Building Information Modelling (BIM) Guide for Building Services Installation (Version 1.1)

Building Services Branch
Architectural Services Department

Objective

The primary purpose of this Guide is to gather and present factual materials in such a manner that project officers, both professional and technical, could obtain a common reference of the various practices on the adoption of BIM in design and construction for building services installations in building projects undertaken by the Building Services Branch of the Architectural Services Department.

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1. Introduction

1.1 Overview

This Building Information Modelling (BIM) Guide for Building Services Installation (hereinafter as the "Guide") documented the general requirements in the management and production of BIM models for new works projects managed by Architectural Services Department (ArchSD). It aims at providing the general requirements and practices for the processing of BIM model and related deliverables at design, construction and handover stages as reference. The Guide is formulated base on local and international recognized BIM standards, guidelines and industry practices. BIM is still under rapid development and this Guide would subject to regular review and update to suit the latest development on BIM.

1.2 Reference BIM Standards and Guidelines

This Guide has made referenced to the following international and local standards and guidelines:

(a) CIC Building Information Modelling Standards General issued by Hong Kong Construction Industry Council
(b) CIC Building Information Modelling Standards for Mechanical, Electrical and Plumbing (MEP) issued by Hong Kong Construction Industry Council
(c) CIC Production of BIM Object Guide – General Requirements issued by Hong Kong Construction Industry Council
(d) Computer-Aided-Drafting Standard for Works Projects (CSWP) issued by Development Bureau of the HKSAR Government
(e) American Institute of Architects (AIA)'s G202-2013 Building Information Modeling Protocol Form.
(f) BS EN ISO 19650-1: 2018 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling Part 1: Concepts and Principles
(g) BS EN ISO 19650-2: 2018 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling Part 2: Delivery Phase

of the Assets

(h) BS 8536-1:2015 Briefing for design and construction. Code of practice for facilities management (Buildings infrastructure).

(i) PAS 1192-3:2014 Specification for information management for the operational phase of assets using Building Information Modelling.

(j) BS 1192-4:2014 Collaborative production of information Part 4: Fulfilling employers information exchange requirements using COBie – Code of practice

(k) PAS 1192-5:2015: Specification for security-minded Building Information Modelling, digital built environments and smart asset management.

(l) Building Information Modelling – Asset Management (BIM-AM) Standards and Guidelines Version 2.0 issued by EMSD.

(m) BIM Guide for Facilities Upkeep issued by Property Services Branch of Architectural Services Department.

1.3 Terminology

The common terminology for BIM process are listed below:

Terminology	Description
3D	Three-dimensional geometry
4D	Construction sequencing information
5D	Cost information
6D	Project life-cycle information
CAD	Computer-Aided Design
Common Data Environment (CDE)	An electronic platform to manage the collection, creating, sharing and publishing of project information. This is the single source of all information relating to the project and should be set up to facilitate the spatial coordination and information exchange processes described in BS EN ISO 19650-1:2018.

COBie	Construction Operations Building Information Exchange (COBie), an international standard to manage asset data information rather than geometric information such as equipment list and product data. COBie may take several approved formats include spreadsheet and IFC file format.
Object /Element	An occurrence of a building component in BIM software at a particular location and orientation within a model (e.g. MCB board, supply air duct, etc.).
Object file	A data file that contains building elements. It often contains the geometry and parameters representing the elements. It can be created or loaded into the BIM authoring software to assist design.
Federated Model	Compilation of Models from one or more programs that can define a complete or partial data set for a design.
Industry Foundation Class (IFC)	A platform neutral, open and object-based file format specification with developed by buildingSMART to facilitate interoperability in the architectural, engineering and construction industry, and is commonly used collaboration format in BIM based projects. The IFC model specification is registered by ISO as ISO 16739:2013.
LOD	Level of Development (LOD) defined in American Institute of Architects (AIA)'s G202-2013 Building Information Modeling Protocol Form
LOD-G	LOD-Graphics (LOD-G), a more clear definition to describe the graphical representation required of a MEP element as defined in CIC Building Information Modelling Standards for Mechanical Electrical and Plumbing (MEP)
LOD-I	LOD-Information (LOD-I), a more clear definition to describe the non-graphical information required of a MEP element as defined

in CIC Building Information Modelling Standards for Mechanical Electrical and Plumbing (MEP)

2. Data Management Requirements

2.1 General

Prior to BIM model production, a unified data management structure should be established for efficient BIM collaboration and information exchange. The project setup framework should make reference to the BS1192:2007 +A2:2016 – Code of Practice for the Collaborative Production of Architectural, Engineering and Construction Information. A project folder setup should be developed for individual project by the project team according to the agreed /approved BIM Project Execution Plan.

2.2 Project Folder Structure

Project folder structures with reference to the principles of BS1192:2007 on segregation of data within a designated set of folders are recommended as follows:

Design Stage and Construction Stages

Folder Structure	Description
[Project Name]	
BIM	
01_Incoming	**Incoming data**
ADA	*[Architectural data]*
ADS	*[Structure data]*
02_WIP	**Work in process data**
BIM	*[Model under authoring]*
CAD	*[Drawing under authoring]*
Export	*[Export data]*
Object	*[BIM objects under creation]*
SheetFiles	*[Sheet files for create output]*
TSA	*[Temporary shared area]*
03_Shared	**Verified data for sharing**
BIM	*[Design model files]*
CAD	*[CAD or pdf output files]*
Coordinate	*[Federated model files]*

Folder Structure	Description
04_Published	**Published data**
YYYY-MM-DD-Description	*[Sample]*
05_Archive	**Archived data**
YYYY-MM-DD-Description	*[Sample]*
06_Resource	**Project BIM resource data**
Templates	
Title Blocks	
Logos	
Objects	
07_[others as required]	

As-built Model at the time of handover

Folder Structure	Description
[Project Name]	
BIM	
10_Admin	**Published data**
ADA	*[Architectural data]*
ADS	*[Structure data]*
BIMEXP	*[BIM Execution Plan]*
20_As-built	**As-built data**
21 BIM	*[As-built 3D models]*
22 CAD	*[As-built 2D drawings]*
23 Objects	*[BIM objects files]*
30_O&M Documentation	**O&M documents**
301 Lift & Escalator	*[T&C reports & O&M manuals]*
T&C	
O&M Manuals	
Catalogues	
Others	
302 LV Switchboard	*[T&C reports & O&M manuals]*
303 Emergyency Genertor	*[T&C reports & O&M manuals]*
304 HVAC System	*[T&C reports & O&M manuals]*
305 Boiler System	*[T&C reports & O&M manuals]*

