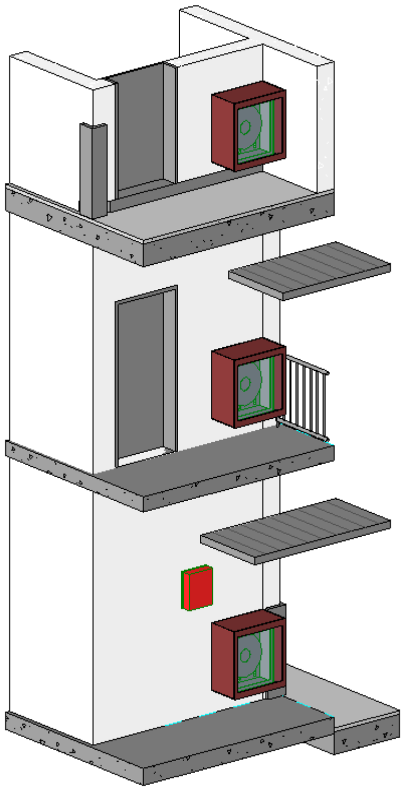
Determine Zone Requirements

To know the number of sprinklers to be place in a particular space of the building it is important to zone the areas using the linked architecture model.

Sprinkler Schedule						
			Maximum Sprinkler Spacing and Area Coverage			
Number	Name	Area	Protection Area Construction Type	Coverage Area	Spacing	Minimum Sprinklers
Type	System Name	Count				
Level 2						
Zone 1						
216A	Corridor	133 m²	Ordinary, Unobstructed	10 m²	4575	13.3
221	Instruction	41 m²	Ordinary, Unobstructed	10 m²	4575	4.1
222	Computer	55 m²	Ordinary, Unobstructed	10 m²	4575	5.5
223	Lounge	133 m²	Ordinary, Unobstructed	10 m²	4575	13.3
224	Caferteria	35 m²	Ordinary, Unobstructed	10 m²	4575	3.5
225	Female	6 m²	Ordinary, Unobstructed	10 m²	4575	0.6
225PC	P-Chase	1 m²	Ordinary, Unobstructed	10 m²	4575	0.1
226	Male	8 m²	Ordinary, Unobstructed	10 m²	4575	0.7
227	Electrical	5 m²	Ordinary, Unobstructed	10 m²	4575	0.5
228	Copy/Print	12 m²	Ordinary, Unobstructed	10 m²	4575	1.2

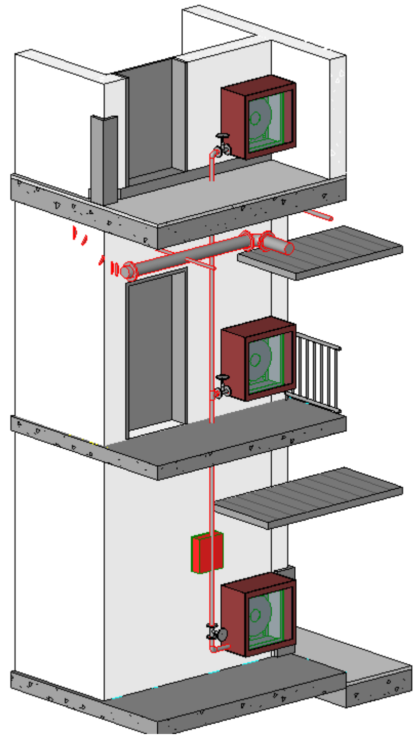
Creating Sprinkler Schedule

After zoning has been done, sprinkler schedule can be easily created using the information derived by the zones.



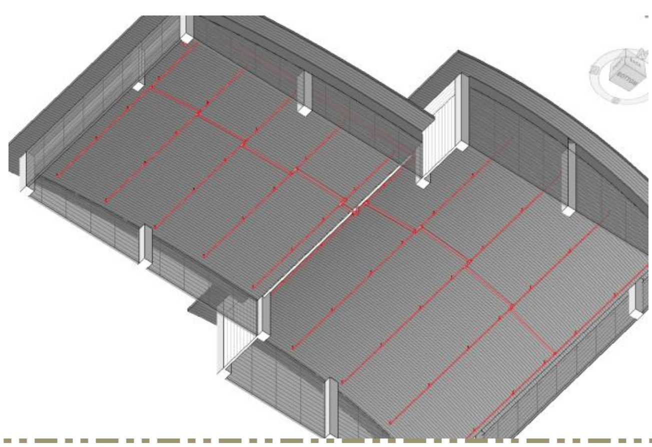
Placing Fire Protection Equipments

All fire protection equipment shall be placed on the architecture model in realistic position. Local regulations must be considered such as distances, elevations, locations, etc



Modelling connections

Pipe shall be place and routed according to the design with correct sizes and levels. Complete with fittings and accessories.



Modelling Sprinkler Heads, Main Pipe and Branches

MODEL REFERENCING IN CONSTRUCTION DOCUMENTS

This is the last step of the design development stage where the model will be prepared for regulatory submission or tendering.

