CONSTRUCTION INDUSTRY COUNCIL
建造業議會

BIM

CIC BIM Standards

Underground Utilities

(in line with ISO 19650)

Version 2 - 2021

Disclaimer

Whilst reasonable efforts have been made to ensure the accuracy of the information contained in this publication (Reference Materials), the CIC nevertheless encourages readers to seek appropriate independent advice from their professional advisers where possible. Readers should not treat or rely on this publication as a substitute for such professional advice.

Enquiries

Enquiries about this Standard may be made to the CIC Secretariat at:

38/F, COS Centre

56 Tsun Yip Street, Kwun Tong, Kowloon

Hong Kong

Tel: (852) 2100 9000

Fax: (852) 2100 9090

Email: bim@cic.hk

Website: www.cic.hk

and HKIUS at:

Unit 209, 2/F, Favor Industrial Center,

2-6 Kin Hong Street, Kwai Chung,

N.T., Hong Kong

Tel: (852) 2967 0000

Fax: (852) 2618 4500

E-mail : info@hkius.org.hk

Website: http://www.hkius.org.hk/

Document Revision Tracking

Issue Date	Notes
August 2019	
2021	Align the terminology with CIC BIM Standards - General (Version 2.1 – 2021)

Table of Contents

Foreword

I am glad to see the release of Construction Industry Council (CIC) BIM Standards for Underground Utilities (Version 2 - 2021). This CIC BIM Standards for Underground Utilities shall be read in conjunction with the CIC BIM Standards - General (Version 2.1 – 2021), which contains major enhancements to align with ISO 19650's Information Management principles, workflows and requirements, also providing Hong Kong Local Annex of ISO 19650-2:2018.

Background

In 2014, the CIC published a report named "Roadmap for the Strategic Implementation of Building Information Modelling (BIM) in Hong Kong's Construction Industry" with an aim to establishing a blueprint for the promotion and adoption of BIM in Hong Kong's Construction Industry. The BIM Roadmap suggested 17 initiatives in nine areas with three imminent actions. Establishment of a local BIM standards is one of the imminent actions aiming to set out a common platform and language for Hong Kong's BIM practitioners. The CIC's BIM Standards will be implemented in stages. The first Standards, renamed as CIC BIM Standards – General was published in September 2015.

Since then, BIM practitioners have gained more practical project experience, and there has been much wider adoption of BIM in various areas of the Architecture, Engineering, Construction, Owner and Operator (AECOO) industry in Hong Kong. With the release of the Technical Circular (Works) Nos. 7/2017, 18/2018, 9/2019 & 12/2020 by the Development Bureau (DEVB) of The Government of the Hong Kong Special Administrative Region (HKSAR), capital works projects with project estimates more than $30 Million are mandated to use BIM from 1st January 2018 onwards. All along the CIC has been continuing to develop and establish the CIC BIM Standards for specific BIM usages and disciplines, and to conduct consultations with relevant stakeholders, as an established practice.

With the establishment of the Task Force on BIM Standards under the Committee on BIM on 21 November 2017, the CIC has been identifying and aligning the common practices as well as setting up new standards and guidelines to facilitate better implementation and adoption of BIM in project execution. The full suite of CIC BIM standards have been published and/or updated covering specific BIM usages or disciplines separately.

In response to demands from the industry, a Task Force on BIM Specifications and Agreement under the ambit of Committee on BIM was established on 23 October 2019. The Task Force is co-chaired by Committee on BIM and Committee on Construction Business Development, and underpinned by two Task Groups, namely Task Group 1 (BIM Specifications) and Task Group 2 (BIM Special Conditions of Contract & Services Agreement). The Task Force developed CIC BIM

Exchange Information Requirements (EIR) Template (BIM Specifications), CIC BIM Special Conditions of Contract, and CIC BIM Services Agreements.

As at December 2021, the full suite of CIC BIM Standards is as follows:

(i) CIC BIM Standards – General (August 2019); (Version 2 - December 2020) and (Version 2.1 - 2021);

(ii) CIC BIM Standards for Architecture and Structural Engineering (Version 2 - December 2020); and (Version 2.1 - 2021);

(iii) CIC BIM Standards for Underground Utilities (August 2019); and (Version 2 - 2021);

(iv) CIC BIM Standards for Mechanical, Electrical and Plumbing (August 2019); and (Version 2 - 2021);

(v) CIC BIM Standards for Preparation of Statutory Plan Submissions (December 2020); and (Version 1.1 - 2021);

(vi) CIC Production of BIM Objects Guide – General Requirements (August 2019); and (Version 2 - 2021);

(vii) CIC BIM Dictionary (December 2020); and (2021);

(viii) CIC BIM Exchange Information Requirements (EIR) Template (December 2020); and (Version 1.1 - 2021);

(ix) CIC BIM Special Conditions of Contract (September 2021);

(x) CIC BIM Services Agreements (September 2021); and

(xi) CIC BIM Guide for using BIM in generation of MEP digital drawings for statutory submissions (2021).

Feedback on the CIC BIM Standards for Underground Utilities (Version 2 – 2021) from practitioners subsequent to the issuance of this publication will be considered in future revisions.

On behalf of the CIC, I would like to thank everyone who has contributed to producing this CIC BIM Standards and subsequent updates, in particular to the members of the Task Force on BIM Standards.

Ar. Prof. Ada FUNG, BBS
Chairperson
Committee on Building Information Modelling
Construction Industry Council

December 2021

Preface

The Construction Industry Council (CIC) is committed to seeking continuous improvement in all aspects of the construction industry in Hong Kong. To achieve this aim, the CIC forms Committees, Task Forces and other forums to review specific areas of work with the intention of producing Alerts, Reference Materials, Guidelines and Codes of Conduct to assist participants in the industry to strive for excellence.

The CIC appreciates that some improvements and practices can be implemented immediately whilst others may take more time for implementation. It is for this reason that four separate categories of publication have been adopted, the purposes of which are as follows:

Alerts	The Alerts are reminders in the form of brief leaflets produced quickly to draw the immediate attention of relevant stakeholders to the need to follow some good practices or to implement some preventive measures in relation to the construction industry.
Reference Materials	The Reference Materials are standards or methodologies generally adopted and regarded by the industry as good practices. The CIC recommends the adoption of the Reference Materials by industry stakeholders where appropriate.
Guidelines	The Guidelines provide information and guidance on particular topics relevant to the construction industry. The CIC expects all industry stakeholders to adopt the recommendations set out in the Guidelines where applicable.
Codes of Conduct	The Codes of Conduct set out the principles that all relevant industry participants should follow. Under the Construction Industry Council (Cap 587), the CIC is tasked to formulate codes of conduct and enforce such codes. The CIC may take necessary actions to ensure compliance with the codes.