Folder Structure	Description
306 Filtration Plant	*[T&C reports & O&M manuals]*
307 FS System	*[T&C reports & O&M manuals]*
308 UPS	*[T&C reports & O&M manuals]*
309 Burglar Alarm	*[T&C reports & O&M manuals]*
310 Radar & Navigation	*[T&C reports & O&M manuals]*
311 Microwave Link System	*[T&C reports & O&M manuals]*
312 Timing & Display System	*[T&C reports & O&M manuals]*
313 AV Electronic System	*[T&C reports & O&M manuals]*
314 Audio Electronic System	*[T&C reports & O&M manuals]*
315 Radio Electronics System	*[T&C reports & O&M manuals]*
316 CCTV System	*[T&C reports & O&M manuals]*
317 Broadcaset Reception	*[T&C reports & O&M manuals]*
318 Lighting	*[T&C reports & O&M manuals]*
319 Electrical Distribution	*[T&C reports & O&M manuals]*
320 Others	*[T&C reports & O&M manuals of others equipment]*
40_Statutory	**Statutory record**
VENT	*[e.g. Ventilation certificate, etc.]*
EE	*[e.g. WR1, etc.]*
FS	*[e.g. FS251, DG certificate, etc.]*
LF	*[e.g. Form 5, Form 11, etc.]*
PL	*[e.g. Approved WWO46, etc.]*
F&IU	*[e.g. Form 5, etc.]*
50_Others	**Other documents not classified above**

Sub-folders 301 to 319 are to match with the 19 types MEP system categories in according to the Building Information Modelling – Asset Management (BIM-AM) Standards and Guidelines issued by EMSD for interface. For BS installations other than the 19 types, sub-folders start from 320 onward should be created to store the required T&C and O&M information.

2.3 Model Division

A project BIM model should be divided into separate services /systems depends on the nature and complexity of the project. For projects with large site footprint where several building blocks

existed, the model may be further divided into several zones (building blocks) for more efficient handling of models. For example:

Example: For project with a single building block:

Model Name	Building	Services /System
ADB-8216-ALL-EE-N	Government Offices	Electrical
ADB-8216-ALL-AC-N	Government Offices	Air-conditioning
ADB-8216-ALL-FS-N	Government Offices	Fire Service

Example: For project with 2 separated building blocks:

Model Name	Building	Services /System
ADB-8312-BK1-EE-N	Government Offices Block 1	Electrical
ADB-8312-BK1-AC-N	Government Offices Block 1	Air-conditioning
ADB-8312-BK1-FS-N	Government Offices Block 1	Fire Service
ADB-8312-BK2-EE-N	Government Offices Block 2	Electrical
ADB-8312-BK2-AC-N	Government Offices Block 2	Air-conditioning
ADB-8312-BK2-FS-N	Government Offices Block 2	Fire Service

Under special circumstances, a single BIM model may be acceptable depends on the nature and complexity of project. The BIM Project Execution Plan shall state the model division strategy (by services /systems or building blocks, etc.). File sizes of each divided BIM model shall be kept in minimum by purging of unused views, BIM objects and settings before publish or submission. In general, the maximum file size for each divided BIM model is preferably control under 300Mb. The modelling practices for all divided BIM models shall be consistent so that they could be combined into federated model together with models of other disciplines in common software platform tools.

2.4 File Naming Conventions

Unified conventions in BIM model file naming are essential to standardize model file structure for coordination of modelling activity in project life cycle. The naming convention as stated in this Guide is for BIM model only. The drawing numbering system currently in use by the department should remain unchanged.

2.4.1 Model File Naming

The recommended model file naming structure (5-6 fields separate by a hyphen "-" between the fields) in design and construction stage is as below:

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
Agent Responsible Code	InForM Number	Zone / Block	System	Type (optional)	Description

Example:

Model File Name	Description
ADB-6603-ALL-EE-WIP.xxx	BS model, InforM 6603, no building zone separation, electrical installation, modelling work in progress
ADB-7781-Z01-FS-	

Remark: ".xxx" – file name extension

Field 1 : 3 characters (alphanumeric) for Agent Responsible Code, e.g.:
ADA for architectural discipline of ArchSD
ADB for building services discipline of ArchSD
ADS for structural discipline of ArchSD

Field 2 : InForM number of the project

Field 3 : Identifier of building zone, block or phase of the project, e.g.:
Zone 1 : "Z01"
No zoning : "All" should be used in this field

Field 4 : 2 characters (alphabetic) for short form of system, e.g.:
BS : Building Services
AC : Air-conditioning
EE : Electrical
FS : Fire Service

Field 5 : 1 character (alphabetic) define the status of the project, e.g.:

A : As-built

E : Existing

M : Maintenance

N : New Works

T : Temporary Works

W : All Works (e.g. combination of the above)

Field 6 : 3 characters (alphabetic) describe the use of model, e.g.:

Code	Use	Workstage involved
P01	Presentation	1-6
D01	SCCU Drainage Submission	3-6
T01	Tender	4
WIP	Work in Progress	1-6
X01	Design Option	1-4

2.4.2 View Naming

View naming convention helps to organize model viewing in the BIM software tool if applicable. Consider that the view naming would not affect the BIM project deliverables, the view naming convention would not be governed at this stage.

3. BIM Uses

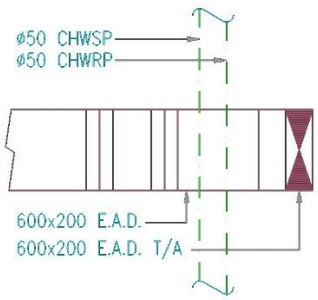
3.1 General

The scope of BIM Uses in public works projects shall be according to the Development Bureau (DEVB) Technical Circular (Works) No. 18/2018. The following sections describe the general requirements and acceptable deliverables for various BIM Uses for building services installation.