Objectives:
To extend the information of the model by putting additional properties such as 2D details and attributes.

Deliverables:

- Model for Tendering
- Model for BIM e-Submission

Preparing BIM model for Tendering and e-Submission

The floor plans, sections and other drawings required for tendering can be generated directly from the BIM model. Reference should be made to the MEP BIM e-submission Guidelines in preparing drawings for regulatory approvals

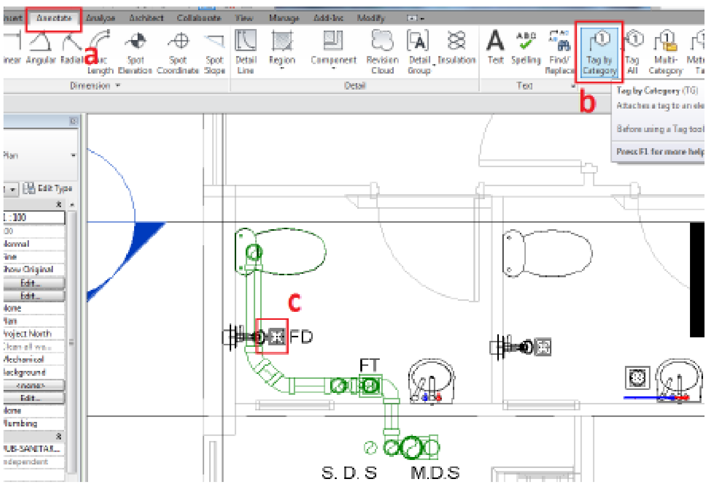
The steps on the following pages can be applied to MEP trades of the project.

Preparing Floor Plans

Open typical floors of the created model. Zoom- in to one of the typical units and do the following steps.

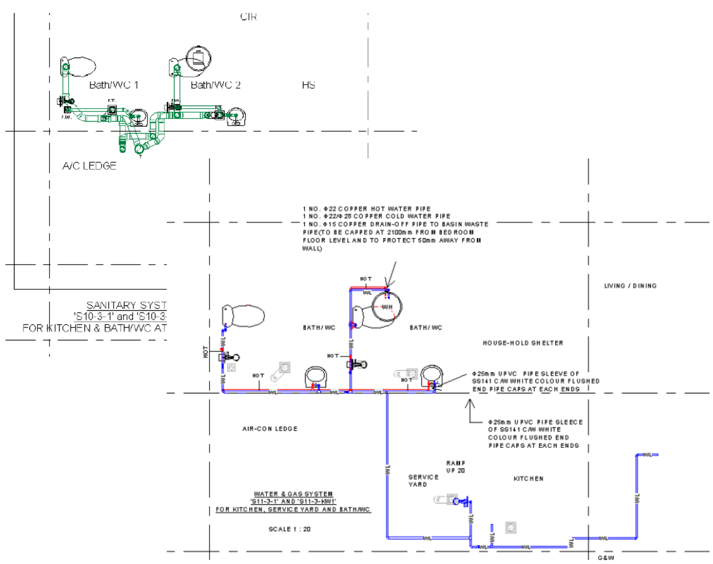
a. From view tab, select **Callout. Right click** to the selected Callout and Open the View

b. From the **Annotate** tab, click **Tag by Category** and select the elements in the model



Standard annotation/tags available in the template can be used to annotate the model.