If you have read this publication, we encourage you to share your feedback with us. Please take a moment to fill out the Feedback Form attached to this publication in order that we can further enhance it for the benefit of all concerned. With our joint efforts, we believe our construction industry will develop further and will continue to prosper for years to come.

Abbreviation

AECO	Architectural, Engineering, Construction and Operations
AIM	Asset Information Model
BIM	Building Information Modelling
CAD	Computer Aided Drafting
CIC	Construction Industry Council, Hong Kong
HEC	The Hongkong Electric Co., Ltd.
LOD	Level of Development
MEP	Mechanical Electrical Plumbing
SCADA	Supervisory Control And Data Acquisition
UU	Underground Utilities

The above abbreviations are not exhaustive. Reference should be made to the CIC BIM Dictionary for additional abbreviations and definitions.

The CIC BIM Standards for Underground Utilities (UU) requirements are expressed in sentences in which the principal auxiliary verb is "shall". Recommendations are expressed in sentences in which the principal auxiliary verb is "should". The use of the auxiliary verb "can" indicates that something is technically possible and the auxiliary verb "may" indicates permission.

1 Introduction

1.1 General

This Standards provides a statement of good practice and a common language for stakeholders to use and share building information models of underground utilities (UU) for project planning, new projects and asset management. The advantage of representing UU in BIM is that precise spatial data, such as size, level and thickness of the utilities can be easily found and extracted directly from the BIM models.

This Standards describes the approach on how to develop BIM models for data-rich UU elements with high positional accuracy which are of direct benefit to a project. Although the required Level of Information Need (LOIN) for UU is not as complicated as that for MEP in a BIM environment, it is important to standardise and agree the LOIN at the outset of a project, to enable information to be used and reused without the need for significant change or re-interpretation. This Standards does not mandate the level of positional accuracy of UU elements to be delivered or achieved, as this should be defined as part of the project specification. This Standards provides the fundamental principles and a basic approach on how to store positional information on UU in a BIM model. Adoption of this Standards should be decided by the appointing party / client.

1.2 Definition of Level of Information Need (LOIN)

The Level of Information Need (LOIN) comprises the graphical representation and the non-graphical information contained in each BIM model elements for each stage. The LOIN should be defined explicitly for a project and used to facilitate team communications throughout the project lifecycle.

Because of different usages of BIM, some projects require model elements to have high graphical representation but low non-graphical information, while other projects require model elements to have low graphical representation but high non-graphical information. To enhance the management of information and facilitates better communication, LOIN in this Standards is separated into graphical representation which is Level of Development – Graphics / Level of Graphics (LOD-G), non-graphical information which is Level of Development – Information / Level of Information (LOD-I) and the documentation representation – Level of Documentation (DOC).

Documentation representation is for some professional deliverables like statutory drawings, contract drawings. The project team shall deliver the model elements that can fulfill

documentation representation based on local standards or the Appointing Party's / Client's requirement.

To make the LOD requirements quite clearly and facilitate communication within the project team, **LOD-Graphics (LOD-G)** and **LOD-Information (LOD-I)** should be defined separately and used to describe the graphical representation and non-graphical information required for each element respectively.

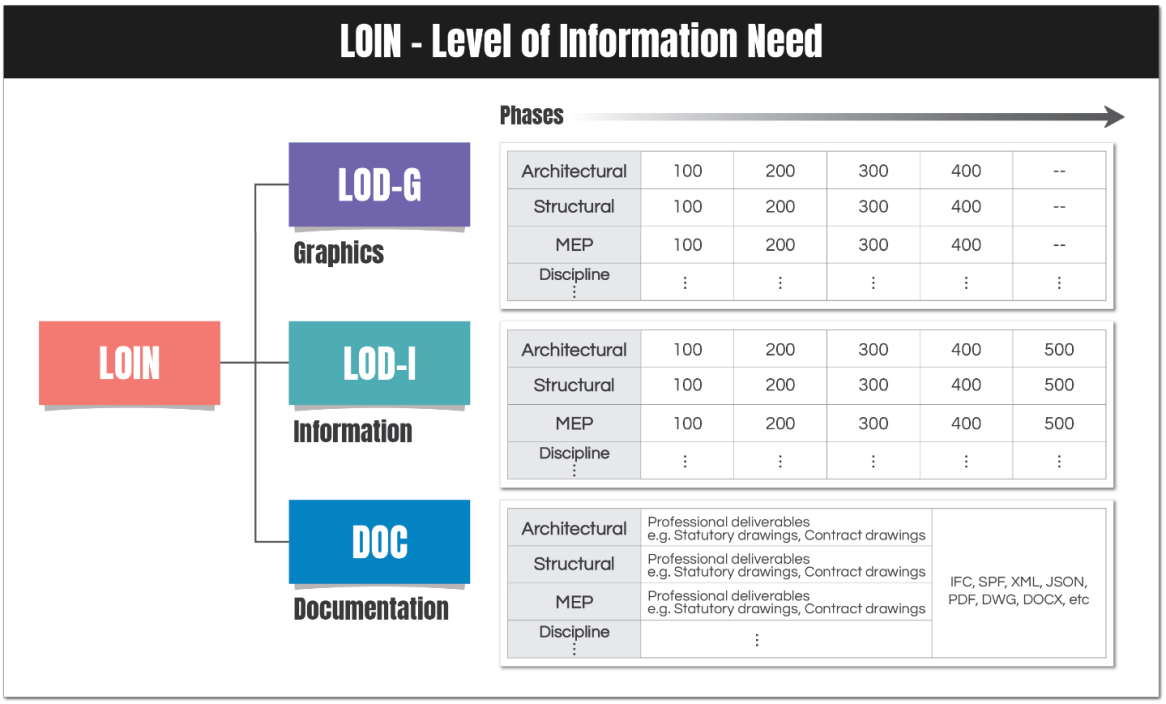


Figure 1 LOIN - Level of Information Need

LOD-Graphics (LOD-G):

Level of Graphics (LOD-G) comprises various graphical scenarios with a model and there is a requirement to subdivide graphical representation as there can be different needs for modelling (3D), symbology (2D), and visualisation.

Graphical representation of elements in the model can include the shape, size, or precise location and specific details for fabrication in each stage of the project.

The definition of LOD-G is shown in the table below.

LOD-Graphics	Definition
100	The model elements is graphically represented within the model by a **rough 3D shape**.
200	The model elements is graphically represented within the model as a **generic system**, **object, or assembly** with approximate quantities, size, shape, location, and orientation. The required spaces for access and maintenance shall be indicated.
300	The model elements is graphically represented within the model as a **specific system**, **object or assembly** in terms of quantity, size, shape, location, and orientation. The model shall include details of the required spaces for handling installation and maintenance and the interface details for checking and coordination with other models / objects. **The graphical representation can easily be recognised without further clarification.**
400	The model elements is graphically represented within the model as a **specific system, object or assembly** in terms of quantity, size, shape, location, and orientation with specific **details for fabrication, assembly and installation.**
500	Not used for the UU discipline. Refer to section 1.4 for details.