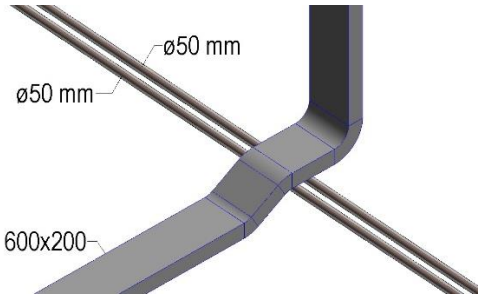
3.2 Design Authoring

Design Authoring is a process of design starting from the outset by using BIM software platform. Unlike traditional design process using 2D software tool, the spatial coordination among services and other disciplines could be perform efficiently by using BIM design software tool. The following graphs show the example on the design coordination between an air duct and chilled water pipes.

Traditional design authoring using 2D software tool



BIM design authoring with coordination among services from the outset



Unlike other disciplines, the design of building services installation usually start from the schematic logic prior to the spatial design. For example, the designer would first outline the electrical power distribution schematic before working on the power distribution routings. Since the market available BIM software tools at present may not have the capability to logically link up between the schematic design and the spatial design information, it is understandable that a hybrid environment, i.e. use of 2D design tools to outline the logical schematic design and use of BIM software tool to exercise 3D spatial design would still be maintained.

3.3 Design Review

Design Review is a process for stakeholders to view BIM model, images from the models or animated walk-throughs of the design, provide feedback and validate design aspects such as meeting design /specification requirements and previewing spaces /layouts in 3D geometry. Examples of the process are as follows:

(a) Regular workshop or meeting to review the federated BIM design model by project team in design stage using BIM software platform;

(b) Regular workshop or meeting to review the federated BIM construction model by project team before construction /installation of equipment in construction stage using BIM software platform; and

(c) Virtual mock-ups for review and approval by project team or client.

There are numerous ways for carrying out design review process. Some examples are animated walk-throughs in BIM software platform, virtual mock-up by BIM software platform and virtual mock-up by using virtual reality technology, etc. where project team may consider to plan and specify if appropriate.

3.4 Existing Conditions Modelling

It is a process of 3D digital survey and production of BIM model for an existing site to facilitate design planning. The digital survey may be carried out by photogrammetry or laser scanning technology to generate Point Cloud model which is later transformed to an editable BIM model. The deliverables should at least include BIM model(s) indicating the existing building services, architectural and structure elements as appropriate. Where specified, the 3D digital survey model should meet the following requirements:

(a) Georeferenced to the absolute coordinate system;

(b) Referenced and generated from the digital Point Cloud survey result;

(c) With colour schemes applied to various building services, architectural and structure elements for differentiation; and

(d) Capable to serve as a base model for next step design authoring use.

3.5 Site Analysis

It is a process in which BIM and GIS tools are used to evaluate a site to determine the most suitable location, position and orientation for a future project. The analysis shall include master planning, sun and shadow studies, daylight analysis and solar envelope analysis. This is normally performed by architect and is only required if specified in project.

3.6 3D Coordination

It is a process of using clash detection software tools to identify conflicts by analyzing 3D design models from time to time during the design authoring process. The goal of the coordination process is to deliver a proper design in design /pre-construction stage where the design /pre-construction scheme should be clash-free. It is an on-going process starting from the outset of design by various disciplines of design professionals. The following deliverables should be provided in design and construction stage as minimum:

(a) Clash analysis reports for the combined building services model for individual zones /floors;

(b) Action plan with target completion schedule to handle and eliminate detected clashes by designer /design consultants; and

(c) The clash analysis shall include the checking of headroom requirements and working spaces for building services operations and maintenance activities.

3.7 Cost Estimation

It is a process of quantity take-offs directly from the BIM model to assist for cost estimation exercise for a project. For example, the use of BIM model to assist for counting the number of major equipment (e.g. AHU) for the project. This is normally performed by quantity surveyor.

3.8 Engineering Analysis

It is a process to analyze and assess different design options to determine the most effective engineering solution by using BIM modelling or associated software. Application examples includes lighting performance analysis, computational fluid dynamic (CFD) analysis and chiller plant energy analysis etc.

3.9 Facility Energy Analysis

It is a process to analyze and assess the building energy performance by using building energy simulation software for the BIM model.

3.10 Sustainability Evaluation

It is a process in which a project BIM model is evaluated base on locally or internationally recognized building environmental performance assessment tool such as BEAM Plus, LEED, etc.

3.11 Space Programming

It is a process in which a spatial program is used to efficiently and accurately assess a design layout model in regard to client spatial requirements. This is normally performed by architect and is only required if specified in project.

3.12 Phase Planning (4D Modelling)

It is a process of linking a construction work programme to the model which is used to show the construction sequence and phasing for construction. The process is usually name as 4D modelling. The following deliverables should be provided in construction stage as minimum:

(a) On top of the overall building construction 4D work sequence model, separate 4D model for the following major building services plants for delivery and installation, and for future dismantle and replacement, should be provided:

- Central air-conditioning chilled water plant with total cooling capacity exceed 10,000kW; and
- Central steam plant with total steam capacity exceed 2 ton/hour.

(b) The 4D work sequence model shall link up the construction master programme to demonstrate the compatibility of the installation works sequences of the BS/E&M plant; and

(c) The model shall be assigned with the delivery path of major building services equipment to demonstrate the feasibility and effectiveness of the installation method statements of the works. All temporary works and site logistic arrangement shall be modelled to demonstrate the feasibility and prove the constructability and buildability of the proposed method statement.

3.13 Digital Fabrication

It is a process to use BIM models to facilitate the fabrication of construction materials or assemblies such as sheet metal fabrication, structural steel fabrication and pipe cutting. The models can also be used for prototyping with 3D printers as part of a design intent review process.

3.14 Site Utilization Planning

It is a process to use BIM models to perform site space planning, site logistics, sequencing requirements, temporary works and safety. If specified, the construction phase BIM model should be linked to the construction schedule (4D) include permanent and temporary facilities on site for all of the phases of the construction process. This is normally performed by the contractor if specified in project.

3.15 3D Control and Planning (Digital Layout)

It is a process utilizes a BIM model to layout project elements such as the position of walls using a total station with survey points preassigned in the model. The process of automating the control of equipment's movement and location such as using GPS coordinates to determine if proper excavation depth is reached.

3.16 As-built Modelling

It is a process of preparing an accurate record of the physical conditions and assets of a project. The as-built model should contain information relating to the building services elements with

links to operation, maintenance, and asset data. Additional information and data for equipment and space planning may be included. The following deliverables should be provided for as-built BIM model:

(a) 3D digital point cloud scanning for the following completed works;

- Central air-conditioning chilled water plant with total cooling capacity exceed 10,000kW; and
- Central steam plant with total steam capacity exceed 2 ton/hour.