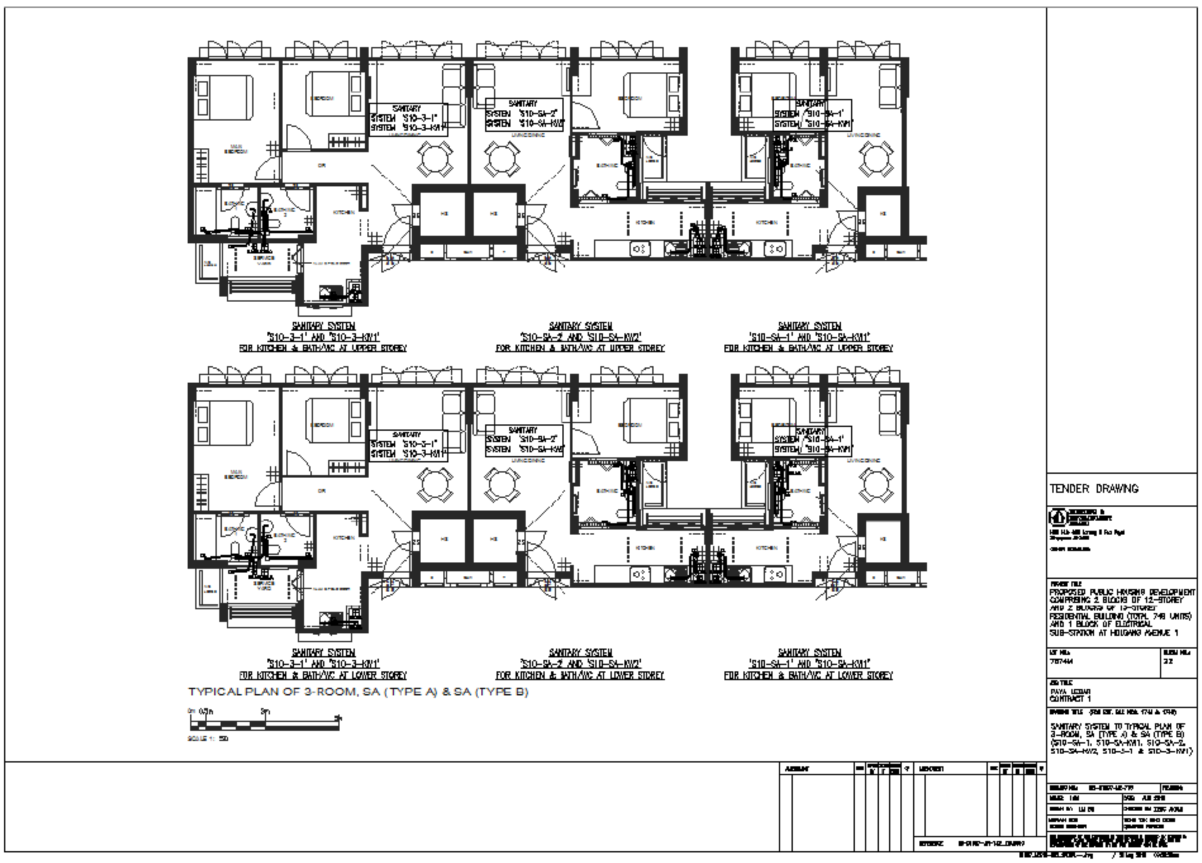
c. Complete the annotation in the model using Text tool and other detailing tool if necessary. See figures Below



Placing Drawing into Sheets

Once the drawing views (plans, schematics etc) are clearly annotated, they can be organized and placed in sheets with the steps below:

a. Create a sheet for the intended tender drawing. Company standards title block loaded into the template. Select the appropriate one.
b. From the project browser, drag and drop the drawing to be placed.
c. Once done, the drawing will be the same as the figure on the next page.



Repeat the same procedures to produce the documents listed below:

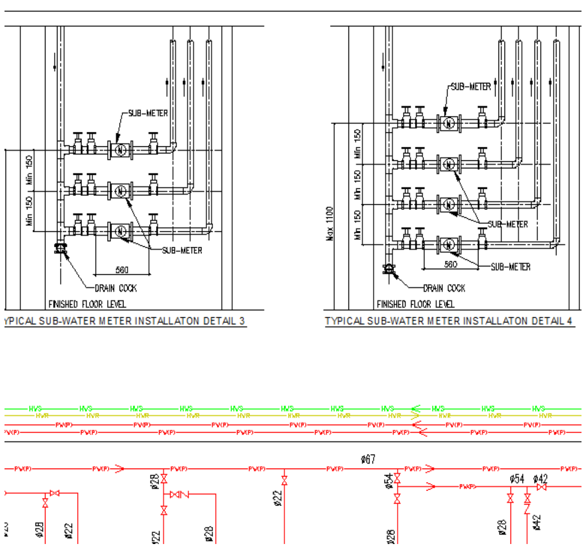
- Key Plans and Layout
- Site Plans
- Floor Plans
- Models

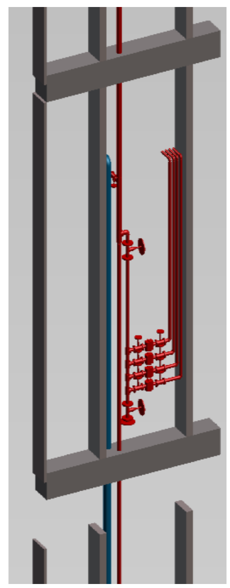
Publishing Model and Drawings to Non-editable File Format

Refer to BIM MEP e-Submission guideline to export/publish to DWF for regulatory submission

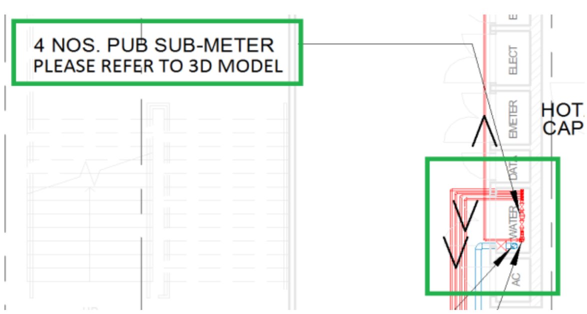
Note: The drawings produced from the BIM model during the Detailed Design stage can form part of the tender documents together with other 2D detail drawings

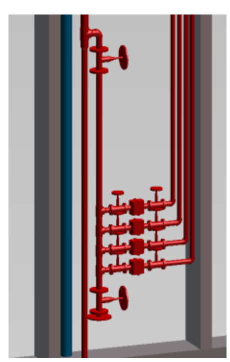
HYBRID METHOD: 2D connection details and 3D representation with generic objects.





