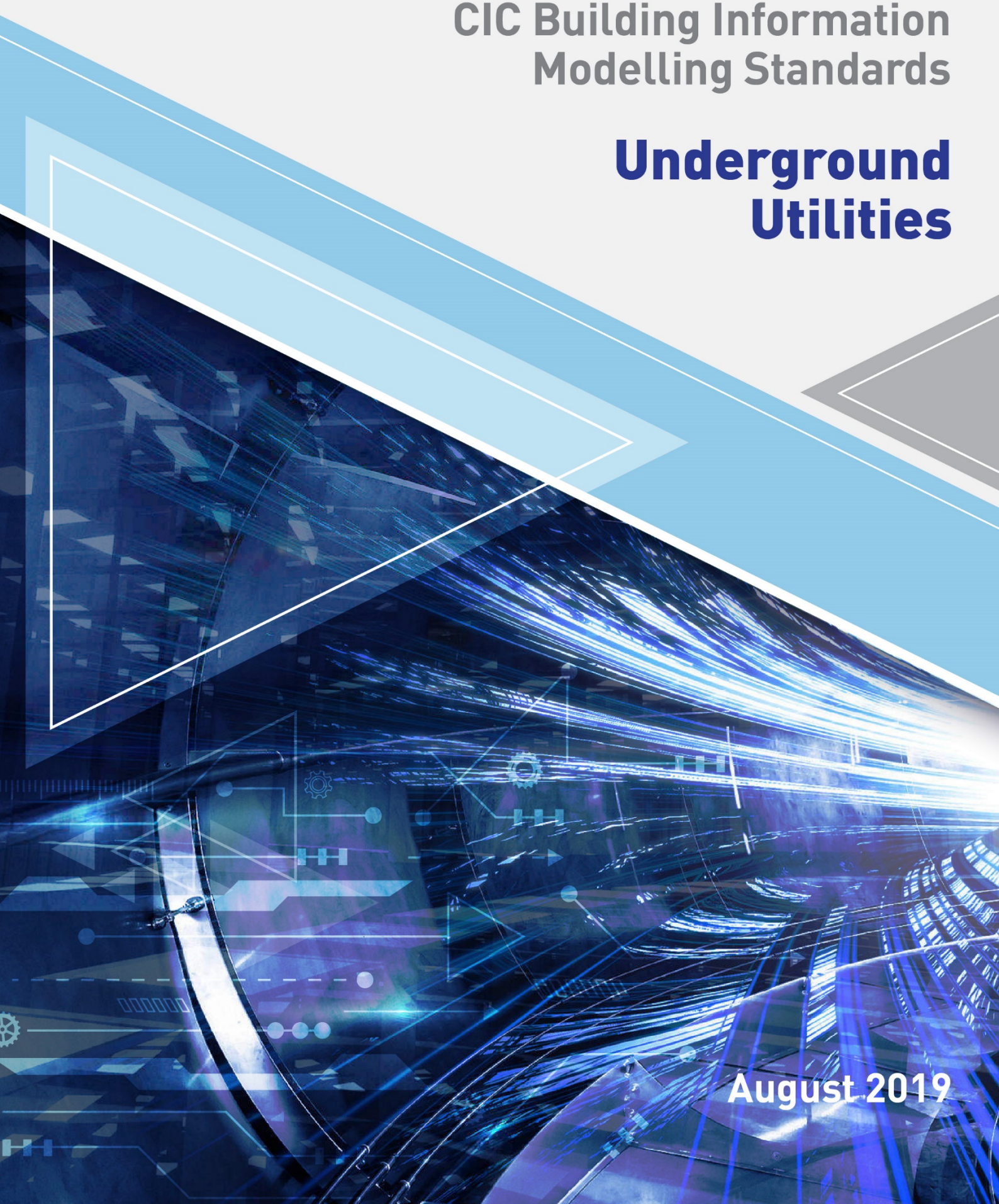
CONSTRUCTION INDUSTRY COUNCIL
建造業議會

BIM

CIC Building Information Modelling Standards

Underground Utilities



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Disclaimer

Whilst reasonable efforts have been made to ensure the accuracy of the information contained in this publication, 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 for taking any relevant actions.

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Foreword

In 2015, the Construction Industry Council (CIC) published the BIM Standards (Phase One)(renamed as the CIC BIM Standards General). These were intended to be simple and straightforward standards that could be easily mastered by laypersons and new BIM practitioners. Since then, BIM practitioners have gained more practical project experience, and there has been much wider adoption of BIM in various areas of the Architectural, Engineering, Construction and Operations (AECO) industry in Hong Kong. With the release of Technical Circular (Works) Nos. 18/2018 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 technology from 1st January 2018 onwards. All along the CIC has continued to elaborate and establish the BIM Standards for specific BIM usages and disciplines, and to conduct consultations with relevant stakeholders.