(b) As-built BIM model(s) with required equipment /materials information embedded;

(c) File folder contains the as-built model(s) and other necessary information, files and documents as required for asset management (refer to other section of this Guide).

3.17 Project System Analysis

It is a process to measure how a project performs compared to the design specifications. This may include assessing how a mechanical system operates, how much energy a project uses, conducting lighting analysis, solar gain analysis and airflow analysis using CFD.

3.18 Maintenance Scheduling

It is a process for planning and managing the maintenance of a project structure, building fabric and equipment during the operational life of a facility. The data required for asset management should be collected during the construction stages and input into the as-built BIM model.

3.19 Space Management and Tracking

It is a process to utilize as-built BIM model to assess, manage and track spaces and associated resources within a project. A BIM database may be integrated with spatial tracking software to analyze the existing use of space, apply transition planning for renovations and refurbishment projects.

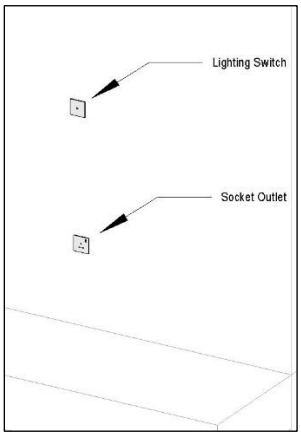
3.20 Asset Management

It is a process of bi-directionally linking an as-Built BIM model database to an organized building management system which can be used to maintain and operate a facility and its assets. The assets may include buildings, infrastructure, systems and equipment which may be operated, maintained and upgraded. The process utilizes the data contained in an as-built BIM model to populate an asset management system. The bi-directional link allows users to visualize an asset in the model before servicing it.

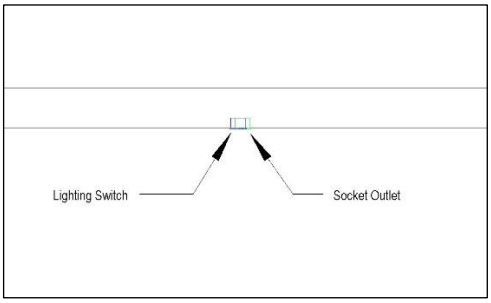
3.21 Drawing Generation (Drawing Production)

It is a process of producing drawing sheets from the BIM model source. For some building services equipment, the direct presentation of their geometry shape in 2D view may not be legible or identifiable on its function. The use of symbols with proper offset are required for clear presentation when generate the 3D geometry model to 2D drawing sheet. Examples are provided in the following images.

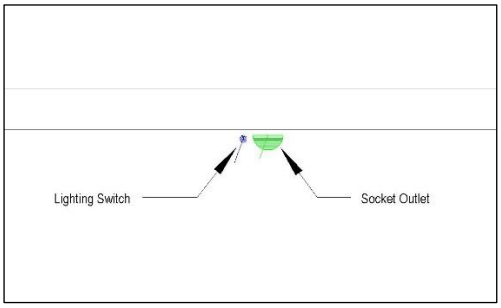
3D geometry arrangement of a lighting switch and socket outlet in a wall



Direct presentation of geometry shape of the lighting switch and socket outlet in 2D plan view, where the presentation is not legible



Use of symbol /legend to present the objects with proper offset



For schematic and control logic diagrams as supplement of design details of building services designs, the use of 2D design authoring tools to produce the drawings are acceptable. 2D drawings which are generated from the BIM model need not to follow CSWP.

4. Modelling Requirements

4.1 Model Origin Point and Orientation

The origin point and orientation of a BIM model shall be defined and coordinated with all disciplines as follows:

(a) Eastings and Northings shall refer to Hong Kong 1980 Grid System; and
(b) Elevations shall refer to Hong Kong Principal Datum (HKPD).

If a model is produced in a local co-ordinate system due to software functionality or limitations, the BIM coordinator or modeller shall be responsible for providing clear instruction and documentation as to the origin x, y, z and bearing translations accompanying their BIM submission.

4.2 Linking to Architectural or Structure Models

The general rules for model linking are as follows:

(a) The coordinates of the architectural and/or structure models should be checked before linking. Same coordinates should be adopted for models to be linked.
(b) Models to be linked should be purged before linking.
(c) Do not link to model under working (WIP).
(d) The linked model should not be a copy of the central model.

4.3 Unit of Measurement

BIM model should be modelled in metric system (International System of Units or SI Units).

4.4 Date Format

Date format should follow ISO 8601 Data elements and interchange formats -Information interchange - Representation of dates and times as follow:

Year				Month		Date	
Y	Y	Y	Y	M	M	D	D

4.5 Scope of Modelling

The BIM model should covers the entire building services installation for the whole project development if associated architectural model is available. In general, components not embedded into concrete or building structure should be model. As a general reference, the building services objects /elements listed in **Annex A – Modelling Scope and Recommended LOD Requirements** should be modelled if applicable to the projects. The list in Annex A is not exhaustive and additional objects /elements specific to individual projects should be included and documented in the BIM Project Execution Plan.

4.6 Level of Development (LOD) for MEP

The recommended LODs for individual building services element at different stages are listed in Annex A. The LOD definitions and requirements of graphical representation (LOD-Graphics) and non-graphical information (LOD-Information) of MEP elements should make reference to the CIC's Building Information Modelling Standards for Mechanical Electrical and Plumbing (MEP).

4.6.1 Level of Development – Graphic (LOD-G)

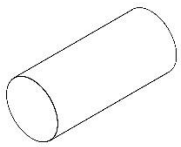
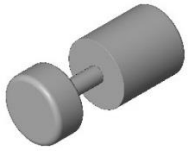
The definitions of various levels of the LOD-G for building services installation are as following table.

Definition of LOD-Graphics (LOD-G)

LOD-G	Definition
100	The model element is graphically represented with a symbol or generic representation. Symbols can be reference to the CSWP.
200	The model element is graphically represented within the model as a **generic** system, object or assembly with approximate quantities, size, shape, location and orientation. The general required spaces for access and maintenance shall be indicated. Model element is graphically represented as assumed size /shape of equipment
300	The model element is graphically represented within the model as a **specific** system, object or assembly in terms of quantity, size, shape, location and orientation. The model / object shall include details for the indication of required spaces for access and maintenance for handling installation and maintenance needs and the details for interfacing checking and coordination with other models / objects. The model element should easily be recognized the graphical representation without further clarification.
400	The object is graphically represented within the model as a **specific** system, object or assembly in terms of quantity, size, shape, location and orientation with detailing, fabrication, assembly and installation information.