Model as a reference for the certain views in floor plan. E.g. Multiple elements stacked at the same place.





PUBLISHING MODEL FOR TENDERING/SUBMISSION

Link Models
- MEP Model
- Reference Models

→

Production
- Production Template
- Submission Template

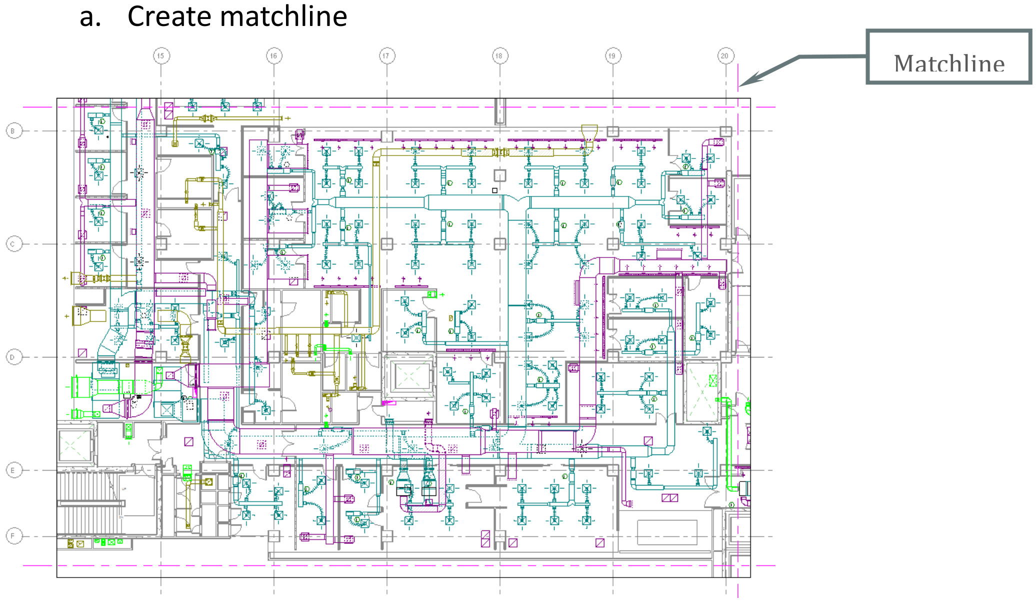
→

Export
- Tender Drawings
- Submission Drawings and Models
- Etc

1. Link Reference models and MEP model to Production Template.

2. Production Template consists of matchline, dependant views, and scope boxes.

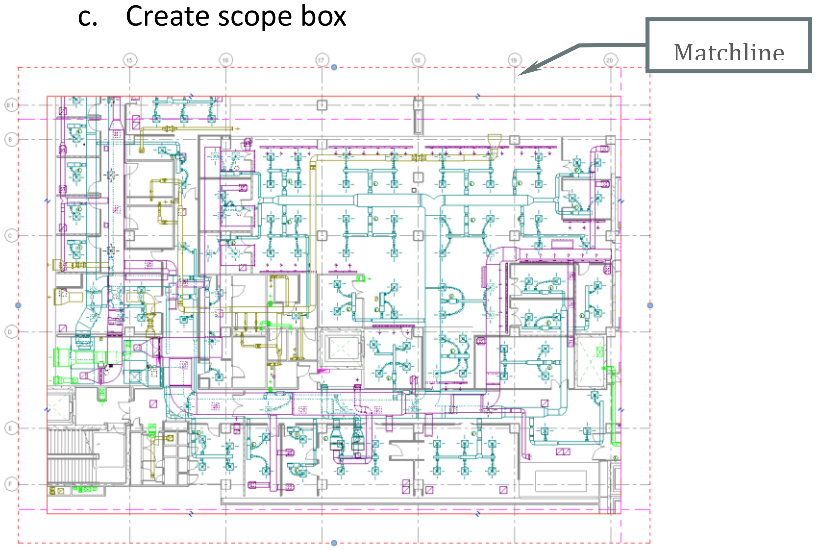
    a. Create matchline



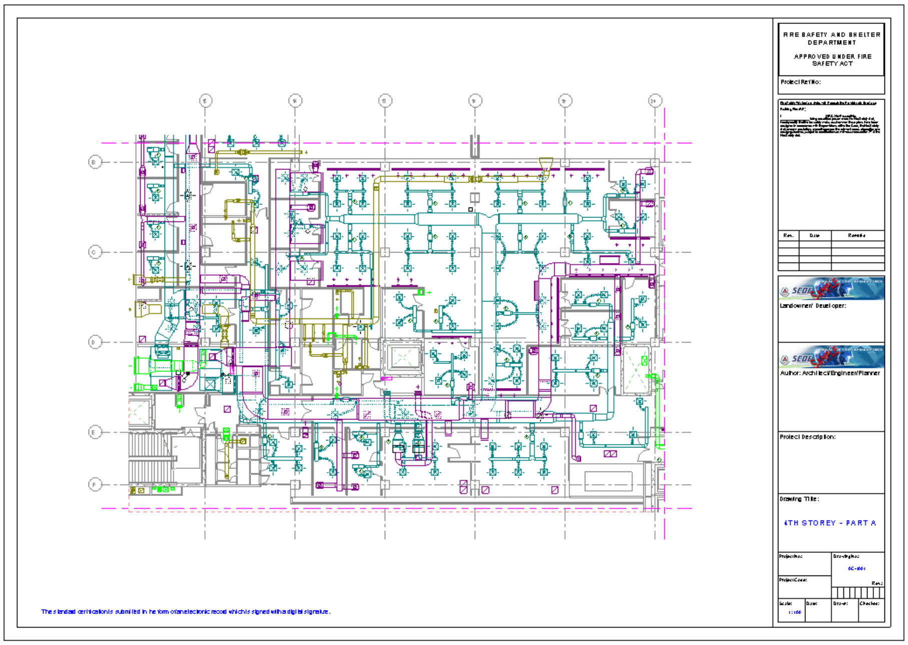
    b. Create dependant views