Table 2 LOD-G Definition

Level of Information (LOD-I)

Level of Information (LOD-I) is the description of non-graphical information in a model element and will evolve as the project progresses. LOD-I requirements should be defined and agreed beforehand. As the required LOD-I varies for each project, this Standards does not aim to provide an exhaustive list of information for each model element, but instead indicates a suitable approach for adoption.

It is recommended that the LOD-I required for the model elements should be determined to meet their intended usage so as to avoid over specification. This Standards indicates a suitable approach providing the minimum information to be attached to common UU elements / objects at five LODs, namely LOD-I 100, LOD-I 200, LOD-I 300, LOD-I 400 and LOD-I 500. Section 5.2 provides details of the LOD-Information requirements.

8

It is recommended that the project client team should define and specify both the LOD-Graphics and LOD-Information of the UU BIM elements at each stage prior to the commencement of the project.

An Information Model, especially with drawings, typically consists of a range of LOD-G and LOD-I. For example, during the design stage, some elements need to be modelled to LOD-G 300 show specific geometrical details while information at LOD-I 200 level is sufficient. For tender stage, some elements need to be modelled to LOD-G 200 which give shape and graphic, together with LOD-I 300.

At the construction stage, most of the element are modelled as LOD-G 300, together with LOD-I 300. However, some of the elements need to be modelled to LOD-G 400 for fabrication, together with LOD-I 300.

During as-built stage, the LOD-G 400 model with LOD-I 500 should be submitted for as-built record purpose. Users may truncate them if they prefer simple models during Operation and Maintenance Stage.

LOIN definitions vary among different organisations and countries. Although the newly-proposed LOIN definitions stated here are considered more appropriate, some practitioners have already adopted LOD definitions (LOD 100 – LOD 500) given in the former CIC BIM Standards - General. The relationship between the old and new definitions are as follows:

1.3 Level of Documentation (DOC)

The Level of Documentation (DOC) is a description of the requirement to meet LOD-G and LOD-I for the professional deliverables in different stages. Each project team should understand their deliverable requirements against a specific use – e.g., presentation styles such as colour, font, 2D symbols associated with certain drawing production, information on standard title block, etc.

For example, during the tender stage, the design of Information Models shall be developed in sufficient detail for co-ordination, to be completed and enables packaged. Tender drawings and shop drawings generated by the Information Models shall meet the deliverable requirement with respect to specific assemblies, precise quantity, size, shape, location, and orientation of model elements.

Professional drawing at construction stage such as shop drawings and fabrication drawings should contain the geometry or symbol and data which meet the requirement

against specific use. Model elements shall be modelled as specific assemblies, complete fabrication, assembly, and detailing information except precise quantity, size, shape, location, and orientation. Non- geometric information to the model elements can also be attached.

The LOIN use table should identify which discipline / role is responsible for the DOC and the detail will then reside within the Task Information Delivery Plan (TIDP). (Refer to CIC BIM Standards – General Section 3.7.17 for further information of TIDP).

The kind of documentation is related to the uses to meet the identified requirements. The project team should understand their deliverable requirements against a specific use. Professional domain knowledge must be applied to DOC as deliverables when statutory and contractual liabilities are involved.

1.4 Field Verification

Field verification of the model elements is important for most projects in Hong Kong. In most local and international BIM standards, “field verified” is the main criterion for the definition of an LOD 500 elements. However, in terms of geometry, a model elements cannot be more detailed than those required for fabrication (LOD-G 400). Therefore the criterion for “field verification” of a model elements should preferably be extracted from the LOD, e.g. a model elements with LOD-G 300 can also be field verified.

The field verification techniques commonly used for the MEP discipline may not be appropriate for verification of UU. The verification of UU is usually conducted by conventional survey or 3D digital survey.

10

2 Background Knowledge for Underground Utilities

This section describes the different types of underground utilities, and sets out terminologies for UU practice used in this Standards, the users should be able to understand and use this Standards effectively and efficiently.

2.1 Types of Underground Utility Networks/Systems

The following table identifies five main types of utility networks/systems covered by this Standards.

	Type of Network/Systems	Examples
1	Gravity Flow Network	Sewer, storm drain, manhole, aqueduct, culvert, chambers, thrust blocks
2	Pressure Network	Water, gas, cooling main, oil/fuel pipes, rising sewer, chambers, thrust blocks
3	Electricity	Power and lighting cables, signalling / communication cables,
4	Telecom	FTNS pipe, telecom cables and fiber optics
5	Others	SCADA, common utility tunnel, concrete surround, foundation

- Underground utilities include, but are not limited to sewer drain, storm drain, water and oil pipes, communication lines, power cables, and gas pipes.
- Sewers and storm drains are pipes from buildings or roads to one or more levels of larger underground gravity flow networks, which convey flows to sewage treatment facilities or by direct discharge to the sea/ocean. Manholes are used to gain access to the sewer pipes or storm drains for inspection and maintenance. They also allow vertical and horizontal angles to be included in otherwise straight pipelines.
- A water supply system or water supply network is a system of engineered hydrological and hydraulic components which provide water supply. The water is typically pressurised by pumping into storage tanks or service reservoirs constructed at the highest local point in the network. One network may have several such service reservoirs.
- An electrical conduit is a tube used to protect and route electrical wiring in a building or structure. Electrical conduit may be made of metal, plastic, fiber, or fired clay. Most conduits are rigid, but flexible conduits are also used for some purposes.

2.2 Project Goals and BIM Uses

To align with the BIM uses in the CIC BIM Standards General and to give a general idea about the use of BIM in UU practice, this section illustrates the project goals and their corresponding BIM uses in the project lifecycle.

	Project Goals	**BIM Uses**
1	UU detection, hazard identification	Existing Conditions Modelling
2	Planning of new UU installations	Design Authoring, Design Review and 3D coordination
3	Engineering Analysis of UU	Engineering Analysis
4	UU Asset Management	As-built Modelling and Asset Management

At the beginning of a project, a desktop utility record search should be conducted, followed by detection and hazard identification of existing UUs. This will then be followed by “planning of new installations”, “engineering analysis”, and finally “asset management” as the project progresses.

Further details are given in Section 3.6.5. of the CIC BIM Standards - General.