Examples of the object graphical representations for a water pump set at different levels of LOD-G are illustrate in following table.

Example of Object Graphical Representation for a Water Pump Set

LOD	Example Image	Description
100		**Schematic Model** The water pump set is modelled to indicate its existence for scheme design purpose
200		**Generic Model** A generic water pump set in which the approximate quantities, size, shape, location and orientation are not specific
300		**Specific Model** A specific water pump set in which the quantity, size, shape, location and orientation are specific for individual design application area
400		**Specific Model with Fabrication Details** A specific water pump set in which the manufacturer size, dimensions and details are specific for fabrication purpose

4.6.2 Level of Development – Information (LOD-I)

LOD-I is the description of non-graphical information of a MEP model element. The information required for the model elements will be enriched as a project progresses and evolves. The minimum data requirements at various levels of LOD-I for building services installation are as following table.

Minimum Data Requirements of LOD-Graphics (LOD-G)

BIM Object Properties	Object Data Requirements	LOD-I				
		100	200	300	400	500
General Properties	General information of the object including equipment identification, designation, type and materials, etc.	R	R	R	R	R
Design Properties	Design information and parameters of the objects.		R	R	R	R
Classification Properties (Optional)	The classification title and code of the model elements may reference to the OmniClass table 23 or other coding system as agreed			R	R	R
Manufacturer's Equipment Properties	Manufacturer's equipment information and parameters of the objects.				R	R
Condition Properties	Installation information including installation month/year, latest testing /commissioning month/year and the field verification method for as-built quality assurance.				R	R
Asset Management Properties	Information for asset management including equipment manufacturer's name, supplier's name, brand name, model number and equipment life expectancy, hyperlink to operational and maintenance manuals, etc.				R	R
Verification Properties	Verification method for site installation of the BIM objects					R

Remark: R – Required

Examples of the object data requirements for an air-cooled at different levels of LOD-I are illustrate in following table.

Example of Object Data Requirements for an Air-cooled Chiller

BIM Object Properties	Object Data Requirements	LOD-I				
		100	200	300	400	500
General Properties	Equipment type : air-cooled chiller Designation : ACC-01	R	R	R	R	R
Design Properties	Cooling capacity : 1,000 kW Chilled water output temperature : 7ºC Chilled water inlet temperature : 12.5ºC Evaporator water flow rate : 43 l/s Ambient temperature : 35ºC AHRI's Coefficient of Performance : 3.2 AHRI's Integrated Part-load Value : 7 Compressor : screw / centrifugal		R	R	R	R
Classification Properties	Reference to the OmniClass table 23			R	R	R
Manufacturer's Equipment Properties	Rated cooling capacity : 1,080 kW Chilled water output temperature : 7ºC Chilled water inlet temperature : 12.5ºC Evaporator water flow rate : 47 l/s Ambient temperature : 35ºC AHRI's Coefficient of Performance : 3.4 AHRI's Integrated Part-load Value : 7.6 Compressor : centrifugal No. of compressor : 1				R	R
Condition Properties	Installation date : Sep 2020 Commissioning date : Oct 2020 Field verification : laser scanning				R	R
Asset Management Properties	Manufacturer : XXX Co. Ltd. Supplier : YYY Co. Ltd. Brand : AAA Model number : ACC-CENT-1000 Country of origin : PRC Compressor life expectancy : 20 years Evaporator life expectancy : 20 years Condenser fan life expectancy : 15 years O&M manual : <hyperlink>				R	R

BIM Object Properties	Object Data Requirements	LOD-I				
		100	200	300	400	500
Verification Properties	Field verified by a measured survey					R

Remark: R – Required

4.7 Presentation Style

The line weight and line type in 2D drawing presentation and the colour code in 3D model view for presentation should be standardarized and follow the recommendations in Annex B - Color Code and Line Style for Systems. The recommended color code and line style should be applied for design, construction and as-built models.

4.8 Clearance Space for Operation and Maintenance

For construction and as-built model, the following major model elements /objects should incorporate clearance spaces to demonstrate operation and maintenance in the BIM model. Clearance should be included in the properties of objects to enable clash detection process in the BIM software tools.

- Chiller
- Boiler
- Plate Type Heat Exchanger
- Air-handling Unit /Primary Air Unit
- High /Low Voltage Cubicle Switchboard
- Generator
- Condensing Units
- Cooling Towers
- Valve set etc.

4.9 MEP Object File

MEP object file is a data file contains building services element and should include the graphical representation and non-graphical information to indicate the element's characteristics. It should also include the 2D component of symbol and tag /label /annotation if applicable.

The MEP object should be provided with a BIM Object Sheet to convince all parties that the MEP object created is complete, satisfying the requirements and the purpose of drawing

production. The details for the creation of MEP object should refer to the CIC Production of BIM Object Guide – General Requirements

4.9.1 General Requirements for MEP Object Creation

The following general requirements should be followed in creation of object:

(a) The object file should include information of physical dimension for coordination of BIM model.

(b) Drawing symbol should be included in an object file for 2D drawing output and can be referenced to the CAD Standard for Works Projects (CSWP). The shape and size of symbol should be coordinated for easy reading in the drawing output.

(c) Symbolic 2D annotation (drawing symbol) should be visible while the 3D geometry should be invisible in drawing output of plan view.

(d) 3D geometry shall be visible for rendering in 3D view.

(e) Object file should include the material /equipment information.

(f) Nesting object file should be limited to 2 levels except for drawing symbol. It is important to understand that nesting object file increases the file size and affects performance, specifically the regeneration process of the object file views.

(g) Host object file should not be allowed.

(h) The LOD, line styles, line weight, line pattern, text style and unit of measurement for modelling of object shall refer to relevant sections of this Guide.

(i) To minimize the object file size, only essential connectors should be used and the object file should be created directly from an object file template to reduce extra information in an object file

(j) Level of the insertion /origin point of the object file is recommended at the centre point at the bottom level of the object.