Floor Plan: ACMV_1st Storey
- Floor Plan: ACMV_1st Storey-Part 1
- Floor Plan: ACMV_1st Storey-Part 2
- Floor Plan: ACMV_1st Storey-Part 3
- Floor Plan: ACMV_1st Storey-Part 4
- Floor Plan: ACMV_1st Storey-Part 5
- Floor Plan: ACMV_1st Storey-Part 6

c. Create scope box



3. Link views to sheets.

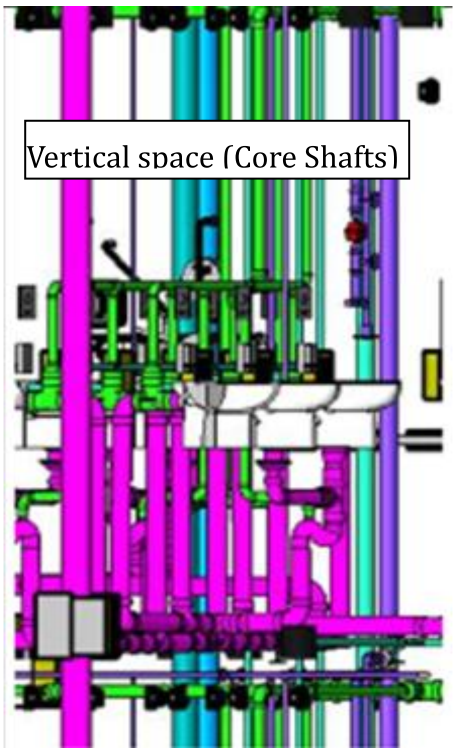


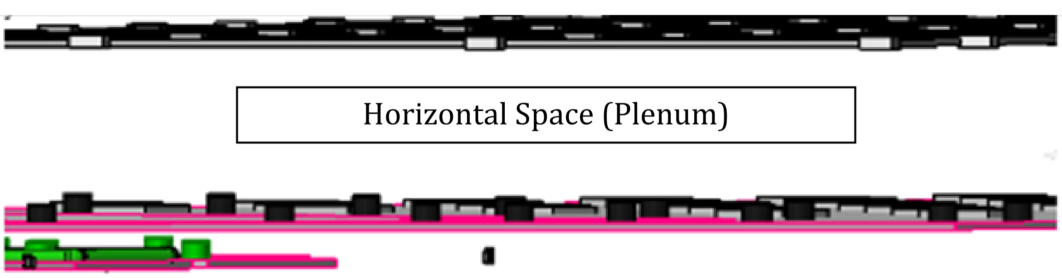
4. Publish sheets.

Collaboration between MEP Sub-Disciplines

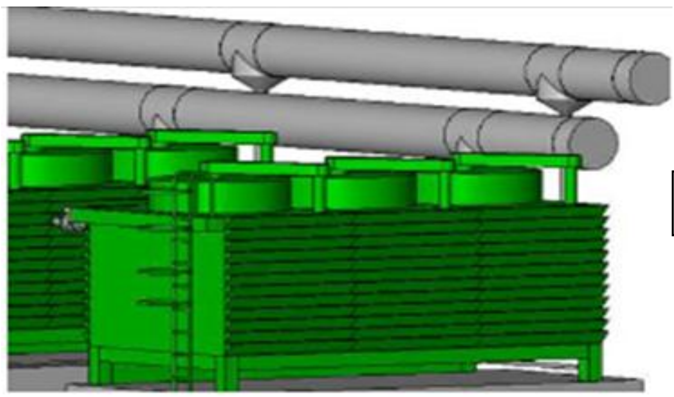
Collaboration Elements within Building

- Level by Level (Storey by Storey)
- Room by room (Below Raised Floor)
- Horizontal Space (Plenum)
- Vertical Space (Core Shafts)





