Appendix VI – LOD-I Requirements, Creation and Extraction

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1. Introduction

This Appendix describes Level of Information (LOD-I) for BIM models and BIM objects. Section 2 lists out and describes LOD-I across the WDs. Section 3 describes how to create attribute fields in different sample authoring software. Section 4 outlines different types of BIM attributes, and Section 5 describes principles of BIM attribute mapping and extraction.

2. LOD-I Across the WDs

Table App VI-1 describes general LOD-I requirements of LOD 100 to 500. The groupings of attributes have been developed based on principles set out in CIC BIM Standards - General: December 2020 Edition. Further descriptions of the attribute table are as follows:

2.1. WDs' Attributes Requirements

Asset owner could define additional information needs. In accordance with paragraph 17 of the Technical Circular (Works) No. 12/2020, WDs should review and collaborate with maintenance agencies of the built assets regarding asset information requirements (AIR). Asset owners who have not defined their information needs should refer to the table below as the basis. Asset owners who have already defined their own required attribute(s) should ensure the pre-defined attributes could cover relevant LOD-I.

2.2. The Groups of Attributes in the LOD-I Requirements

The list of attributes is formulated based on common approaches as discussed with WDs. Table App VI-1 contains the following groups of attributes:

a) Project Information is used to facilitate geolocation and data conversion via the Conversion Engine.

b) General Properties are used to enable information grouping and identification.

c) Design Properties are used to facilitate design review, drawing generation and quantity take-off.

d) Classification Properties are used to facilitate asset classification. Departmental classification(s) in addition to or instead of OmniClass could be defined by WDs.

e) Manufacturer's Equipment Properties, Condition Properties and Verification Properties are used to facilitate asset information management.

2.3. Mandatory and Required Attributes

"M" indicates mandatory information to facilitate metadata extraction and geolocation for Conversion Engine. "R" indicates required information to the WDs. To facilitate information exchange, Table App VI-1 shows the minimum required LOD-I and should be inputted into BIM models as far as practicable. Exemptions to exclude required information to WDs should be sought from **maintenance agencies**, and the records on the decisions should be kept and documented in BEP.

2.4. BIM Authoring Software

Attributes that are built-in to BIM authoring software should be utilised as far as practicable. In the last two columns of Table App VI-1, Revit and Civil 3D are used as examples for the attributes' creation methods. If software other than these two software is adopted, the methods for creating attributes should be properly documented in the BEP.

2.5. Samples of Attributes Files

To facilitate WDs' adoption of the LOD-I across the WDs, a project-specific shared parameter text file for Autodesk Revit (refer to Figure App VI-1) and a .dwg file including for Autodesk Civil 3D with those attributes will be sent by CD-ROM with the final hard copy of this Guide.

Figure App VI-1 Shared Parameter File for Revit

Revamp Model Common Attributes.txt

```
# This is a Revit shared parameter file.
# Do not edit manually.
*META   VERSION MINVERSION
META    2   1
*GROUP  ID  NAME
GROUP   1   Classification Properties
GROUP   2   General Properties
GROUP   3   Design Properties
GROUP   4   Manufacturer's Equipment Properties
GROUP   5   Condition Properties
GROUP   6   Verification Properties
*PARAM  GUID    NAME    DATATYPE    DATACATEGORY    GROUP   VISIBLE DESCRIPTION USERMODIFIABLE
PARAM   ba3c3418-a4ba-460d-bb47-f25ba4d56a8e    Equipment Capacity  TEXT        4   1       1
PARAM   f184fa44-50fe-4e0d-be15-f9e776181cd2    Contract Number of the Equipment    TEXT        4   1       1
PARAM   87dabc67-a110-4bca-982b-548150a66ed8    Verification    TEXT        6   1       1
PARAM   24d8fb6d-3f01-4a8c-b254-f55a95dda970    Material Grade  TEXT        3   1       1
PARAM   71f6107b-59c8-486f-8b2d-82f6c1aea810    CAT Code    TEXT        2   1       1
PARAM   de760a88-d846-4697-a9d2-b04bd0f58115    Manufacturer Name   TEXT        4   1       1
PARAM   7b262c88-0db1-4a8d-9b70-f8730a0a33ec    Design Capacity TEXT        3   1       1
PARAM   2be8dc88-6137-48ab-8a7e-564259dd95c4    Model Number    TEXT        4   1       1
PARAM   56848590-dd58-45b4-8561-4d90e97168bc    Departmental Unique ID  TEXT        2   1       1
PARAM   8979349f-9719-4416-9204-af0f333e75d1    Certified Completion Date   TEXT        5   1       1
PARAM   2a3681ac-2d41-47e6-922e-3282c823b9dd    Handover Date   TEXT        5   1       1
PARAM   c92b6fc2-f76c-4065-908f-adf5f22eb83e    Asset ID    TEXT        4   1       1
PARAM   cac282cd-9403-4c82-aeb4-a88757c778b7    OmniClassTitle  TEXT        1   1       1
PARAM   d06feedf-d592-495f-8db5-b0aafea86e98    LOD-G   TEXT        1   1       1
PARAM   e3f4d6e5-b221-42b4-ad34-49282662d045    Brand Name  TEXT        4   1       1
PARAM   56cb03ea-0752-490e-812b-19bfb0c50a5e    OmniClassVersion    TEXT        1   1       1
PARAM   676bb5f6-a71b-4a20-bf4e-5e8c143862a9    OmniClassCode   TEXT        1   1       1
PARAM   de1780f8-89a1-4175-a779-00e83675ad1a    Location    TEXT        2   1       1
PARAM   28e1f8f9-479b-4de7-8a8f-53525653f350    LOD-I   TEXT        1   1       1
```

Table App VI-1 LOD-I Across the WDs

No.	Grouping	Attribute Name	Description	LOD-I					Proposed Input Format	Creation Method for Sample Authoring Software	
				100	200	300	400	500		Revit	Civil 3D
1	Project Information	Organisation Name	Client name (per agreement/ contract)	M	M	M	M	M	Alphanumeric	Use default attribute in Project Information Dialog Box Refer to Section 3.1	Use Custom Property in Drawing Properties Dialog Box Refer to Section 3.2
		Project Issue Date	Project Commencement date	M	M	M	M	M	MMM YYYY (eg. Nov 2014)		
		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	Shared Parameter Refer to Section 3.3	Property Set Refer to Section 3.4
		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		