4.9.2 Object File Naming Convention

The recommended object file naming structure (4-5 fields separate by a hyphen between the fields) in design and construction stage is as below:

Field 1	**Field 2**	**Field 3**	**Field 4**	**Field 5**
Category	Sub-Type	Originator	Descriptor 1	Descriptor 2 (Optional)

Example:

Model File Name	**Description**
HVAC-CHR-ADB-AIR_COOLED-800KW	Object created by ArchSD BSB, HVAC System, Chiller, 800kW rating
EL-DTB-ADB-400A	Object created by ArchSD BSB, Electrical Distribution System, Distribution Board, 400A rating

Remark: ".xxx" – file name extension

Field 1 : 3 - 4 characters (alphabetic) for category of the BIM object as specified as the "System Code" in the EMSD's latest version of the BIM-AM Standards and Guidelines, e.g.:
HVAC : Heating, Ventilation and Air-Conditioning
EMG : Emergency Generator

Field 2 : 2 - 4 characters (alphabetic) for sub-type of the BIM object as specified as the "Equipment Code" in the EMSD's latest version of the BIM-AM Standards and Guidelines, e.g.:
AHU : Air-handling Unit
DTB : Distribution Board

Field 3 3 characters (alphanumeric) indicate the Originator (who own or create the BIM object), same as the Agent Responsible Code, e.g.:
ADA for architectural discipline of ArchSD
ADB for building services discipline of ArchSD
ADS for structural discipline of ArchSD

Field 4 : Maximum 20 characters (alphanumeric) further describe the BIM object, e.g.:
AIR_COOLED : Air-cooled
400A : 400 ampere

Field 5 : Optional field, maximum 20 characters (alphanumeric) further describe the BIM object, e.g.:
AIR_COOLED : Air-cooled
13A : 13 ampere

5. Data Requirements for Asset Management

5.1 Data Format of As-built Information

The requirements of BIM folder structure, file coding, naming convention, model presentation style (colour code, line type, line weight, etc.) and unit of measurement of the as-built BIM model for building services installations should make reference to the Building Information Modelling – Asset Management (BIM-AM) Standards and Guidelines issued by EMSD. The BIM-AM Standards and Guidelines can be downloaded in the EMSD Internet.

For the requirements of as-built BIM model for plumbing and drainage installations, reference should be made to the BIM Guide for Facilities Upkeep issued by Property Services Branch of Architectural Services Department.

If the building MEP facilities would not be handed over to EMSD for maintenance (example: Schedule 2 hospital to be maintained by the Hospital Authority), the project client should be consulted on the detailed as-built BIM data requirements and the explicit referencing to the EMSD's BIM-AM Standards and Guidelines may not necessary required.

5.2 Deliverables

The following deliverables should be included in the as-built information file folder:

(a) BIM execution plan indicating the adopted modelling methodology and details;
(b) As-built BIM models for all disciplines and 2D drawing files for building services installation;
(c) Design authoring tools' templates, title block, BIM object files and other necessary resources for viewing of the as-built BIM model;
(d) Testing and Commissioning reports;
(e) Operation and Maintenance manuals;
(f) Relevant statutory certificates, approval documents and forms; and
(g) Other relevant project information as required.

Annex A – Modelling Scope and Level of Development (LOD) Requirement

FS : Feasibility Study /Conceptual Design model
SD : Sketch Design / Approval-in-Principle (AIP) model
DD : Detailed Design / Detailed Design Approval (DDA) model
SA : Submission to Approval Authority (e.g. SCCU)
TN : Tender model
CON : Construction shop model
Ab : As-built model
V : Field vertification
V(I) : Field verification by visual inspection
V(M) : Field verification by measured survey

MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
HVAC Installation															
Chiller	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Heat pump	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Cooling tower	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Heat exchanger	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Calorifier	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Chilled water pump	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Heating water pump	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Condenser tube cleaning equipment	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
VRV/DX indoor and outdoor unit	-	-	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Standalone air-conditioner /Split-type unit	-	-	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Primary air unit (PAU)	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)

Annex A – Modelling Scope and Level of Development (LOD) Requirement

FS : Feasibility Study /Conceptual Design model
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V(M) : Field verification by measured survey

MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Air-handling unit (AHU)	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Fan-coil unit (FCU)	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Computer room air-conditioning (CRAC) unit	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Ventilation fan	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Booster fan	-	-	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Jet fan	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Rotary fan (fixed type)	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Ceiling fan	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Water scrubber	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Constant air volume box /air valve	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Variable air volume box /air valve	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Air duct	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

Annex A – Modelling Scope and Level of Development (LOD) Requirement

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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Chilled /Heating water pipe	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Condensate drain pipe	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Water pipe (others)	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Valve (>20mm dia.)	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Air damper	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Fire /smoke damper	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Air diffuser /grille	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Direct digital control (DDC) panel	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
CCMS server /server rack	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Control console	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Steam and Hot Water System															
Steam /hot water boiler	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)

Annex A – Modelling Scope and Level of Development (LOD) Requirement

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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Heat exchanger	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Calorifier	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Feed /blow down water tank	-	-	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Steam /hot water pipe	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Steam condensate pipe	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Steam flash vessel	-	-	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Valve (>20mm dia.)	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Steam trap	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Main control console /panel	-	-	-	-	200	200	-	-	200	200	300	300	300	500	V(I)
Electrical Installation															
Transformer (customer owned)	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Switchboard cubicle	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)

Annex A – Modelling Scope and Level of Development (LOD) Requirement

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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Cut-out supply panel	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Motor control centre	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Motor control panel	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Uninterruptible power supply unit (except small-scale standalone UPS for computer)	-	-	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Variable speed drive (standalone)	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
MCCB /MCB board	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Socket outlet	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Floor box	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fuse spur unit	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Electric vehicle charging panel /station	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Generator set	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Generator remote radiator	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)

Annex A – Modelling Scope and Level of Development (LOD) Requirement

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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Generator cooling water pump	-	-	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Fuel tank	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Fuel pump	-	-	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Fuel pipe	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fuel valve (>20mm dia.)	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Photovoltaic panel	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Wind turbine	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Capacitor bank cubicle	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Harmonic filter cubicle	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Control /metering panel	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Luminaire /light fitting	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Lamp pole / bollard	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

Annex A – Modelling Scope and Level of Development (LOD) Requirement

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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Stage lighting bar	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Occupancy /daylight sensor	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Power busduct	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Cable ladder	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Cable tray	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Trunking	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fire Service Installation															
Sprinkler / FS / Booster water pump	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Water tank	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Street fire hydrant	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fire hydrant / Hose reel	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Sprinkler control valve	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