Collaboration Elements at outside of Building - Roof Top, external face of building, external works etc



At Roof Top

- Mechanical System - ACMV Equipment and distribution such like Cooling tower, AHU, Ducting, etc
- Plumbing and Sanitary System - Pumps, water holding tanks, pool filtration equipment, Sump, sewage pit, grease and sand traps, etc
- Fire Protection System – Fire sprinkler pumps, sprinkler tanks fire shutter, smoke curtains, piping system, etc
- Electrical System – Transformer, Lifts, Switch boards, panel, cable trays, trucking containment, etc

Example:

Plenum levels may need to be inserted to appropriately define the Mechanical Zones. Light fixtures and air terminals may also be referenced to a ceiling plenum level.

- Elements between Diffusers and Ceiling Lighting fixtures
- Elements between Ducting runs and piping system or Cable trays or Light fixtures and Sprinkler head
- Elements between Fire dampers and piping system

Others

VALUE- ADDED SERVICES

For detailed information, refer to ***Singapore BIM Guide***

REGULATORY SUBMISSIONS

For detailed information, refer to ***MEP BIM e-Submission Guideline***

MODEL VERSION CONTROL

As the project progresses, consequently is the model change. Model will change according to specific requirements needed in every stage. Few factors of having numerous model versions are as follows:

- Design Change
- Authority Submission and Re-submission
- Model Update
- Remote Office Locations

Different model versions are certain. Managing these versions is the possible option that we may implement to avoid having it. Few recommendations listed below will help all project members to avoid confusion.

Organized Folder Structure

- To implemented office-wide.
- Saving the specific file on their corresponding location will be helpful for all, and will also reduce the time spent in searching.
- To avoid duplicating files on their own PC to avoid confusion when working.
- “Backup”, “Superseded” or similar folder name where all backups/ outdated files are located.
- “Archive”, “Published” or similar folder name where all copies of issued files are located.

- “Working”, “WIP” or similar folder name where only “one working model” (varies on project setup) is located.

Keeping “One Working Model”

- Project Server to serve as a central location of model, where every team member can access and work.
- “Graphisoft BIM Server”, “Revit Server” or similar will allow two or more teams located in remote office locations to update their changes to one central file simultaneously.

NOTE: RECOMMENDATIONS ARE NOT APPLICABLE TO ALL. THESE VARY DEPENDING ON PROJECT AND OFFICE REQUIREMENTS.

Appendix A – Typical BIM Elements by Discipline

Kindly tick and write down the attributes of the selected elements on the table.

(I) ARCHITECTURAL BIM ELEMENTS

	Element	Elements or Parameters needed by each non-Architectural discipline
Site Model	Site infrastructure within site boundary (roads, pavements, car park spaces, access and parking arrangements and surrounding land use)	
	Street fire hydrant (only indication of locations necessary)	
	Surface drainage (only indication of locations necessary)	
	External drainage & underground drainage	
	Hard landscaped areas within site boundary	
	Planter boxes including sub-soil drainage systems	
	Massing of adjacent buildings relevant to project	
Rooms / Spaces	Room spaces, corridors, other spaces, plant and equipment rooms (including designated use)	
Walls and Curtain Walls	Interior / Exterior walls / Non-structural walls / Blockwork walls (*Including finishes to identify if tiled / painted / plastered)*	
	Curtain wall with mullions and transoms with true profile and window glazing units including shading devices	
Doors, Windows and Louvers	Interior / Exterior doors	
	Interior / Exterior windows	
	Louvers	
Basic structure	Beams (based on location and size indicated by the Structural Engineer)	
	Columns (based on location and size indicated by the Structural Engineer)	
Roofs	Roofs with overall thickness (including finishes & insulation)	
Ceilings	Ceilings (without support sub-frames) including module arrangement, material choices and finishes.	
	Hangars and sub-frames for ceilings∗	
Floors	Horizontal floors	

	Sloped floors and ramps	
	Floor finishes details including tiling, carpet, screed only	
Vertical Circulation	Steps & stairs including risers, threads and railings including headroom clearance requirements	
	Elevator shafts (without fit-out installations by lift contractor)	
	Access ladders and catwalks	
Architectural Specialties and Casework	Precast / Prefab / GRC / Fibreglass facades	
	Railing & parapets, including mesh & metalwork	
	Fixed Building Maintenance Units in their overall bulk form	
Schedules	Schedules allowing information to be extracted from elements	
Fixtures and Equipment ∗ (with input from interior designers, specialist sub-contractors, etc)	Loose furniture including desks and computer workstations, casework (carpentry), including upper and lower cabinets	
	Appliances such as in kitchen equipment	
	Toilet fixtures, plumbing faucets	

∗ these elements may cause BIM models to become too big and unmanageable.