With the establishment of the Task Force on BIM Standards (Phase Two) held on 21 November 2017, CIC would identify and align the common practices, as well as set up new standards and guidelines to facilitate better implementation and adoption of BIM technologies in project execution. The BIM Standards (Phase Two) cover the following specific BIM usages or disciplines:

(i) Statutory Plan Submission
(ii) Underground Utilities (UU)
(iii) Mechanical Electrical and Plumbing (MEP)

Underground utility lifecycle management with BIM seeks to integrate processes throughout the various project stages up to the handover and facility management by the owner of maintenance authority. The focus is to create and reuse consistent digital information by the stakeholders throughout the project lifecycle. However, the accurate detection, identification, verification and location of UU assets have always been difficult tasks, subject to interpretation and inaccuracies. Not having sufficient or reliable information on the leads to various undesirable outcomes, e.g.:

- Risk to the safety of workers and to the public;
- Abortive and unnecessary work;
- Damage to third party assets;
- Inefficient design solutions

Accurate UU data may also create opportunities for other benefits to be achieved, such as

the use of remote robotic techniques to maintain assets in busy networks, thereby reducing the need for intrusive maintenance practices (e.g. road excavations). Accurate mapping of utility networks also improves asset modelling capabilities with more precise outcomes. Implementation and use of BIM systems for such purposes require dramatic changes to current practices, and bring new challenges to stakeholders, e.g. the need for new knowledge of emerging technologies and a skills gap. This Standards provides a guideline on the use of BIM technology in underground utility practice within a complete project lifecycles. In due course it is expected that further education and experience in the application of this Standards will lead to more effective planning and safer execution of utility-based activities and related street works, civil works and ground works. The use of Standard or Standard should be aligned.

This CIC BIM Standards for Underground Utilities (the 'Standards') is software-neutral. It has been co-developed with the Hong Kong Institute of Utility Specialists (HKIUS), with appropriate reference to both local and international BIM standards and practices. The framework and approach in this Standards apply for the underground utilities.

The CIC understands that the level and depth of BIM adoption in different AECO organisations in Hong Kong vary considerably. This Standards covers the essential aspects of underground utility lifecycle management to encourage wider adoption of BIM. More advanced approaches can be developed based on this Standards as the industry progresses further in managing data within the BIM environment. The CIC will review the Standards regularly to suit industry demands and expectations.

Ada FUNG

Chairperson

Committee on Building Information Modelling

Construction Industry Council

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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

Requirements in this CIC BIM Standards for Underground Utilities (UU) are expressed in sentences in which the principal verb is "shall". Recommendations are expressed in sentences in which the principal verb is "should". Use of the verb "can" indicates that something is technically possible. Use of the verb "may" indicates preference.

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 development (LOD) for UU is not as complicated as that for MEP in a BIM environment, it is important to standardise and agree the LOD 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 project client / employer.

1.2 Definition of Level of Development (LOD)

The LOD comprises the graphical representation and the non-graphical information contained in each BIM model elements for each stage. The LOD should be defined explicitly for a project and used to facilitate team communications throughout the project lifecycle.

In some projects, model elements need high graphical representation but low non-graphical information, while other projects require model elements to have low graphical representation but high non-graphical information. It is difficult to apply one single LOD to represent both graphical representation and non-graphical information.

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.

LOD-Graphics (LOD-G) definition:

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.**
350	Not used for UU discipline.
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 1.3 for details.

LOD-Information (LOD-I) definition:

LOD-I is the description of non-graphical information in a model elements and will evolve as the project progresses. LOD-I requirements should be defined and agreed beforehand. As the required LOD-I varies for different projects, this Standards is not able to provide an exhaustive list of information, 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.

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.

A BIM model consists a wide range of LOD-Graphics and LOD-Information. For example, during the construction stage, some elements need to be modelled to LOD-G 300 to give specific shape and graphics, together with LOD-I 200 while other elements need to be modelled to LOD-G 400 for fabrication, together with LOD-I 300. For elements modelled to LOD-G 400 in the construction stage with fabrication details, the LOD-G 400 model should be submitted for as-built record purpose. Users may truncate them if they prefer simple models during O&M.

1.3 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.