Annex A – Modelling Scope and Level of Development (LOD) Requirement

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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Sprinkler pre-action valve set	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Sprinkler flow switch	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Sprinkler head	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Gas flooding spray head	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Drencher spray head	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fire /Smoke /Heat /Beam detector	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Breakglass unit	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Alarm bell	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Visual fire alarm	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fire alarm / battery panel	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Portable fire extinguisher	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fixed automatically operated appliance	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

Annex A – Modelling Scope and Level of Development (LOD) Requirement

FS : Feasibility Study /Conceptual Design model
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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Exit /Directional sign	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Emergency luminaire	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Water pipe	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Valve (>20mm dia.)	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Pressurization fan	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Smoke extraction fan	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Smoke extraction air duct	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Total flooding gas pipe	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Burglar Alarm and Security Installation															
Drop arm barrier	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Mechanical road block	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Access card reader	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

Annex A – Modelling Scope and Level of Development (LOD) Requirement

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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Door release button	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Emergency breakglass unit	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Doorphone unit	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
CCTV camera	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Movement detector	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Glass break detector	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Watchman tour patrol point	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Centralized security system server /rack	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
CCTV video recorder /rack	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
CCTV control console	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
CCTV /Security system display panel	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Security system control panel	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

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	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Broadcast Reception Installation															
Aerials	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Preamplifier /Amplifier	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fibre optical panel	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Outlet	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Lift and Escalator Installation															
Lift car	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Lift machine	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Lift landing call panel	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fireman's switch	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Dumbwaiter car	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Escalator	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)

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	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Passenger conveyor	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Vertical lifting platform	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Stairlift	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Catering Equipment															
Food processing equipment	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Sink	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Dish washer	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Refrigerator	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Freezer	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Liquefied Petroleum /Town Gas Installation															
Gas pipe	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Gas valve	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

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	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Outlet	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Swimming Pool Water Treatment Installation															
Sand filter	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Ozone reaction tank	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Carbon filter tank	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Ozonator	-	-	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Sodium hypochlorite generation equipment	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Hypochlorite storage tank	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Hydrogen blower	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Hydrogen gas detection system	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
pH and Chlorine controller	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Mixed oxidant disinfection equipment	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

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	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Brine tank	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Mixed oxidant solution tank	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
UV chamber	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Water pump set	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Water pipe (>20mm dia.)	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Water valve (>20mm dia.)	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Medical Gas Pipeline System															
Vacuum insulated Evaporator (VIE) tank	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(M)
Oxygen manifold	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Medical /non-medical air compressor plant	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Air receiver	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Air dryer	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Dust /carbon filer	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Bacteria filer	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Compressed air manifold	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Anaesthetic gas scavenging manifold	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Vacuum air compressor	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Vacuum receiver /vessel	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Medical gas alarm zone panel	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Medical gas pipe	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Medical gas valve	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Medical gas outlet	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Mechanical Installation															
Gondola	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(M)

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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Fuel filling station	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fuel tank	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fuel pipe	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Fuel valve	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Car washing equipment	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Compressed air equipment	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Winch and pulley set	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Hoisting set	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Pneumatic Tube Transportation System															
Blower	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Diverter	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Reject station	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

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Empty chamber storage station	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Valve	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Transport station	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Transport tube	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Controller panel	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Automatic Refuse Collection System															
Refuse chute /pipe	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Compactor	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Exhauster	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Container	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Conveyor	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Refuse separator	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

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Refuse disposal inlet	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Inlet/ discharge valve	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Diverter valve	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Air treatment device	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Air blower	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Plumbing Installation															
Water tank	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Water pump set	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Pneumatic tank	100	100	100	200	200	200	-	-	200	200	300	300	300	500	V(I)
Water pipe (>20mm dia.)	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Valve (>20mm dia.)	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Rainwater Harvesting Installation															

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	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Water tank	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Sand filter	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Carbon filter	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Cartridge filter	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
UV chamber	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Pump set	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Pneumatic tank	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Water pipe (>20mm dia.)	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Valve (>20mm dia.)	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Drainage Installation															
Drainage pipe	-	-	100	100	200	200	200	200	200	200	300	300	300	500	V(I)
Manhole	-	-	100	100	200	200	200	200	200	200	300	300	300	500	V(I)

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	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Storm water inlet	-	-	100	100	200	200	200	200	200	200	300	300	300	500	V(I)
Floor drain inlet	-	-	100	100	200	200	200	200	200	200	300	300	300	500	V(I)
Sewage Pumping System															
Sewage pump	-	-	100	100	200	200	200	200	200	200	300	300	300	500	V(I)
Sewage pipe	-	-	100	100	200	200	200	200	200	200	300	300	300	500	V(I)
Sewage valve	-	-	100	100	200	200	200	200	200	200	300	300	300	500	V(I)
Greywater Recycling System															
Water tank	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Sand /Coarse filter	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Membrane bioreactor unit	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
UV chamber	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Pump set	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

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SA : Submission to Approval Authority (e.g. SCCU)
TN : Tender model
CON : Construction shop model
Ab : As-built model
V : Field vertification
V(I) : Field verification by visual inspection
V(M) : Field verification by measured survey

MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Pneumatic tank	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Water pipe	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Valve	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Sewage Water Treatment System															
Water tank	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Sand /Coarse filter	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Membrane bioreactor unit	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
UV chamber	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Pump set	100	100	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Pneumatic tank	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Water pipe	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Valve	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

Annex A – Modelling Scope and Level of Development (LOD) Requirement

FS : Feasibility Study /Conceptual Design model
SD : Sketch Design / Approval-in-Principle (AIP) model
DD : Detailed Design / Detailed Design Approval (DDA) model
SA : Submission to Approval Authority (e.g. SCCU)
TN : Tender model
CON : Construction shop model
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V : Field vertification
V(I) : Field verification by visual inspection
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MEP Object	Minimum LOD Requirements and Field Verification Method for as-built BIM Model Quality Assurance														
	FS		SD		DD		SA		TN		CON		Ab		
	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	LOD-G	LOD-I	V
Fixing and Maintenance Accessories															
Hanger	-	-	-	-	-	-	-	-	-	-	300	300	300	500	V(I)
Spring Isolation Unit	-	-	-	-	-	-	-	-	-	-	300	300	300	500	V(I)
Hoisting beam and chain block	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)
Hoisting eye	-	-	100	100	200	200	-	-	200	200	300	300	300	500	V(I)