(II) STRUCTURAL BIM ELEMENTS

Element	Elements or Parameters needed by each non-Structural discipline
Foundations including piles, pile caps, tie / ground beams & footings	
Diaphragm walls & retaining walls	
Beams	
Columns	
Walls	
Slabs, including slab on grade and floating slab, recesses, curbs, pads and major penetrations	
Other types of transfer structure not mentioned above	
Stairs (steps, risers, threads, landings): all framing members and openings	

Shafts and Pits (and openings)	
Precast & Prestressed concrete systems: all primary and secondary elements	
Temporary structures and platforms	
Concrete reinforcement details (Rebar), imbeds and cast-ins ∗	
Steel frame structures including bracing systems ∗	
Base plates, bolts, clip angles, fixings, etc. ∗	
Connection details of structural steel members ∗	

∗ these elements may cause BIM models to become too big and unmanageable.

(III) CIVIL BIM ELEMENTS

	Element	Elements or Parameters needed by each non-Civil discipline
Digital Terrain Model (DTM) ❄	3D surface based on topography that shows site conditions and building locations Include existing walkways, roads, curbs, ramps and parking lots etc	
Geology Report △	Soil investigation report (A BIM Model is not required)	
Utilities Model	All points of connection for existing and new utilities within site boundary	
Rainwater & storm water pipe work	Includes outlets, surface channels, slot channels and manholes	
Underground Public Utilities	For drainage only	
Others	Drains, canals, crossings, retaining walls, and underground harvesting tanks	
	Underground electrical supply cables and sewer lines, IDA (telecom) line and Gas Lines.	

❄ Data of Digital Elevation Model to be provided by registered surveyors

△ Data of Geology Report to be provided by geotechnical engineers

(IV) ACMV BIM ELEMENTS

	Element	Elements or Parameters needed by each non-ACMV discipline
ACMV Equipment	Air Handling unit	
	Chiller unit	
	Variable refrigerant unit	
	Cooling Tower	
	Split-type indoor & outdoor air conditioning units	
	Exhaust or extract air fans	
	Fresh air fans	
	Other fans such as jet fans	
	Heat Exchanges for projects with District Cooling	
ACMV Distribution	Exhaust air ducts (excluding hangars)	
	Fresh air ducts (excluding hangars)	
	Supply air ducts (excluding hangars)	
	Return air ducts (excluding hangars)	
	Transfer air ducts (excluding hangars)	
	Diffusers, air-boots, air grilles, air filters, registers	
	Fire dampers, motorized dampers, volume control dampers, CO_2 sensors, CO sensors	
Mechanical Piping	Chilled water supply pipes including connections, fittings & valves	
	Chilled water return pipes including connections, fittings & valves	
	Condensate drain pipes including connections, fittings & valves	
Others	Switch boards, control, BMS & DDC panels, BMS control & monitoring modules	
	Fan Coil unit	
	Engineering Smoke Extract System (e.g. smoke curtains, ductless fans)	

(V) PLUMBING AND SANITARY BIM ELEMENTS

Element	Elements or Parameters needed by each non-Plumbing and Sanitary discipline
Pipe supports and brackets ∗	
Pumps	
Control panels, monitoring and control sensors	
Plumbing BIM Elements only	
Fresh water piping, fittings, valves including hot & cold water pipe work with all plumbing equipment, sinks	
Water meters	
Storage, water holding tanks	
Pressure Vessels	
Underground Public Utilities for water supply	
Underground Public Utilities for drainage	
Grey water systems	
Pool filtration equipment	
Sanitary BIM Elements only	
Foul drainage, kitchen waste pipe work including floor drains, open trapped gullies, sealed trapped gullies and clean outs, vents and manholes	
Grease and sand traps	
Sump and sewage pits	

∗ these elements may cause BIM models to become too big and unmanageable.

(VI) FIRE PROTECTION BIM ELEMENTS

Element	Elements or Parameters needed by each non-Fire Protection discipline
System piping, droppers, fittings, valves and sprinkler heads, sprinkler inlets, sprinkler control valve set, subsidiary valves, flow switches	
Pipe supports and brackets ∗	
Fire alarm gongs & break glass unit	
Fire sprinkler pumps	
Sprinkler tanks	
Hydrants and hose reels (location of street fire hydrant determined by architects)	
Gas piping for suppression systems	
Heat or smoke detectors, control panels, monitoring and control sensors, pump panels, check meter positions	
Fire extinguishers	
Fire shutters & hoods above	
Smoke Curtains	

∗ these elements may cause BIM models to become too big and unmanageable.