No.	Grouping	Attribute Name	Description	LOD-I					Proposed Input Format	Creation Method for Sample Authoring Software	
				100	200	300	400	500		Revit	Civil 3D
3	Design Properties	Material	Singular material or all materials pertaining to the assembly		R	R	R	R	Alphanumeric	Family parameter Refer to Section 3.7	Property Set Refer to Section 3.4
		Material Grade	Material grade (e.g. concrete grade, steel grade)		R	R	R	R	Alphanumeric	Shared Parameter Refer to Section 3.3	
		Design Capacity	Design capacity		R	R	R	R	Alphanumeric		
		Number	Room Number				R	R	Alphanumeric	Use default attributes under "Room" Refer to Section 3.8	N/A
		Name	Room Name				R	R	Alphanumeric		
4	Classification Properties **(see Remark 2)**	OmniClassCode	OmniClass code			R	R	R	Alphanumeric	Classification Refer to Section 3.5	Classification Refer to Section 3.6
		OmniClassTitle	OmniClass title			R	R	R	Alphanumeric		
		OmniClassVersion	OmniClass version			R	R	R	Alphanumeric		

No.	Grouping	Attribute Name	Description	LOD-I					Proposed Input Format	Creation Method for Sample Authoring Software	
				100	200	300	400	500		Revit	Civil 3D
5	Manufacturer's Equipment Properties	Brand Name	Brand name				R	R	Alphanumeric	Shared Parameter Refer to Section 3.3	Property Set Refer to Section 3.4
		Manufacturer Name	Manufacturer name				R	R	Alphanumeric		
		Model Number of element / equipment	Model number				R	R	Alphanumeric		
		Equipment Capacity	Equipment capacity				R	R	Alphanumeric		
		Asset ID	Asset ID				R	R	Alphanumeric		
		Contract Number of the Equipment	The equipment's contract number				R	R	Alphanumeric		
6	Condition Properties	Certified Completion Date	Certified completion date				R	R	MMM YYYY (eg. Nov 2014)	Shared Parameter Refer to Section 3.3	Property Set Refer to Section 3.4
		Handover Date	Handover date				R	R	MMM YYYY (eg. Nov 2014)		

No.	Grouping	Attribute Name	Description	LOD-I					Proposed Input Format	Creation Method for Sample Authoring Software	
				100	200	300	400	500		Revit	Civil 3D
7	Verification Property	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)	Shared Parameter Refer to Section 3.3	Property Set Refer to Section 3.4

Remarks:

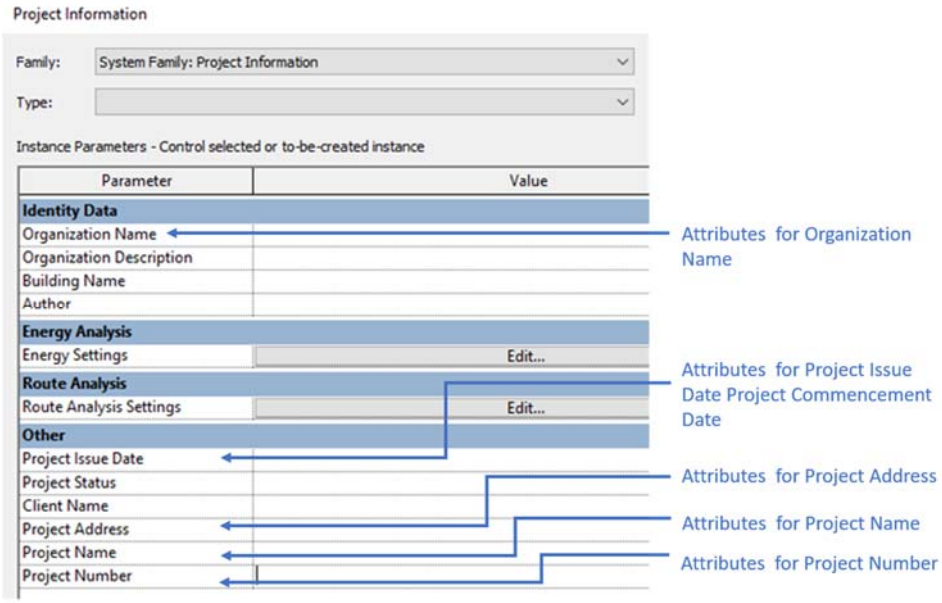
1. Category (in the form of the shared parameter “CAT Code” under “General Properties”) could facilitate grouping and data filtering. In addition, “category” may refer to:
   a) The use of appropriate category or object types when creating BIM objects to minimize data loss (especially LOD-G) during open 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. Department-specified classification(s) in addition to or instead of OmniClass could be defined by WDs.

3. Creation of Attributes for Required Information

3.1. Creation of Project Information Attributes in Revit

In Revit, default attributes can be utilised for inputting Project Information under **Manage** tab → **Settings** panel → **Project Information**. The figure below illustrates the Revit Parameters used for Project Information.

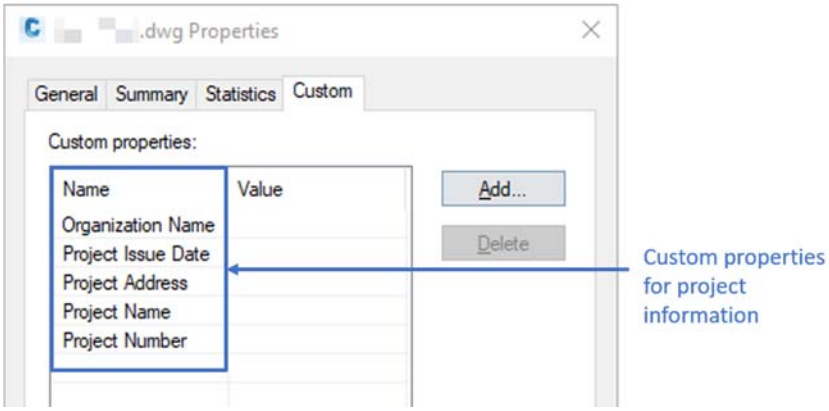
Figure App VI-2 Project Information Attributes in Revit