3 Use of the Standards

This section describes the recommended approach in defining the scope of BIM for UU in project execution and the corresponding sections of the document. The Standards is not intended as a set of mandatory requirements for a project, but instead as guidance on how to develop the project requirements. It is understood that requirements will vary for project to project and practitioners may use this Standards as a foundation to further develop their BIM Project Execution Plan.

The following table summarises the approach

	Recommended Approach	Who	How
1.	Define the BIM uses in the projects	Appointing Party / Client	Refer to the CIC BIM Standards General
2.	Specify the Project Information / Asset Information Requirements of the project	Appointing Party / Client	Refer to "**3.1 Client Requirement Specification**" of CIC BIM Standards General
3.	Understanding of the terminology used in this Standards	All project teams	Refer to **"2. Background knowledge for Underground Utilities"**
4.	Define the LOD-G, LOD-I and DOC of the model elements to be specified	Appointing Party / Client, design consultants, contractors	Refer to **"4. LOD Responsibility Matrix", "5. LOD Elements Specification", "6. Recommended Minimum LOD"**
5.	Identify whether the elements need to be field verified and which method of field verification to be used	Appointing Party / Client, design consultants	Refer to **"4. LOD Responsibility Matrix"**
6.	Production of Information Models	Design consultants, contractors	Refer to **"7. Common Practice for Information Modelling"**

4 LOD Responsibility Matrix

The LOD responsibility matrix should be used to prepare the BEP at different stages of a project. This involves defining both the LOD-Graphics and LOD-Information to be achieved at each stage so that the project team can produce a high quality Information Model with appropriate information.

As stated in Section 1.4, the requirement for "field verification" should be defined in addition to the LOIN. The additional column "V" in the LOD responsibility matrix serves this purpose. The project Appointing Party / Client should define clearly which field verification method should be used for each elements or, "N/A" meaning Not Applicable should be indicated if field verification is not required for the specific elements.

Sample templates of the LOD Responsibility Matrix are shown in **Appendix A**. The elements involved in the matrix are not exhaustive and the classification of the elements follows that from Section 2.1. The project BIM manager may add or remove elements from the list to suit the project specific needs, or alternatively use the project client's classification if available.

Description of the fields in the LOD Responsibility Matrix is shown in the table below.

Field	Description
Required	Yes (Y) or No (N)
UOM	Unit of Measurement
Classification	This code can be used for Quality Assurance and review of models. OmniClass® Table 23 system code* can be used for this field if no other specific requirements from the project Appointing Party / Client.
AUT	Model Author
G	LOD-Graphics
I	LOD-Information
V	Method for field verification of the object/equipment. It is subject to the agreement of the Appointing Party / Client. Refer to Section 1.4 for the details of field verification.

* China Guobiao (China GB), UK Uniclass and US Onmiclass have been considered to be the classification system of model elements

LOD Responsibility Matrix (sample format)

Field										
Model elements	**Required**	**UOM**	**Classification**	**Project stage e.g. Detailed Design**			**Project stage e.g. As-Built**			
				AUT	G	I	AUT	G	I	V
Element 1	Y / N									
Element 2	Y / N									
Element …	Y / N									

The tender stage specified in the LOD Responsibility Matrix is assumed to be the middle stage of a traditional “Design-Tender-Build” contract type. The project team may decide to use another contract type if it is being adopted in the project.

5 LOD Elements Specification

This section describes the minimum acceptable requirements for LOD-G and LOD-I for different MEP model elements / objects. As there are innumerable types of individual model elements, only commonly used model elements are included, and are classified as different types from OmniClass®. In this way users should be able to understand the principles involved and apply them in defining LOD-Graphics and LOD-Information for other elements as required.

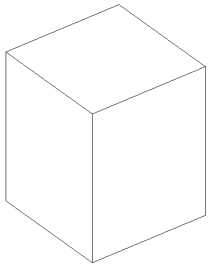
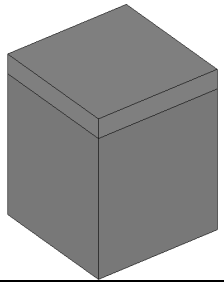
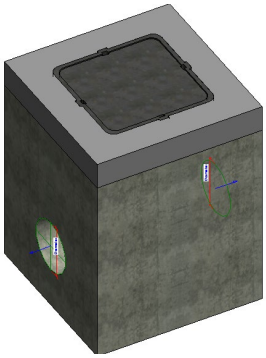
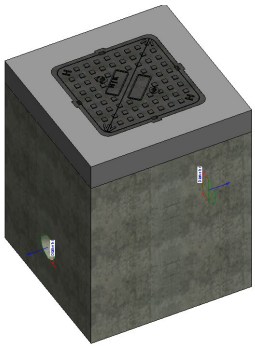
5.1 LOD-Graphics Requirements

The main UU elements / objects requiring LOD-Graphics specification are classified in the following table:

Elements (classified according to Section 2.1)
Gravity Flow Network • Manhole
Pressure network • Valve
Electricity, Telecom • Wire and cable pipe

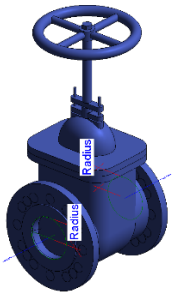
(Gravity Flow Network) Manhole

OmniClass: 23-39 29 11 13 11

LOD-Graphics	Requirements		Sample Image
100	- Conceptual, schematic elements or symbol	N/A	
200	- Generic elements - Nominal size, dimensions	Overall Shape according to DSD standards manhole	
300	- Specific elements - Actual dimensions - Proposed location and orientation - Actual number of pipes connected	Manhole cover, Associated features inside the manhole, e.g. cat ladder, step irons, safety cage, etc.	
400	- Specific elements - Actual dimensions - Actual location and orientation - Actual number and location of pipes connected - Sufficient detail and accuracy for fabrication	N/A	

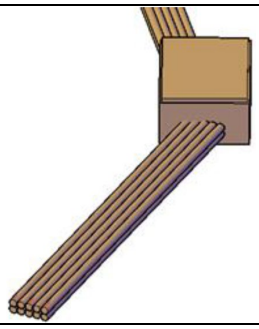
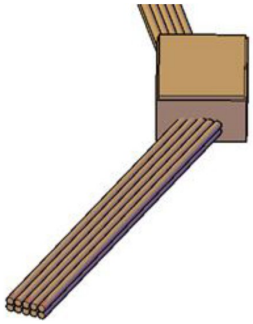
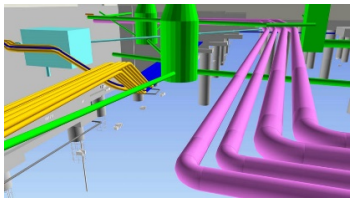
(Pressure network)
Valve