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 1.5.2.1 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
Define the BIM uses in the projects	Client / Employer	Refer to the CIC BIM Standards General
Specify the Client or Employer information/asset information requirements of the project	Client / Employer	Refer to "**1.1 Client Requirement Specification**" of CIC BIM Standards General
Understanding of the terminology used in this Standards	All project teams	Refer to **"2. Background knowledge for Underground Utilities"**
Define and agree on the LOD of the project	Client / Employer, design consultants, contractors	Refer to **"4. LOD Responsibility Matrix", "5. LOD Elements Specification", "6. Recommended Minimum LOD"**
Identify whether the elements need to be field verified and which method of field verification to be used	Client / Employer, design consultants	Refer to **"4. LOD Responsibility Matrix"**
Production of BIM Models	Design consultants, contractors	Refer to **"7. Common Practice for BIM UU Modelling"**

4 LOD Responsibility Matrix

The LOD responsibility matrix should be used to prepare the BIM project execution plan at different stages of a project. This involves defining both the LOD-Graphics and LOD-Information to be achieved at each stage and what will be delivered by the project teams.

As stated in Section 1.3, the requirement for “field verification” should be defined in addition to the LOD. The additional column “V” in the LOD responsibility matrix serves this purpose. The project client / employer 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.

Field	**Description**
Required	Yes (Y) or No (N)
CAT Code	This code can be used for QA and review of models. OmniClass Table 23 system code* can be used for this field if no other specific requirements from the project 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 project client. Refer to section 1.3 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

Discipline according to classification										
Model elements	**Required**	**UOM**	**CAT Code**	**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

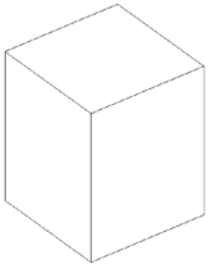
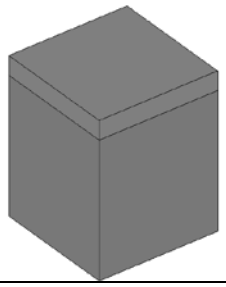
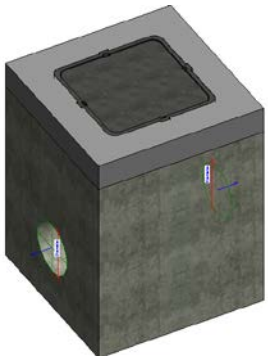
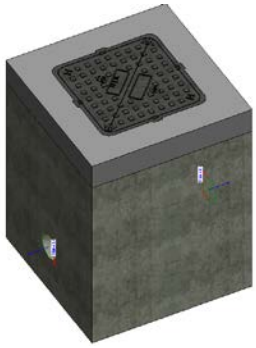
The minimum acceptable requirements for various LOD-Graphics and LOD-Information for different UU elements / objects are described in this section. Not all UU elements are included here. The same approach for specifying LOD-G and LOD-I should be applied for other elements which are not included in this section. Whatever the situations, the LOD of the elements should not deviate from the LOD definitions stated in Section 1.2 of this document.

5.1 LOD-Graphics Requirements

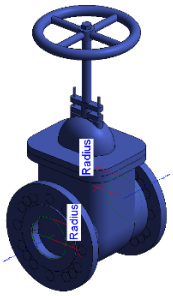
The main UU elements / objects requiring LOD-Graphics specification are classified in the following table:

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

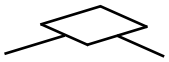
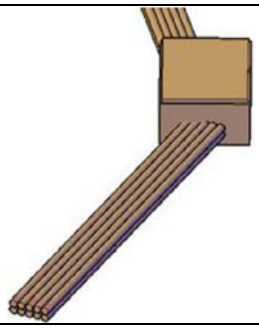
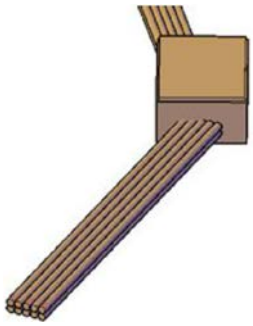
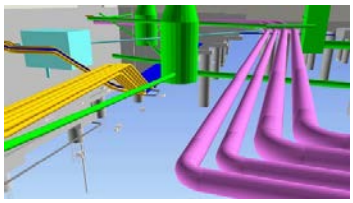
(Gravity Flow Network) Manhole

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

LOD-Graphics	Requirements		Sample Image
100	- Conceptual, schematic elements or symbol	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

LOD-Graphics	Requirements		Sample Image
100	- Conceptual, schematic elements or symbol	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-Information required for development of a BIM model, it is well understood that every department/organization may have their own specific requirement for LOD-Information. This section only provides an approach using samples instead of attempting to give an exhaustive list of information requirements. Software-specific guidelines are not covered in this section.