3.2. Creation of Project Information Attributes in Civil 3D

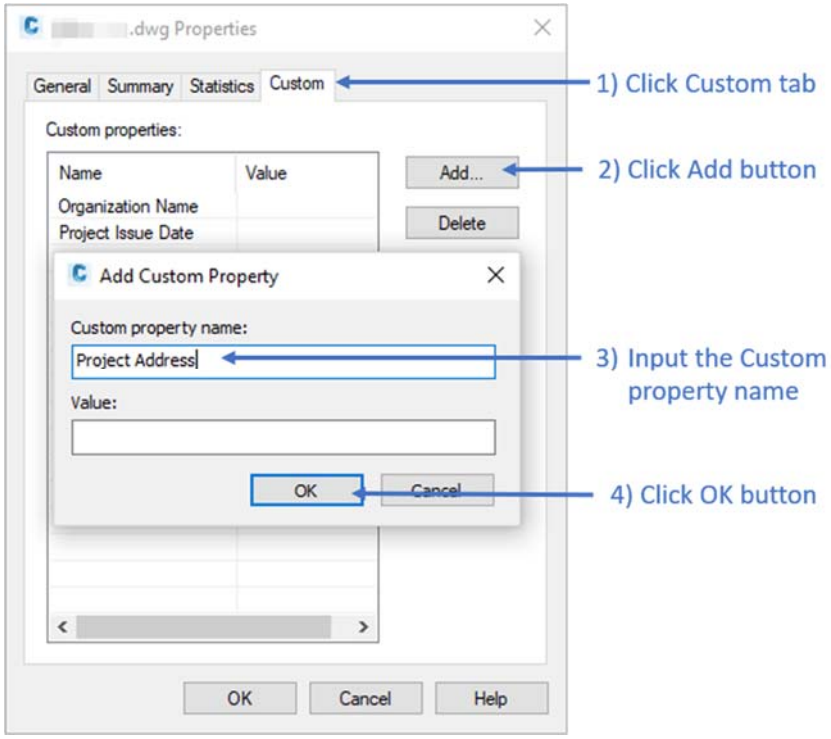
In Civil 3D, Project Information attributes can be created by using **Custom Property** in **Drawing Properties** dialog box.

Figure App VI-3 Project Information Attributes in Civil 3D



To create the Custom Property, first input "**DWGPROPS**" in the command line to show the **Drawing Properties** dialog box, then follow the steps as illustrated in the figure below to add the Project Information attributes.

Figure App VI-4 Adding Custom Property Name in Civil 3D



3.3. Creation of Shared Parameters in Revit

3.3.1. In Revit, Shared Parameters are identified by unique GUIDs to facilitate attribute consistency across BIM files. Shared Parameters could be applied to BIM object and BIM model.

3.3.2. Adding Shared Parameters to Revit Family Files (BIM objects in .rfa format)

a) Create a new family or open an existing one.

b) Click **Create** tab ➤ **Properties** panel ➤ (**Family Types**).

c) In the **Family Types** dialog, under the **Parameters** group box, click **Add**.

d) In the **Parameter Properties** dialog, select **Shared Parameter**.

e) Click **Select** and choose the appropriate shared parameter from the appropriate parameter group. If desired, click **Edit**; this will return to the **Edit Shared Parameters** dialog which allows opening a different shared parameter file or adding new parameters (refer to the steps in Section 3.3.4).

f) Choose whether to store the parameter by instance or type.

g) Click **OK**. The parameter name appears in the **Family Types** dialog.

h) Optionally, enter a value for the shared parameter or create a formula to calculate its value.

3.3.3. Adding Shared Parameters to Revit Project Files (BIM models in .rvt format)

a) Create a new project or open an existing one.

b) Click **Manage** tab ➤ **Settings** panel ➤ (**Project Parameters**).

c) In the **Project Parameters** dialog, click Add.

d) In the **Parameter Properties** dialog, select **Shared parameter**.

e) Click **Select** and choose the appropriate shared parameter from the appropriate parameter group. If desired, click Edit; this will return to the **Edit Shared Parameters** dialog which allows opening a different shared parameter file or adding new parameters (refer to the steps in Section 3.3.4).

f) Choose whether to store the parameter by instance or type.

g) Select the categories to add the shared parameter on the right-hand side.

h) Click **OK**. The parameter will appear in the elements.

i) Optionally, enter a value for the shared parameter or create a formula to calculate its value.

3.3.4. Adding new Shared Parameters in Edit Shared Parameters Dialog

a) Click **Create**.

b) In the **Create Shared Parameter File** dialog, enter a file name, and save the dialog to a desired location.

c) In the **Groups** box, click **New** and enter a name for the parameter group.

d) From the **Parameter Group** drop-down menu, select a group.

e) In the **Parameters Group** box, click New.

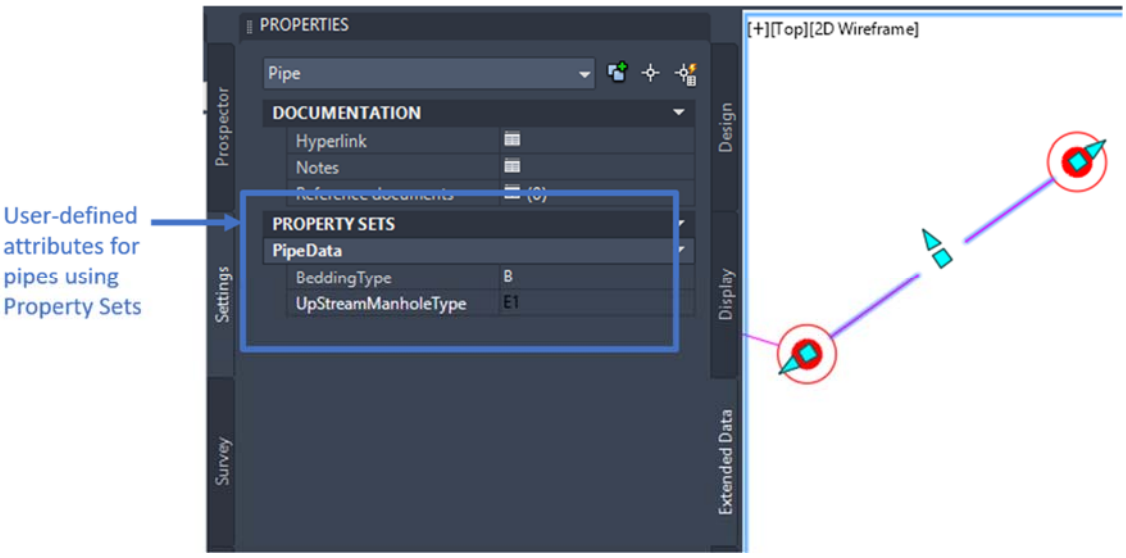
f) In the **Parameter Properties** dialog, enter a name, discipline, and type for the parameter.

g) Optionally, under **Tooltip Description**, click **Edit Tooltip**. In the **Edit Tooltip** dialog, enter the tooltip text, up to 250 characters.