OmniClass: 23-27 31 00

LOD-Graphics	Requirements		Sample Image
100	- Conceptual, schematic elements or symbol	N/A	N/A
200	- Generic elements - Approximate nominal size, dimensions	Overall Shape	
300	- Specific elements - Actual size, dimensions and orientation - Proposed location	Overall Shape, Actuator Parts, Connectors, Flange Joint, etc.	
400	- Specific elements - Manufacturer size, dimensions and orientation - Actual location - Actual setting out - Sufficient detail and accuracy for fabrication	N/A	

(Electricity, Telecom) Wire and Cable Pipe

OmniClass: 23-35 33 25

LOD-Graphics	Requirements		Sample Image
100	- Conceptual, schematic elements or symbol	N/A	N/A
200	- Generic elements - Approximate nominal size, dimensions	Overall Shape	
300	- Specific elements - Actual dimensions - Proposed location and orientation - Actual number of pipes connected	Overall Shape, Pipe Details, Covers, Inside Components, Connection Details, etc.	
400	- Specific elements - Actual dimensions - Actual location and orientation - Actual number and location of pipes connected - Sufficient detail and accuracy for fabrication	N/A	

For definitions of individual BIM elements / objects, refer to the latest “CIC Production of BIM Object Guide - General Requirements”.

For 2D representative symbols of the BIM elements / objects, refer to the “CAD Standard for Works Projects” by the Development Bureau (DEVB).

5.2 LOD-Information Requirements

This section describes the LOD-I required for an Information model, it is well noted that project Appointing Parties / Clients may have their own requirement for LOD-I. This section sets out a software-neutral approach for determining LOD-I, using samples instead of attempting to giving an exhaustive list of requirements. The BIM standards developed by HKSAR Works Departments should be referred to for further details. These and other relevant publications are given in the CIC BIM Portal: https://www.bim.cic.hk/en/resources/publications for relevant publications.

The following table lists the attributes commonly attached to individual model elements / objects. (where M means "Mandatory" and R means "Required".)

No.	Type	Attribute Name	Description	LOD-Information					Proposed Input Format
				100	200	300	400	500	
1	Project Information (Appointing Parties specific)	Organisation Name	Client name (per agreement/ contract)	M	M	M	M	M	Alphanumeric
		Project Issue Date	Project Commencement date	M	M	M	M	M	MMM YYYY (e.g. Nov 2021)
		Project Address	The street address of the project	M	M	M	M	M	Alphanumeric
		Project Name	The project name as shown on the drawing sheet's title block	M	M	M	M	M	Alphanumeric
		Project Number	The project number as shown on the drawing sheet's title block	M	M	M	M	M	Alphanumeric
2	General Properties	CAT Code	Departmental category **(see Remark 1)**	R	R	R	R	R	Alphanumeric
		Locations	Location (e.g. district code for outdoor object)		R	R	R	R	Alphanumeric
		Departmental Unique ID	The unique ID for departmental information management		R	R	R	R	Alphanumeric
		Reference Level	Reference level used for 2D drawing annotation	R	R	R	R	R	Alphanumeric
		Z level	Refer to Appendix E for details		R	R	R	R	Number
		Size			R	R	R	R	Number

No.	Type	Attribute Name	Description	LOD-Information					Proposed Input Format
				100	200	300	400	500	
		Minimum Cover provided			R	R	R	R	Number
		No. of ducts			R	R	R	R	Alphanumeric
		Type of Protection	Protection of the elements		R	R	R	R	Alphanumeric
		Status	Status of the UU elements: Existing or New Build		R	R	R	R	Alphanumeric
		Year of construction	Year of construction of the UU elements				R	R	Alphanumeric
		Owner	Owner of the UU elements				R	R	Alphanumeric
3	Design Properties	Material	Singular material or all materials pertaining to the assembly		R	R	R	R	Alphanumeric
		Material Grade	Material grade (e.g. concrete grade, steel grade)		R	R	R	R	Alphanumeric
		Design Capacity	Design capacity		R	R	R	R	Alphanumeric
		Number	Room Number **(see Remark 2)**		R*	R*	R	R	Alphanumeric
		Name	Room Name **(see Remark 2)**			R*	R	R	Alphanumeric
4	**Classification Properties (see Remark 3)**	**OmniClassCode**	**OmniClass code**			**R**	**R**	**R**	**Alphanumeric**
		OmniClassTitle	OmniClass title			R	R	R	Alphanumeric
		OmniClassVersion	OmniClass version			R	R	R	Alphanumeric
5	Manufacturer's Equipment Properties	Brand Name	Brand name				R	R	Alphanumeric
		ManufacturerName	Manufacturer name				R	R	Alphanumeric
		Model Number of element / equipment	Model number				R	R	Alphanumeric
		EquipmentCapacity	Equipment capacity				R	R	Alphanumeric
		Asset ID	Asset ID				R	R	Alphanumeric
		Contract Numberof the Equipment	The equipment's contract number				R	R	Alphanumeric
6	Condition Properties	Certified Completion Date	Certified completion date				R	R	MMM YYYY (e.g. Nov 2021)

		Handover Date	Handover date				R	R	MMM YYYY (e.g. Nov 2022)
7	Verification Properties	Verification	Verification method (input A for "field verified by visual inspection" and B for "field verified by a measured survey")					R	Text (e.g. A or B)
		QL Standard	Qualification level of the UU elements/objects **(see Remark 7)**					R	Alphanumeric
		QL Grade	Grade of the quality level **(see Remark 7)**					R	Alphanumeric

Remarks:

1. Category (in the form of the shared parameter "CAT Code" under "General Properties") could facilitate grouping and data filtering. In addition, "category" may refer to:
   a) The use of appropriate category or object types when creating BIM objects to minimize data loss (especially LOD-G) during open format exchange.
   b) BIM Object naming's abbreviation code fields 1 & 2 to facilitate BIM object library management and consistency of information container ID naming.
2. R* - Room Name and Room Number are required when statutory and contractual drawings are produced.
3. Individual Appointing Party's classification(s) in addition to or instead of OmniClass could be defined by respective Appointing Parties.
4. It is recommended that a full list of element-specific LOD-I should be clearly defined before a project commences.
5. Design Properties should be defined in line with any agreement or Appointing Party / Client Information Requirements provided for individual projects.
6. For details of the attributes "Z level", "Size", "Thickness" and "No. of ducts" refer to Appendix E.
7. For details of the attributes "Z level", "Size", "Thickness" and "No. of ducts" refer to Appendix E.

   Among the above attributes, "Reference Level", "Status", "QL Standard" and "QL Grade" are relatively new to the current UU industry, and further guidance is given for these attributes.