The following table lists the attributes commonly attached to model elements / objects at the different LOD-I levels

Type	Information/ Attributes	Data Type	Unit	Example	Descriptions	LOD-Information				
						100	200	300	400	500
General Properties	Reference Level	Text	N/A	Top level	Reference level used for 2D drawing annotation	R	R	R	R	R
	Z level	Number	mPD	80	Refer to Appendix E for details		R	R	R	R
	Size	Number	mm	200			R	R	R	R
	Minimum Cover provided	Number	mm	200			R	R	R	R
	No. of ducts	Text	N/A	2x6			R	R	R	R
	Type of Protection	Text	N/A	Concrete	Protection of the elements		R	R	R	R
	Status	Text	N/A	Existing	Status of the UU elements: Existing or New Build		R	R	R	R
Classification Properties	Classification Title	Text	N/A	Manhole	Classification title agreed by project team if necessary			R	R	R
	Classification Code	Number	N/A	23-39 29 11 13 11	Classification coding agreed by project team if necessary			R	R	R
Contract no. and contractor name	Contract no. & contractor name	Text	N/A	11/ABC/16 DEF Ltd.	Contract no. & contractor name			R	R	R
Manufacturer Properties	Material	Text	N/A	Concrete	Material of the UU elements				R	R
Condition Properties	Year of construction	Text	N/A	2009	Year of construction of the UU elements				R	R
	Owner	Text	N/A	ABC	Owner of the UU elements				R	R
Specification Properties	Product Specification	Hyperlink	N/A	http://www.cic.com	Hyperlink of the specification or technical documents. The file path/directory should be agreed by project client / employer				R	R
Verification Properties	QL Standard	Text	N/A	PAS-128	Qualification level of the UU elements/objects					R
	QL Grade	Text	N/A	QL-B	Grade of the quality level					R

R: Required

The above table only specifies the common attributes for UU elements / objects. It is recommended that a full list of element-specific information requirement should be well-defined before the project starts.

When defining the LOD-information, it is recommended that the Information / Attributes under "**General Properties**" should be input at the detailed design stage, and "**Manufacturer Properties**", "**Condition Properties**", "**Specification Properties**" during the construction stage. Input for "**Classification Properties**" and "**Verification Properties**" is optional, depending on the project needs. It is important to reach a consensus and agreement with the project client / employer and the project team if additional costs are necessary for any field verification works.

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 client / employer 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 client / employer.

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 client / employer.

Example project assumptions:

- A field verification method will be used for the project and should be agreed by project client / employer. 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 client / employer.

Example LOD Responsibility Matrix

Gravity Flow Network

Model elements	Required	UOM	CAT Code	Concept, Feasibility, Planning			Preliminary, Scheme			Detailed Design			Submission for Approval			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	30	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	CAT Code	Concept, Feasibility, Planning			Preliminary, Scheme			Detailed Design			Submission for Approval			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.

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 client / employer’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 v1.0
2. Architectural Services Department
   BIM Guide for BS Installation Ver1.0_Jun18
3. Drainage Services Department
   BIM _Modelling Manual (First Edition)
4. Water Supplies Department
   BIM Standard for Asset Management
5. Hong Kong Housing Authority and Housing Department
   BIM Standards Manual, version 1.0
6. CAD Standard for Works Project (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

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- Airport Authority Hong Kong
- Buildings 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 (Phase 2)

Members	Representative of:
Dr. Jack Cheng	The Hong Kong University of Science and Technology
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Mr. Ben Chan	Lands Department
Mr. Eric Lee	Buildings Department
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Mr. Aaron Chan	The Hong Kong Institute of Architects
Mr. Clement Chung	The Association of Consulting Engineers of Hong Kong
Dr. Neo Chan Mr. David Fung	Hong Kong Institute of Building Information Modelling (HKIBIM)
Convenor and Secretary	
Mr Alex Ho Mr Ron Ng Mr Lok Fung Mr Elvis Chiu	Construction Industry Council

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**.