3.4. Creation of Property Set in Civil 3D

3.4.1. In Civil 3D, **Property Sets** could be used for user-defined attributes for BIM model elements. Below is an example of user-define attribute for pipe using **Property Sets**.

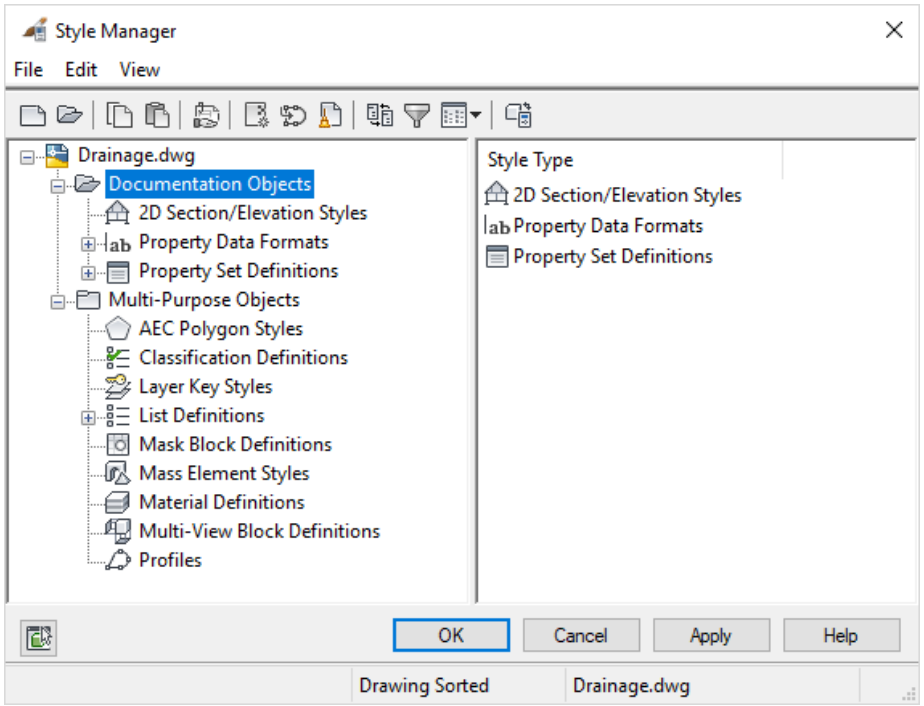
Figure App VI-5 An Example of User-define Attribute for Pipe Using Property Sets



3.4.2. **Property Sets** could be defined in **Style Manager**. The following are key steps for setting up **Property Set**s for user-defined attributes for Civil 3D BIM object.

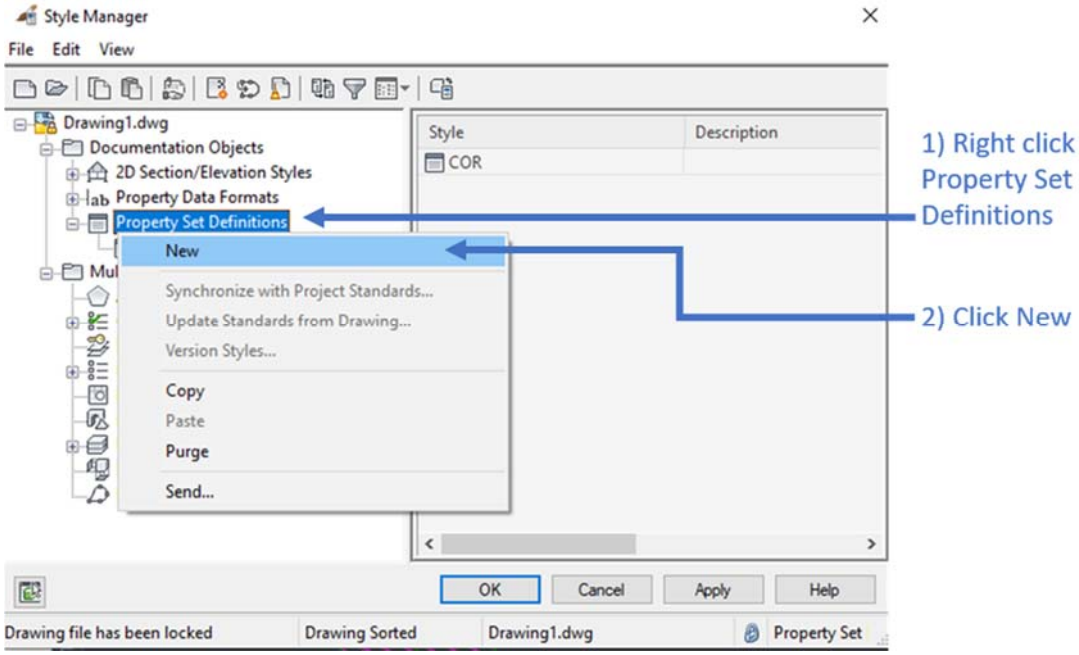
a) Input command "**STYLEMANAGER**" in the command line to open the **Style Manager** which is shown as below Figure:

Figure App VI-6 Step a of Setting up Property Sets for Civil 3D BIM Object



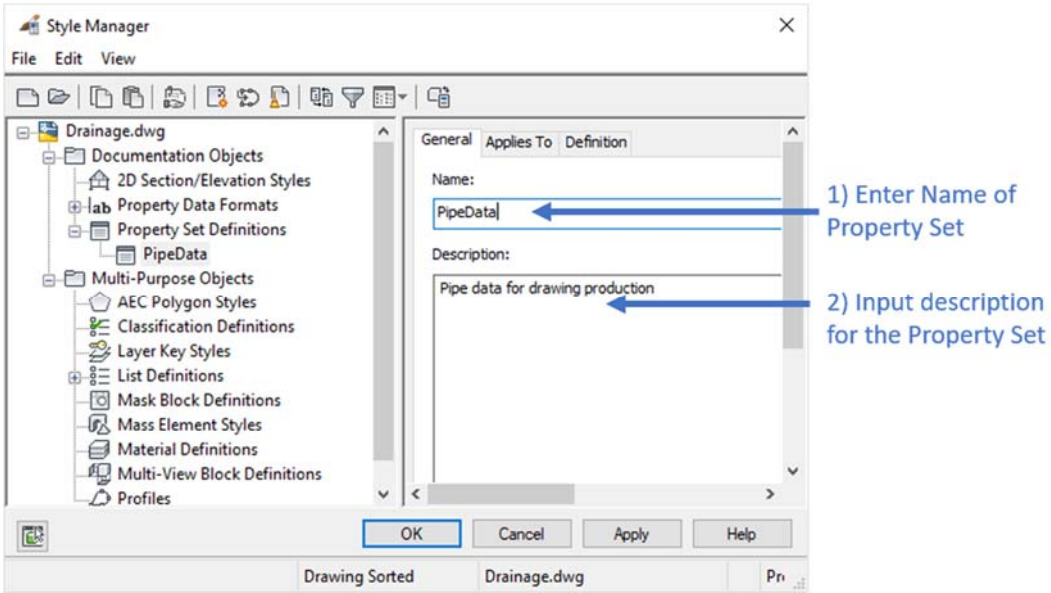
b) Under **Style Manager**, right click **Property Set Definitions** under **Documentation Objects**, then click **New**.

Figure App VI-7 Step b of Setting up Property Sets for Civil 3D BIM Object



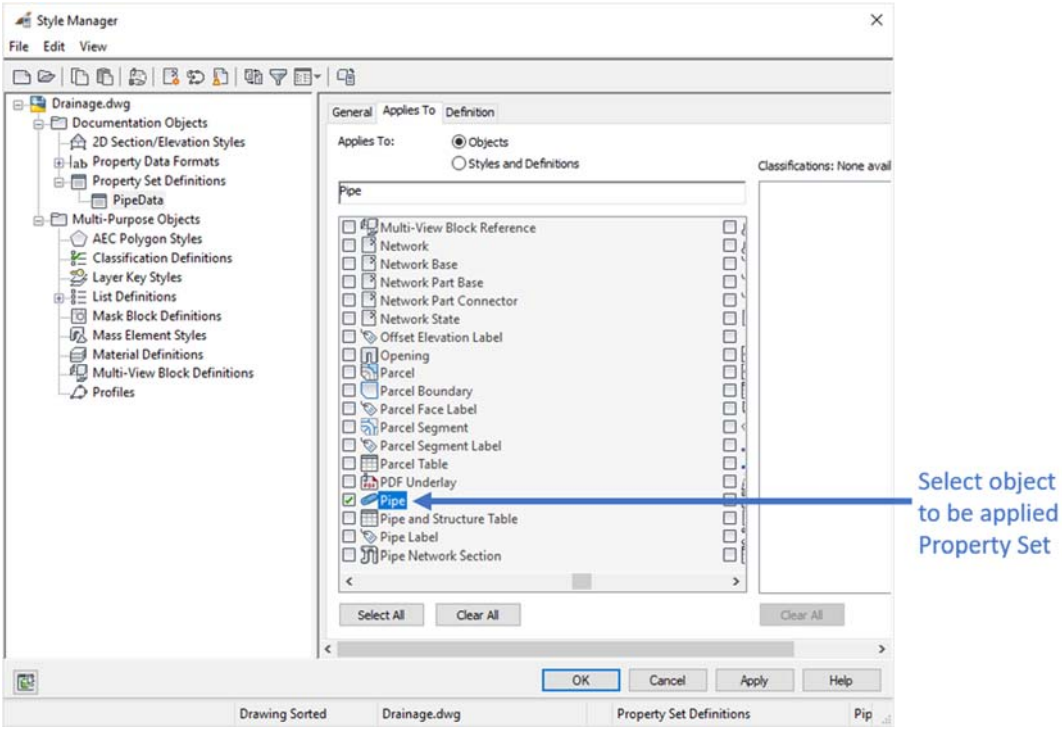
c) Input the **Name** and **Description** of the **Property Set** in **General** tab.

Figure App VI-8 Step c of Setting up Property Sets for Civil 3D BIM Object



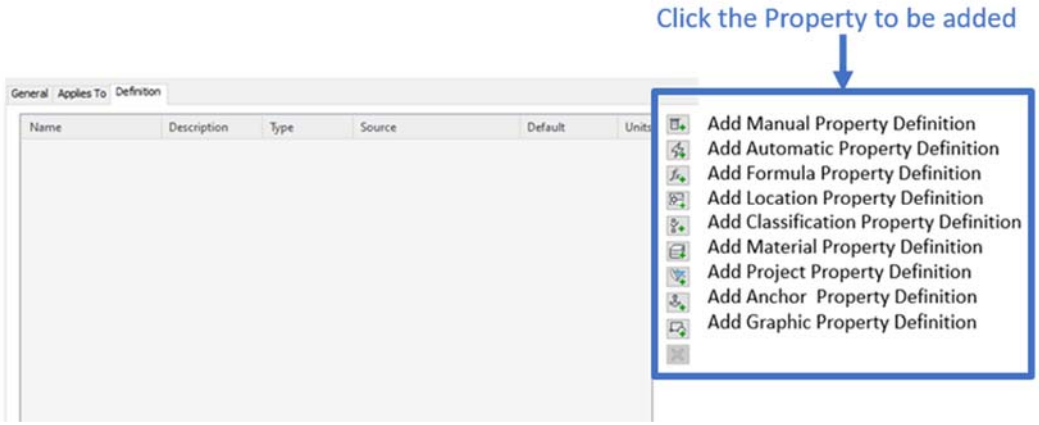
d) Under **Applies To** tab, select the types of object (e.g. Pipe) to be applied in the **Property Set**.