- Reference Level: Care must be taken in annotating the correct levels when generating 2D drawings from BIM models. This attribute/information states which reference level shall be used for annotation when generating 2D drawings. Reference levels for UU are usually presented in the following ways:
    1. Top level
    2. Crown level
    3. Centre level
    4. Invert level (by manhole survey of gravity flow pipeline)
    5. Bottom level
    6. Cover Depth

  For detailed description of the different reference levels refers to Appendix F.

- Status: In some situations, existing UU elements may need to be modelled for coordination with their elements, this attribute/information indicates whether the UU elements is an existing elements or a new-build elements.

- QL Standard: This attribute/information informs the users of the BIM model what standard/specification of accuracy is used for the UU elements. The project team should have an agreed QL specification or standard at the outset. If no any specific requirements are stated, PAS 128 can be a reference, with details as given in Appendix B. This attribute/information is optional and is subject to the individual project needs.

- QL Grade: This attribute/information describes the grade or level of the QL standard for the UU elements, e.g. if PAS 128 is being used, the grade of PAS 128 shall be used to describe the accuracy of the elements, (e.g. QL-A, QL-C). This attribute/information is optional and is subject to the individual project needs.

Apart from the above attribute/information, it is recommended to have the following documents/project information or folder path structure in place to link up with the BIM Models, if available:

- Conduit condition evaluation report
- Manhole and pipes internal condition survey (CCTV and report)
- Comprehensive utility survey
- Water leakage detection report.
- Survey of buried water carrying services
- Routine inspection reports
- Repair and maintenance record

Any product-specific technical information/attributes should be agreed with the project Appointing Party / Client of the project.

Further details of the information / attributes described in the section are given in the BIM standards developed by the Works Departments. These and other relevant publications are included in the CIC BIM Portal https://www.bim.cic.hk/en/resources/publications for the relevant publications.

6 Recommended Minimum LOD

This section recommends a minimum LOD to be used at different stages of a project. The LOD defined should fit the purpose and care should be taken to avoid over specification. Users can adjust or define a higher LOD for required model elements to suit their project needs. Users should be aware that creating model elements with higher LOD-G or LOD-I than the recommended minimum will require more effort and time. Appropriate LOD that fits the purpose and are not over-specified are the most effective.

The minimum LOD described in this section are a combination of different LOD in terms of LOD-G and LOD-I. The final decision on LOD requirements will depend on the availability of relevant information and should be confirmed by the project Appointing Party / Client.

An example of recommended minimum LOD for a Gravity Flow Network is given on the next page.

The following points should be noted:

- The same principles and approach should be applied to set out the LOD for other elements which are not included.
- The field verification method “V” is subject to the individual project specification. This Standards does not recommend any particular type.
- The appropriate Unit of Measurement (UOM) for each model element/object depends on the project specification/requirement and should be decided by the project Appointing Party / Client.

Example project assumptions:

- A field verification method will be used for the project and should be agreed by project Appointing Party / Client. Example:

Method	Description
A	Ground penetrating radar
B	Electromagnetic location

- The tolerance of the field verification method in terms of mm should be agreed by project Appointing Party / Client.

Example LOD Responsibility Matrix

Gravity Flow Network

Model elements	Required	UOM	Classification	Concept, Feasibility, Planning			Preliminary, Scheme			Detailed design			Submission to approval authority			Tender			Construction			As-Built			
				AUT	G	I	AUT	G	I	AUT	G	I	AUT	G	I	AUT	G	I	AUT	G	I	AUT	G	I	V
Manhole	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	
Box Culvert	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	
Sewer Piping	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300*	400	DEF	300*	500	
Storm Piping	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300*	400	DEF	300*	500	
Gully Drainage Channel	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	
Valve	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	
Valve Chamber	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	
Fitting	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	
Rising Main	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	

Gravity Flow Network

Model elements	Required	UOM	Classification	Concept, Feasibility, Planning			Preliminary, Scheme			Detailed design			Submission to approval authority			Tender			Construction			As-Built			
				AUT	G	I	AUT	G	I	AUT	G	I	AUT	G	I	AUT	G	I	AUT	G	I	AUT	G	I	V
Sand Trap	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	
Oil/Fuel Piping	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	
Duct Bank	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	
Water Tunnel	Y			ABC	100	/	ABC	200	100	ABC	200	200	ABC	200	300	ABC	200	300	DEF	300	400	DEF	300	500	

* The LOD-G of Sewer piping/Storm piping should be 400 if pipe fabrication is requested.

28

7 Common Practice for BIM UU Modelling

This section briefly summarises the key steps commonly practised for high-quality UU modelling in Hong Kong,

1. The origin point and orientation of the Model should refer to HK1980 Grid System defined by the HKSAR Lands Department.
2. Elevations should refer to Hong Kong Principal Datum.
3. The BIM model should be set up using the metric system.
4. To ensure accuracy of the BIM model and enhance multidisciplinary coordination, the tolerances between disciplines and model elements should be defined and agreed among the whole project team.
5. Creation of BIM elements / objects should follow the “CIC Production of BIM Object Guide - General Requirements”.
6. All unused views should be purged and unused BIM model elements / objects should be removed before submission or publishing.
7. BIM files should be kept to a minimum size, with due consideration given to the capability and performance of the project software and hardware.
8. The BIM models can be divided into zones, disciplines or systems by agreement among the project team.
9. The presentation style should follow the colour scheme according to the Appointing Party / Client’s requirement or as agreed among the project team.
10. The gradient of pipes should be incorporated realistically (e.g. pipes drained by gravity illustrated with a negative slope in the direction of flow).
11. Filters should be used for the identification of existing or new build UU elements.
12. The connectivity in the network should be considered. The model should be able to recognise the total number of connected pipes to a manhole/ drawpit.
13. Manhole and pipe schedules should be generated from the BIM model.
14. Concrete surrounds to individual elements/objects should be modelled to facilitate consideration of clash detection, constructability and interface coordination.
15. The initial BIM model is commonly generated from a hydraulic model, e.g. InfoWorks. In such cases the design parameter should be transferred from the analytical software to the BIM software.
16. Annotation e.g. invert level, MH ID, cover level, etc. should be generated from the BIM model used for the drawing production and field record verification.

8 References

1. Electrical and Mechanical Services Department
   BIM-AM Standards and Guidelines v2.0
2. Architectural Services Department
   BIM Guide for BS Installation Ver1.0_Jun18
3. Drainage Services Department
   BIM Modelling Manual (Second Edition)
4. Water Supplies Department
   BIM Standard for Asset Management
5. Hong Kong Housing Authority and Housing Department
   BIM Standards and Guidelines (Version 2.0)
6. CAD Standard for Works Projects (CSWP), Development Bureau
7. BCA Singapore BIM Guide Version 2
8. Singapore BIM Essential Guides
9. BIM Forum LOD Specification 2019
10. AEC (UK) BIM Protocol
11. Handbook for the introduction of Building Information Modelling by the European Public Sector
    EU_BIM_Task_Group_Handbook_FINAL
12. NATSPEC National BIM Guide
    NATSPEC_National_BIM_Guide_v1.0_Sep_2011

9 Acknowledgement

The CIC would like to acknowledge the co-development and contribution of Hong Kong Institute of Utility Specialists (HKIUS) especially Mr NG Chun Keung, President of HKIUS (2017/2019).