(VII) ELECTRICAL BIM ELEMENTS

Element	Elements or Parameters needed by each non-Electrical discipline
Cable trays, trunking & cable containment, electrical risers, conduit, bus duct, power feeds	
Outlets, panels, wall switches, circuiting to devices, security devices, card access and “plug moulds” (socket points)	
HV & LV switch boards, switchgear, MCCB boards, MCB boards	
Transformers	
Light fittings & fixtures & housings for light fixtures	

Conduit associated with access, data communication, security systems and electrical equipment	
Telecom equipment and computer racks	
Generators and exhaust flues including acoustic treatments	
Diesel tanks & fuel pipes	
Security system including CCTV camera, smart card system, door monitoring system	
Car park control system, barrier gates	
Equipment and associated installations maintained by public utility companies (including manholes / drawpits for the Power Grid)	
Earthing and lightning protection system	
Lifts, PA systems, BMS equipments including display panels (e.g. power consumption display)	

∗ these elements may cause BIM models to become too big and unmanageable.

(VIII) GAS BIM ELEMENTS

Element	Elements or Parameters needed by each non-Gas discipline
Gas piping and supply	

Appendix B – Suggested Colour Coding for Modelling

ACMV

SYSTEM TYPE	COLOR	RED	GREEN	BLUE
Supply Air	150	0	127	255
Return Air	92	0	189	0
Fresh Air	200	191	0	255
Exhaust Air	34	129	64	0
Primary Air	130	0	255	255
Kitchen Supply Air	210	255	0	255
Stair Pressurization Air	200	191	0	255
Lobby Pressurization Air	200	191	0	255
Toilet Exhaust Air	34	129	64	0
Kitchen Exhaust Air	40	255	191	0
Smoke Engineering Air	34	129	64	0
Chilled Water Supply Pipe	55	129	129	86
Chilled Water Return Pipe	55	129	129	86
Refrigerant Pipe	55	129	129	86
Condensate Drain Pipe	55	129	129	86
Mechanical Equipment	32	189	94	0
Motor Control Panel	32	189	94	0
Supply Air Grille	151	170	212	255
Return Air Grille	93	126	189	126
Fresh Air Grille	201	234	170	255
Exhaust Air Grille	35	129	107	89
Primary Air Grille	131	170	255	255
Kitchen Supply Air Grille	211	255	170	255
Toilet Exhaust Air Grille	35	129	107	89
Kitchen Exhaust Air Grille	41	255	234	170
Fire Damper	244	129	0	31
Motorized fire Damper	7	255	255	255
Damper	7	255	255	255
Access Panel	7	255	255	255
ACMV Text	52	189	189	0
Equipment Text	32	189	94	0

ELECTRICAL

SYSTEM TYPE	COLOR	RED	GREEN	BLUE
Normal Power Cable Tray/Trunking/Ladder (Hatch)	131	170	255	255
Emergency Power/GSM/Security Cable Tray/Trunking/Ladder (Hatch)	80	63	255	0
Telecommunication System (Tel/Data Scv)	131	170	255	255
Power System	80	63	255	0
Public System	80	63	255	0
Lighting Fixture	241	255	170	199
Lighting Fixture	71	212	255	170
Lighting Circuit (Dashed Line Type)	51	255	255	170
Lighting Circuit (Divide Line Type)	61	234	255	170
Lighting Fixture	131	170	255	255
Lighting Fixture	71	212	255	170
Electrical Equipment	2	255	255	0
Electrical Panel	80	63	255	0
Electrical Power Bus-Bar Trunking	2	255	255	0
Electrical Equipment (Centre Line Type)	2	255	255	0
Cable TV Lead-In Pipes/ Underground Cables	230	255	0	127
Security System/ Electrical Opening	141	170	234	255
Telephone Lead-In Pipes	230	255	0	127
TV Antenna System, Cable TV System (TV Pt., Data Pt., Tele Pt. Etc...)	131	170	255	255
Revision Cloud	50	255	255	0
Electrical Lead-In Pipe/ Underground Cables (Hidden Line Type)	2	255	255	0

PROTECTION, PLUMBING, SANITARY & GAS

SYSTEM TYPE	COLOR	RED	GREEN	BLUE
Fire Protection Pipe	241	255	170	191
Fire Protection Concealed Pipe	134	0	129	129
Fire Protection Exposed Pipe	231	255	170	212
Sanitary SWP	240	255	0	63
Sanitary WP	240	255	0	63
Vent	94	0	129	0
Domestic Cold Water Booster Pipe	214	129	0	129
Domestic Cold Water Gravity Pipe	240	255	0	63
Domestic Cold Water Transfer Pipe	230	255	0	127
Domestic Hot Water Booster Pipe	214	129	0	129
Domestic Hot Water Gravity Pipe	240	255	0	63
Domestic Hot Water Return Pipe	30	255	127	0
NEWater Water Booster Pipe	214	129	0	129
NEWater Water Gravity Pipe	240	255	0	63
NEWater Water Transfer Pipe	230	255	0	127
Plumbing Annotation	51	255	255	170

This guide is part of the BIM Essential Guide Series

BIM Essential Guide	FOR EACH BIM PROJECT		FOR EACH ORGANIZATION
	WITHIN EACH DISCIPLINE	ACROSS MULTIPLE DISCIPLINES	ALL DISCIPLINES
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For MEP Consultants	●		
For Contractor	●		
For BIM Execution Plan		●	
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