Figure App VI-9 Step d of Setting up Property Sets for Civil 3D BIM Object



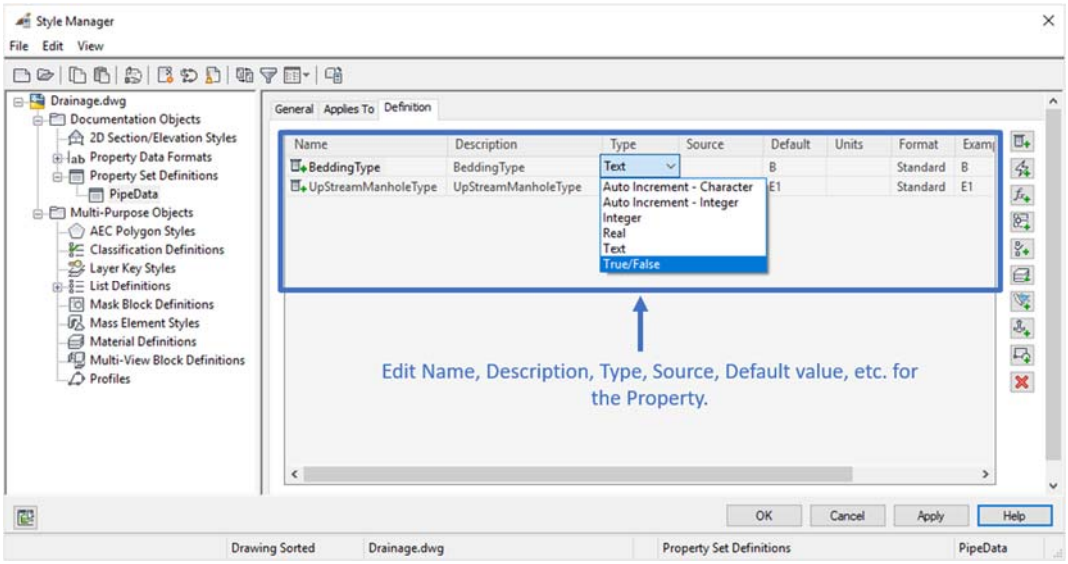
e) In **Definition** tab, click the properties as required to be added to the **Property Set**.

Figure App VI-10 Step e of Setting up Property Sets for Civil 3D BIM Object



f) Edit the Name, Description, Type, Source, Default value, etc. for the properties.

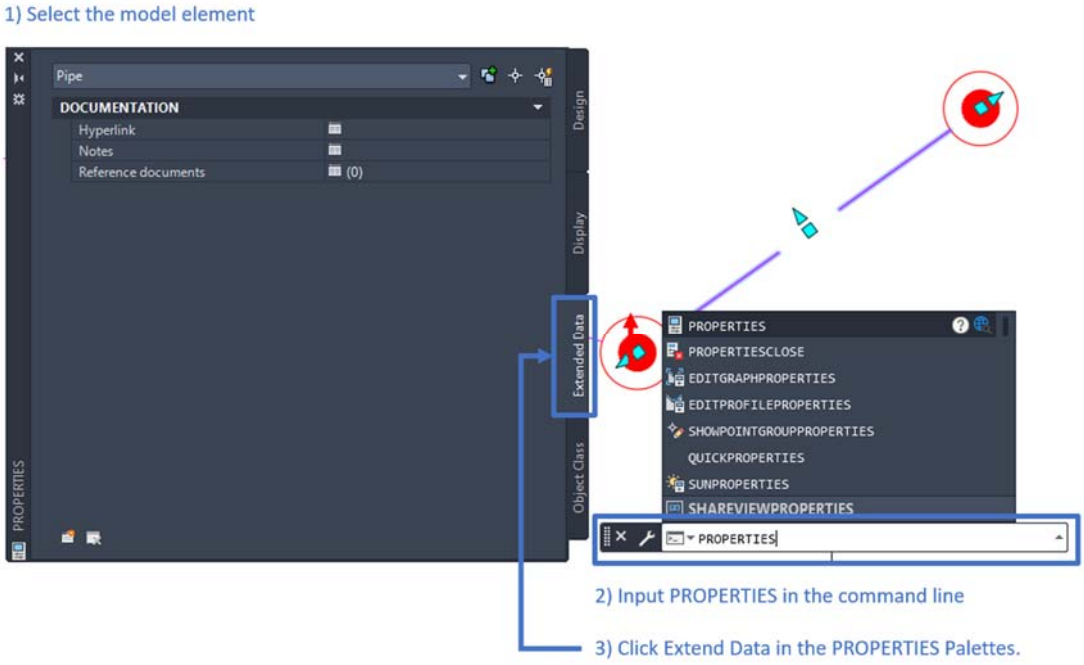
Figure App VI-11 Step f of Setting up Property Sets for Civil 3D BIM Object



3.4.3. The steps for applying **Property Set** to Civil 3D BIM objects are as follows:

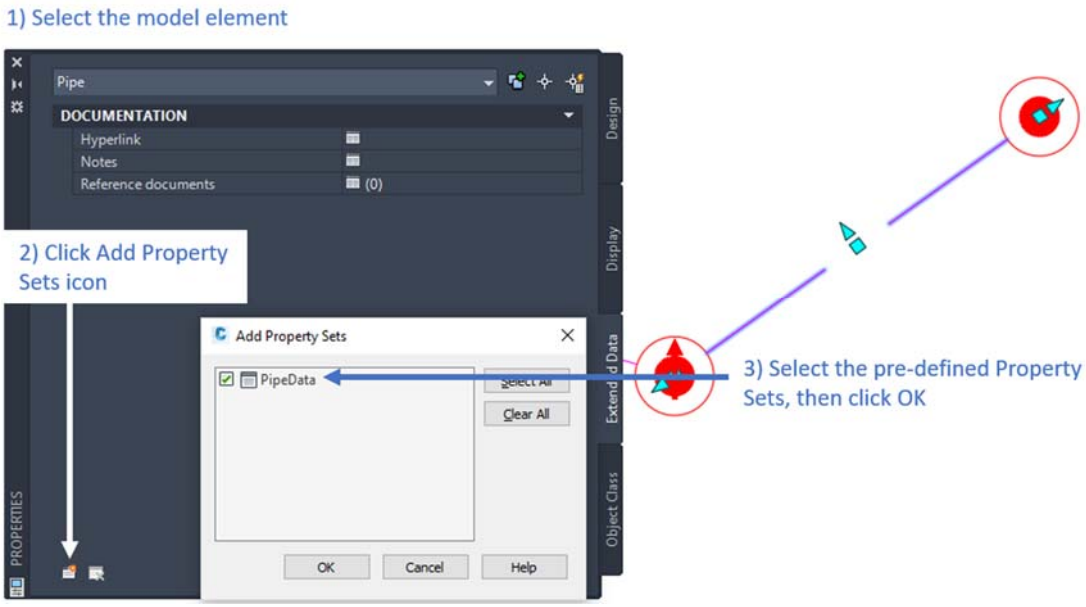
a) Select the model element, input **PROPERTIES** command in the command line, then click **Extend Data** in the **PROPERTIES** palettes.