The CIC would like to acknowledge the assistance of the following organisations in the production of this Standards:

- Airport Authority Hong Kong
- Architectural Services Department
- Buildings Department
- Civil Engineering and Development Department
- Development Bureau
- Drainage Services Department
- Electrical and Mechanical Services Department
- Highways Department
- Hong Kong Electric Company
- Joint Utilities Policy Group
- Lands Department
- The Association of Consulting Engineers of Hong Kong
- The Hong Kong Institute of Architects
- The Hong Kong Institute of Building Information Modelling
- The Hong Kong Institution of Engineers
- The Hong Kong Institute of Surveyors
- Hong Kong Institute of Utility Specialists
- The Hong Kong University of Science and Technology
- Water Supplies Department

The CIC would also like to acknowledge Drainage Services Department for providing valuable graphics for the Standards.

The CIC thanks all stakeholders who have participated in the Stakeholders Consultation Forums and offered opinions.

10 Member List of the Task Force on BIM Standards

Members	Representative of:
Prof. Jack Cheng (Chairperson)	The Hong Kong University of Science and Technology
Ar. Ada Fung	Chairperson of the Committee on BIM
Ir Vincent Chow Ir Boris Yiu	Development Bureau (DevB)
Mr. Ben Chan Mr. CHANG Kwok-fai	Lands Department
Sr Eric Lee Sr Mark Lai	Buildings Department
Ir Kelvin Wong	Airport Authority Hong Kong
Ar. Aaron Chan	The Hong Kong Institute of Architects
Ir Clement Chung	The Association of Consulting Engineers of Hong Kong
Dr. Neo Chan Ar. David Fung Sr Thomson Lai Mr. Froky Wong	Hong Kong Institute of Building Information Modelling (HKIBIM)
Mr. Billy Wong	Hong Kong Construction Association
Mr. Kwok Tak Wai	The Hong Kong Federation of Electrical and Mechanical Contractors Limited
Convenor and Secretary	
Mr. Alex Ho Mr. Ron Ng Mr. Lok Fung Mr. Elvis Chiu Mr. Michael Leung	Construction Industry Council

32

Appendix A LOD Responsibility Matrix

(Please refer to separate document)

Appendix B Quality Level of Utility Records according to PAS128

For reference only and optional

Table 1 – Quality level of survey outputs (normative)

Survey type (Establish with client prior to survey)		Quality level (Practitioner to determine post survey)	Post-processing	Location accuracy		Supporting data
				Horizontal 1)	Vertical 2)	
D	Desktop utility records search	QL-D	—	Undefined	Undefined	—
C	Site reconnaissance	QL-C	—	Undefined	Undefined	A segment of utility whose location is demonstrated by visual reference to street furniture, topographical features or evidence of previous street works (reinstatement scar).
B	Detection 3)	QL–B4	No	Undefined	Undefined	A utility segment which is suspected to exist but has not been detected and is therefore shown as an assumed route.
		QL-B3	No	±500 mm	Undefined (No reliable depth measurement possible)	Horizontal location only of the utility detected by one of the geophysical techniques used.
		QL-B3P	Yes			
		QL-B2	No	±250 mm or ±40% of detected depth whichever is greater	±40% of detected depth	Horizontal and vertical location of the utility detected by one of the geophysical techniques used. 4)
		QL–B2P	Yes			
		QL-B1	No	±150 mm or ±15% of detected depth whichever is greater	±15% of detected depth	Horizontal and vertical location of the utility detected by multiple 5) geophysical techniques used.
		QL–B1P	Yes			
A	Verification	QL-A	—	±50 mm	±25 mm	Horizontal and vertical location of the top and/or bottom of the utility. Additional attribution is recorded as specified in **9.2.5**.

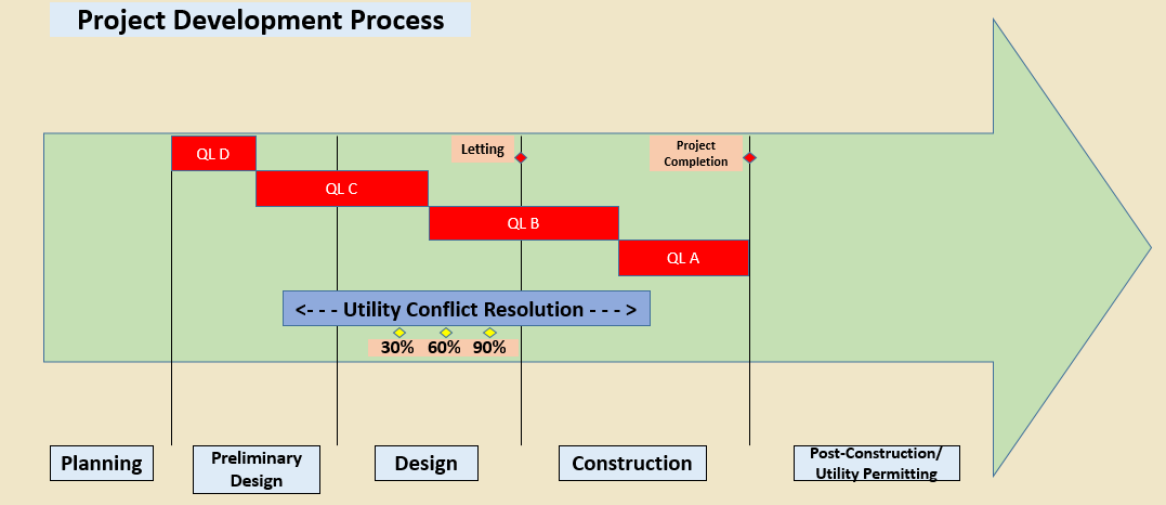
1) Horizontal location is to the centreline of the utility.
2) Vertical location is to the top of the utility.
3) For detection, it is a requirement that a minimum of GPR and EML techniques are used (see **8.2.1.1.2**).
4) Electronic depth readings using EML equipment are not normally sufficient to achieve a QL-B2 or higher.
5) Some utilities can only be detected by one of the existing detection techniques. As a consequence, such utilities cannot be classified as a QL-B1.

(For details of PAS 128 refer to https://www.pas128.co.uk/)

Appendix C Proposed PAS 128 Quality Level at Different Project Stages

For reference only and optional subject to requirements and agreement with the project Appointing Party / Client and the project team.