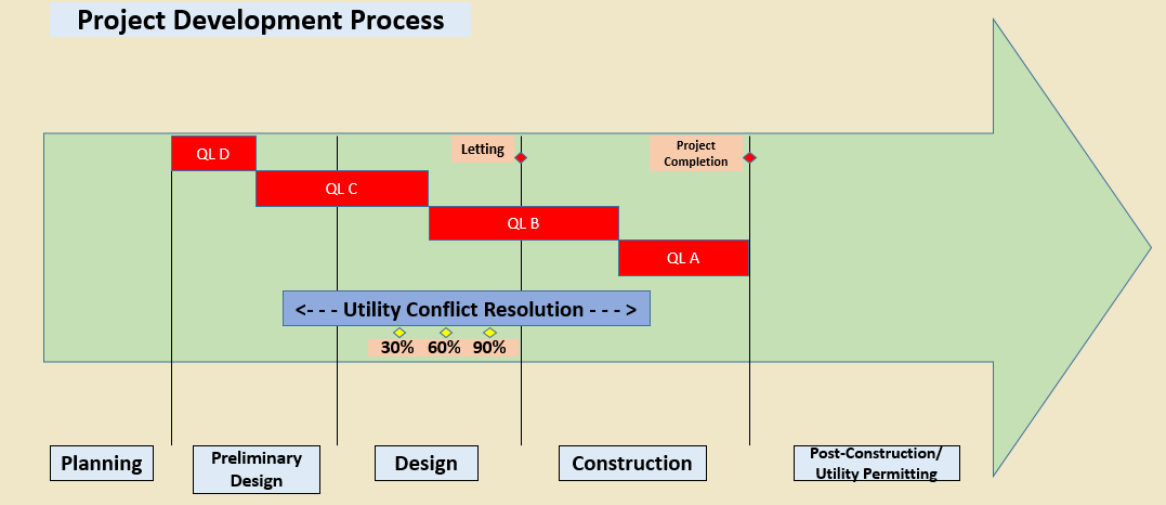
[1] Horizontal location is to the centreline of the utility.
[2] Vertical location is to the top of the utility.
[3] For detection, it is a requirement that a minimum of GPR and EML techniques are used (see **8.2.1.1.2**).
[4] Electronic depth readings using EML equipment are not normally sufficient 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 client / employer 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 client / employer 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			

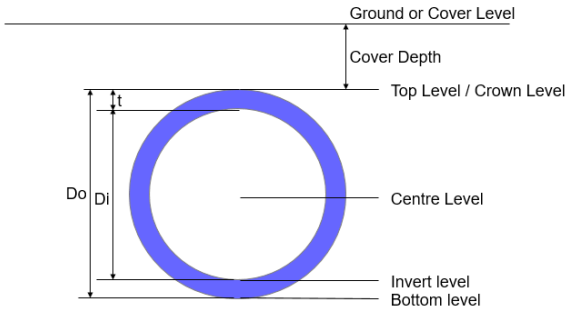
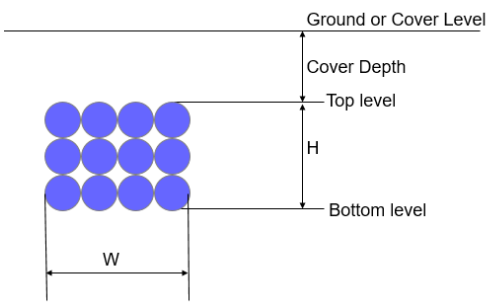
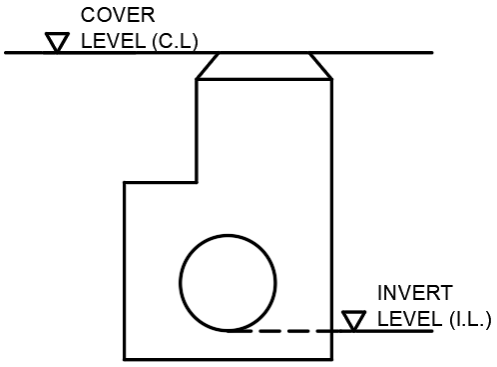
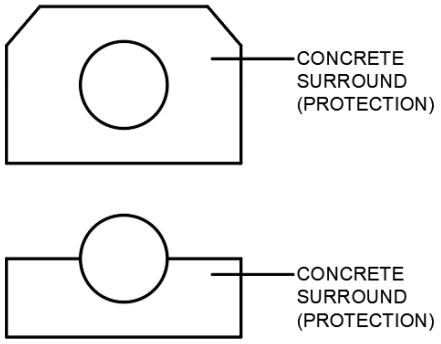
Appendix E Key Levels and Dimensions of Different Types of UU

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

	
Pipe Level	Duct Bank Level
	
Cover Level & Invert Level	Concrete Surround (Protection)

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Comprehensive	❑	❑	❑	❑	❑
Useful	❑	❑	❑	❑	❑
Practical	❑	❑	❑	❑	❑
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	❑		❑		❑
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	❑	❑	❑	❑	❑
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