Figure App VI-12 Step a of Applying Property Sets to Civil 3D BIM Object



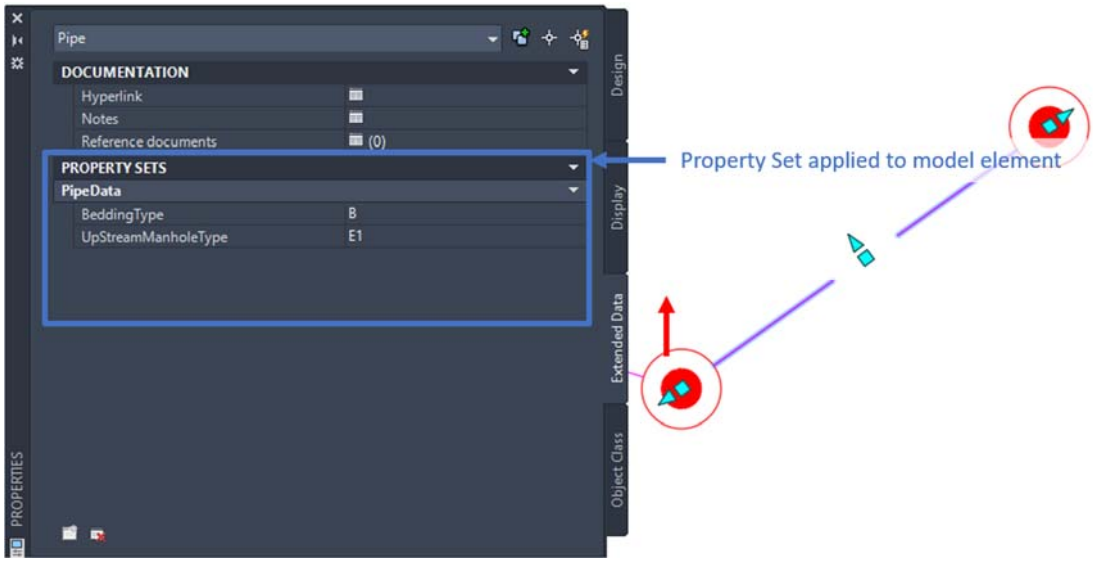
b) Click **Add Property Sets** icon in the bottom left of the **PROPERTIES** palettes. In the **Add Property Sets** dialog, click to select the pre-defined Property Set **"PipeData"**, then click the **OK** button.

Figure App VI-13 Step b of Applying Property Sets to Civil 3D BIM Object



c) The "**PipeData**" of **Property Set** is now added to BIM object shown as below Figure.

Figure App VI-14 Step c of Applying Property Sets to Civil 3D BIM Object



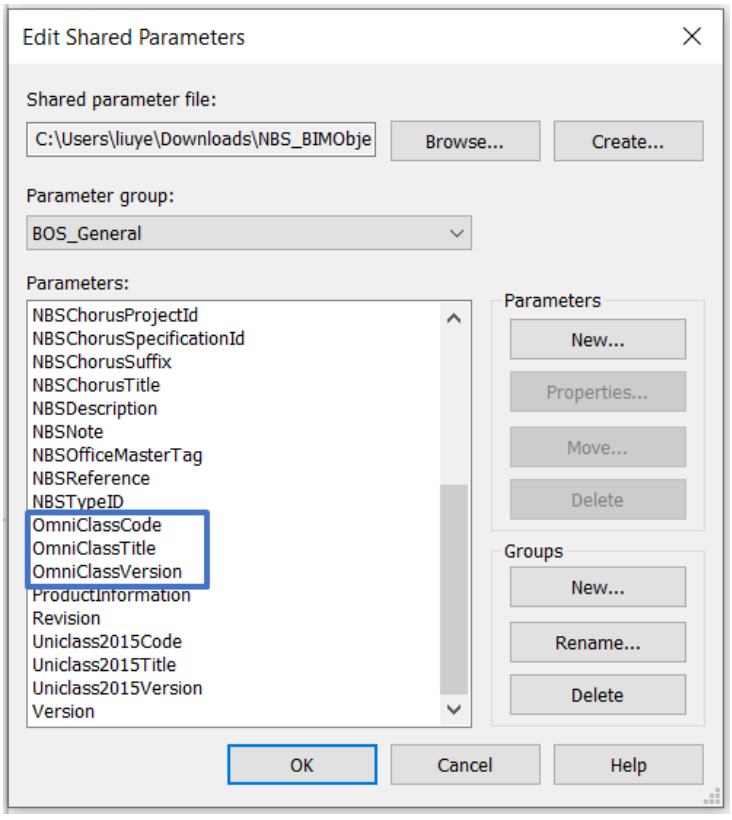
3.5. Creation of Classification in Revit

This section describes the methods of adding classification information in Revit. Classification information could be department-specified classification(s), additional classification (e.g. OmniClass), or both. If department-specified classification(s) are used, classification information could be created as Shared Parameters (refer to Section 3.3 for details). If OmniClass classification is used, there are three creation methods as described in sections below.

3.5.1.

This section describes a sample creation method for classification information especially for OmniClass, as this method is not limited by OmniClass and Revit's updates. Considering OmniClass version would be updated from time to time, to ensure consistency, if OmniClass is the project-specific or stakeholder-specified classification system, OmniClass information should be inputted as Shared Parameters. Refer to the figure below for an example and Section 3.3. for details.