Stage	PAS128
Concept, Feasibility, Planning	QL D
Preliminary, Scheme	QL C/D
Detailed Design	QL B/C
Submission for Approval	QL B
Construction	QL A/B
As-Built	QL A



Appendix D Proposed Quality Level by HKIUS

For reference only and optional, subject to requirements and agreement with the project Appointing Party / Client and the project team.

Refer to the official website http://www.hkius.org.hk/ for the quality level proposed by HKIUS.

Level	Purpose	Tolerance(mm)	Confidence Level
0	Routing Statutory	N/A	N/A
I	Planning	500 or 0.25D	80%
II	Design	350 or 0.2D	85%
III	Works	150 or 0.15D	90%
IV	Investigation	Up to 150 or 0.1D	Up to 90%
QA/QC Office 5% or min. 100 sq.m; On site (Subject to instruction and payment): 1% or min. 10 sq.m			

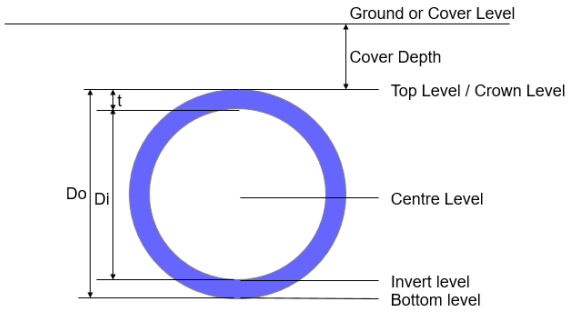
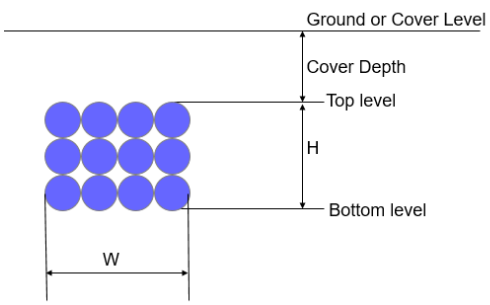
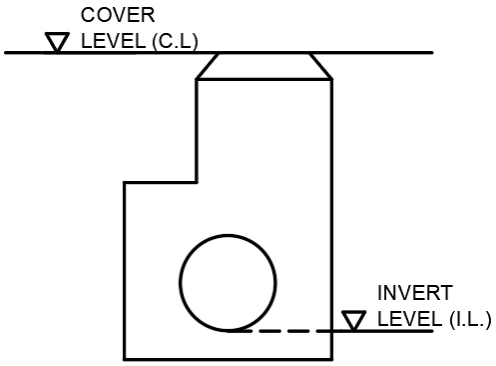
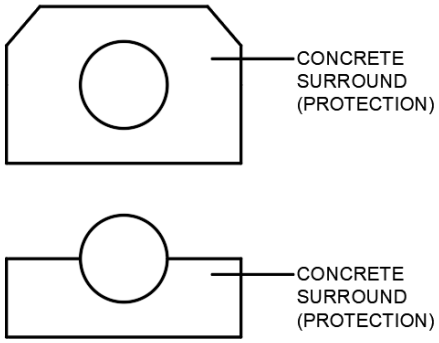
Appendix E Key Levels and Dimensions of Different Types of UU

Type of networks/systems		Z level (for new build elements)	Z level (for existing elements by detection)	Size	Thickness	No. of ducts
1. Gravity Flow Network	Circular Pipe	Invert	Top	Di	t	N/A
	Rectangular Culvert	Invert	Top	W x H	t	N/A
	Other elements	Invert	Top	W x H	N/A	N/A
2. Pressure Network	Circular Pipe	Top	Top	Di	t	N/A
	Other elements	Top	Top	W x H	N/A	N/A
3. Electricity	Single duct	Top	Top	Do	t	N/A
	Duct Bank	Top	Top	W x H	t	n x m
	Other elements	Top	Top	W x H	N/A	N/A
4. Telecom	Single duct	Top	Top	Do	t	N/A
	Duct Bank	Top	Top	W x H	t	n x m
	Other elements	Top	Top	W x H	N/A	N/A
5. Others	Circular Pipe	Top	Top	Do	t	N/A
	Rectangular Culvert	Top	Top	W x H	t	N/A
	Other elements	Top	Top	W x H	N/A	N/A

For non-uniform or irregular duct sizes within a duct bank, “Irregular” can be inputted into “Thickness” and “No. of ducts”.

Di: Inner Diameter
Do: Outer Diameter
W: Width
H: Height
t: Thickness
n: No. of Rows
m:No. of Columns

Appendix F Illustration of UU Reference Levels

<table>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Pipe Level</td><td>Duct Bank Level</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Cover Level & Invert Level</td><td>Concrete Surround (Protection)</td></tr>
</table>

CONSTRUCTION INDUSTRY COUNCIL
建造業議會

Feedback Form

CIC Building Information Modelling Standards for Underground Utilities (UU)

To improve future editions of this publication, we would be grateful to have your comments.

(Please put a "✓" in the appropriate box.)

1. As a whole, I feel that the publication is:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Informative	❑	❑	❑	❑	❑
Comprehensive	❑	❑	❑	❑	❑
Useful	❑	❑	❑	❑	❑
Practical	❑	❑	❑	❑	❑
2. Does the publication enable you to understand more about the subject?	Yes		No		No Comment
	❑		❑		❑
3. Have you made reference to the publication in your work?	Quite Often		Sometimes		Never
	❑		❑		❑
4. To what extent have you incorporated the recommendations of the publication in your work?	Most		Some		None
	❑		❑		❑
5. Overall, how would you rate our publication?	Excellent	Very Good	Satisfactory	Fair	Poor
	❑	❑	❑	❑	❑
6. Other comments and suggestions, please specify (use separate sheets if necessary).					
Personal Particulars (optional):* Name: Mr. / Mrs./ Ms./ Dr./ Prof./ Ar / Ir / Sr ^ Company: Tel: Address: E-mail:					

* The personal data in this form will be used only for this survey. Your data will be kept confidential and dealt with only by the Construction Industry Council.

^ Circle as appropriate.

Please return the feedback form to:

CIC Secretariat – BIM
E-mail: bim@cic.hk
Address: 38/F, COS Centre, 56 Tsun Yip Street, Kwun Tong, Kowloon, Hong Kong
Fax No.: (852) 2100 9090

Construction Industry Council

Address : 38/F, COS Centre
56 Tsun Yip Street
Kwun Tong, Kowloon
Tel : (852) 2100 9000
Fax : (852) 2100 9090
Email : enquiry@cic.hk
Website : www.cic.hk