Annex B – Color Code and Line Style for Systems

System /Installation	System Code	Presentation (2D)		Presentation (3D)					
		Lineweight	Linetype	RED	GREEN	BULE	Color Palette		
HVAC System									
Primary Air Duct	PAD	0.35	Continuous	0	255	255			
Exhaust Air Duct	EAD	0.35	Continuous	0	255	0			
Fresh Air Duct	FAD	0.35	Continuous	0	0	255			
Supply Air Duct	SAD	0.35	Continuous	255	0	0			
Return Air Duct	RAD	0.35	Continuous	255	0	255			
Transfer Air Duct	TAD	0.35	Continuous	0	128	255			
Smoke Extraction Duct	SED	0.35	Continuous	128	128	0			
Make Up Air Duct	MAD	0.35	Continuous	192	192	192			
Staircase Pressurization Duct	SPD	0.35	Continuous	192	192	192			
Condensate Drain Pipe	CDP	0.18	Dashed2	255	128	0			
Chilled Water Return Pipe	CHWR	0.25	Dashdot2	0	255	0			
Chilled Water Supply Pipe	CHWS	0.25	Dashdot2	0	0	255			
Condensing Water Supply Pipe	CDWS	0.25	Border2	0	128	64			
Condensing Water Return Pipe	CDWR	0.25	Border2	0	128	255			
Chemical Dosing Pipe	CHDP	0.25	Hidden	192	192	192			
Make-up Water Pipe	MWP	0.25	Continuous	192	192	192			

Annex B – Color Code and Line Style for Systems

System /Installation	System Code	Presentation (2D)		Presentation (3D)					
		Lineweight	Linetype	RED	GREEN	BULE	Color Palette		
Heating Hot Water Supply Pipe	HHSP	0.25	Phantom2	128	0	0			
Heating Hot Water Return Pipe	HHRP	0.25	Phantom2	255	128	64			
Electrical Installation									
Low Voltage Electricity Supply	ES-LV	0.35	Divide2	0	255	0			
High Voltage Electricity Supply	ES-HV	0.35	Divide2	0	255	0			
Normal Power	TR-N	0.35	Dashdot2	0	255	0			
Emergency Power	TR-E	0.35	Continuous	255	0	64			
Building Management System	BMS	0.35	Continuous	0	255	0			
Uninterruptible Power supply	UPS	0.35	Continuous	128	64	64			
Lighting General	LTG	0.35	Center2	0	255	0			
LV Switchboards	LVS	0.35	Divide2	128	128	0			
Emergency Generator	EMG	0.35	Continuous	255	0	64			
Fire Service Installation									
Sprinkler Pipe	SPR	0.25	Continuous	255	0	0			
Hose Reel / Fire Hydrant Pipe	FSP	0.25	Continuous	255	0	0			

Annex B – Color Code and Line Style for Systems

System /Installation	System Code	Presentation (2D)		Presentation (3D)					
		Lineweight	Linetype	RED	GREEN	BULE	Color Palette		
Automatic Fire Detection and Alarm System Pipe	AFA	0.25	Divide2	255	0	0			
Gas Suppression System Pipe	GSS	0.25	Continuous	255	0	0			
Burglar Alarm and Security Installation									
Access Control System	ACS	0.25	Continuous	128	255	255			
Burglar Alarm System	BAS	0.25	Continuous	128	255	255			
CCTV and Intercom System	CCTVI	0.25	Continuous	255	153	102			
Smart Card System	SCS	0.25	Continuous	128	255	255			
Call Alarm System	CAS	0.35	Center2	128	255	255			
Videophone System	VPS	0.25	Continuous	128	255	255			
Keypad Lock System	KLS	0.25	Continuous	128	255	255			
Drop-arm Barrier	DAB	0.25	Continuous	128	255	255			
Electronic Systems									
Broadcast Reception System	BRI	0.35	Continuous	128	255	255			
Radar and Navigation System	RNS	0.25	Continuous	0	153	0			
Microwave Link System	MLS	0.25	Continuous	0	64	64			
Timing & Display System	TDS	0.25	Continuous	128	128	128			

Annex B – Color Code and Line Style for Systems

System /Installation	System Code	Presentation (2D)		Presentation (3D)					
		Lineweight	Linetype	RED	GREEN	BULE	Color Palette		
Audio Video System	AV	0.25	Continuous	0	128	128			
Audio System	AUS	0.25	Continuous	102	102	51			
Radio System	RS	0.25	Continuous	204	153	255			
Lift and Escalator Installation									
Lift / Escalator	LAE	0.25	Continuous	128	0	128			
Swimming Pool Water Treatment System									
Filtration Plant Pipe	FP	0.25	Continuous	0	128	0			
Return Pipe	RP	0.25	Continuous	0	128	128			
Overflow Pipe	OP	0.25	Continuous	0	128	0			
Supply Pipe	SP	0.25	Continuous	0	128	255			
Plumbing Installation									
Cleansing Water Pipe	CLWP	0.25	Dash	0	0	255			
Cold Water Pipe	CWP	0.25	Long Dash Dash	0	0	255			
Flushing Water Pipe	FLWP	0.25	Center	255	255	0			
Fresh Water Pipe	FWP	0.25	Continuous	0	255	0			
Hot Water Supply Pipe	HWSP	0.25	Dash dot	255	0	0			

Annex B – Color Code and Line Style for Systems

System /Installation	System Code	Presentation (2D)		Presentation (3D)					
		Lineweight	Linetype	RED	GREEN	BULE	Color Palette		
Hot Water Return Pipe	HWRP	0.25	Long Dash dot	255	128	128			
Irrigation Water Pipe	IRWP	0.25	Dash dot dot dot	0	255	255			
Grey Water Pipe	GWP	0.25	Continuous	0	128	255			
Steam Pipe	BLR	0.35	Continuous	255	255	0			
Drainage Installation									
Waste Pipe	WP	0.35	Divide2	128	128	0			
Soil and Waste Pipe	SWP	0.35	Center2	128	0	0			
Vent Pipe	VP	0.35	Hidden	0	128	255			
Rainwater Pipe	RWP	0.35	Phantom2	0	255	255			
Pumped Soil & Waste Pipe	PSWP	0.35	Center2	64	0	0			
Pumped Waste Pipe	PWP	0.35	Divide2	64	64	0			
Pumped Rainwater Pipe	PRWP	0.35	Phantom2	0	128	128			