Figure App VI-15 An Example of Adding OmniClass Information as Shared Parameter in Revit

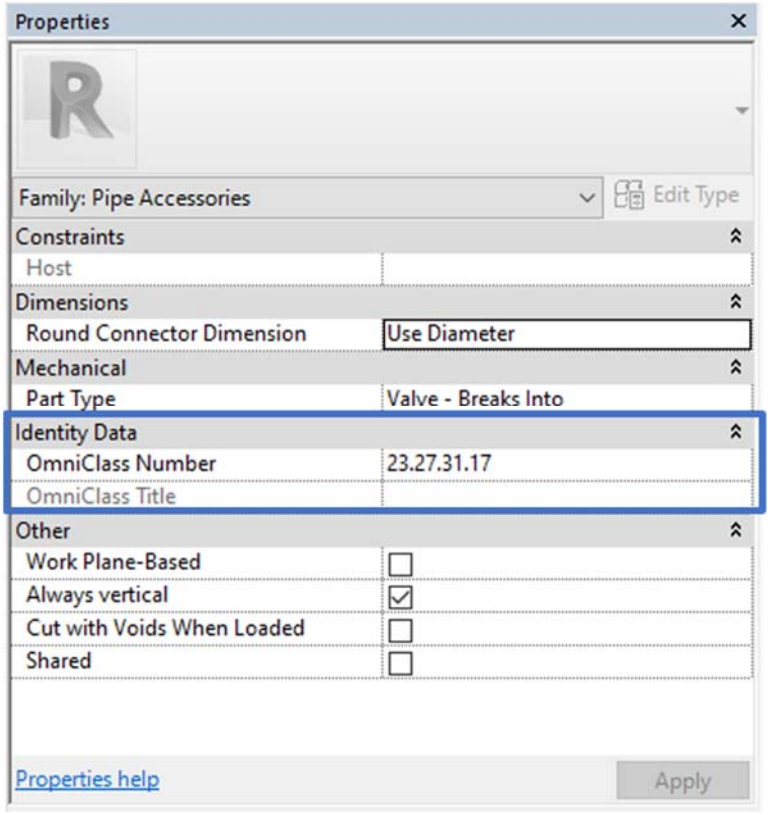


3.5.2. Revit has an add-in program named as "Classification Manager" for classification management. Refer to the below link for the details of the add-in program.

https://knowledge.autodesk.com/support/revit-products/getting-started/caas/simplecontent/content/classification-manager-for-revit-quick-start.html?st=classification%20manager

3.5.3. Revit provides pre-set parameters "OmniClass Number" and "OmniClass Title" under Identity Data for Revit families. These parameters correspond to OmniClass "Table 23 – Products" in Revit Family. Classification number could be defined by editing the Revit family's properties. Refer to the figure below for an example.

Figure App VI-16 An Example of Pre-set Parameters "OmniClass Number" and "OmniClass Title" under Identity Data in Revit Family



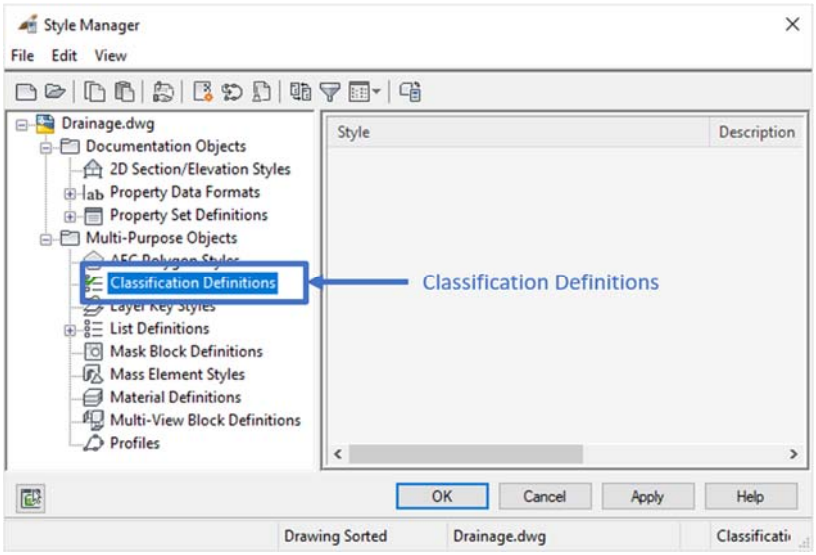
If OmniClass 2012 standards is assigned to be used and the OmniClass numbers supplied in Revit are incorrect, please refer to below link and update the OmniClass Taxonomy File accordingly.
https://knowledge.autodesk.com/support/revit-products/troubleshooting/caas/CloudHelp/cloudhelp/2020/ENU/Revit-Troubleshooting/files/GUID-BA0B2713-ADA0-4E51-A7CD-85D85511F3ED-htm.html

3.6. Creation of Classification in Civil 3D

3.6.1. In Civil 3D, there are no pre-set parameters function for OmniClass. **Classification Definitions** could be used for setup OmniClass information for the Civil 3D BIM objects under **Style Manager**. The key steps are as follows:

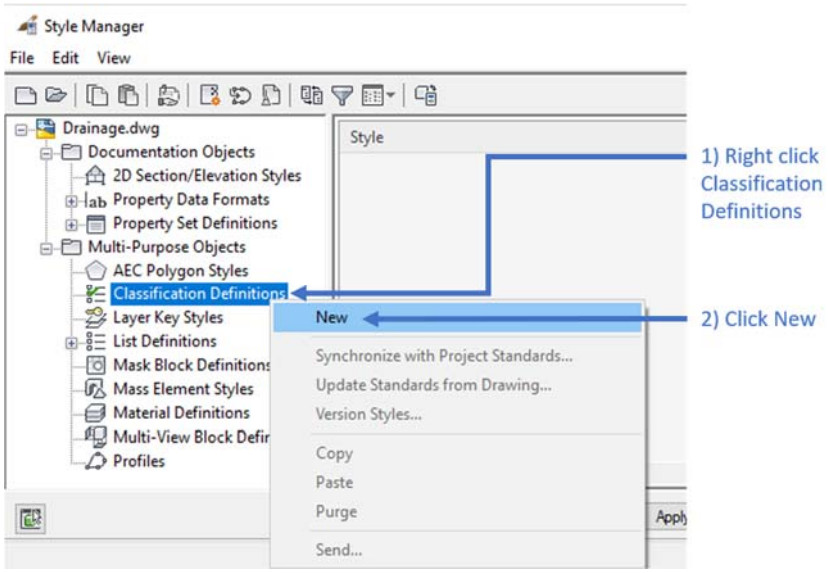
a) Input command "**STYLEMANAGER**" in the command line to open the Style Manager. **Classification Definitions** could be found under **Style Manager**.

Figure App VI-17 Step a of Setting up OmniClass information under Style Manager for Civil 3D BIM Objects



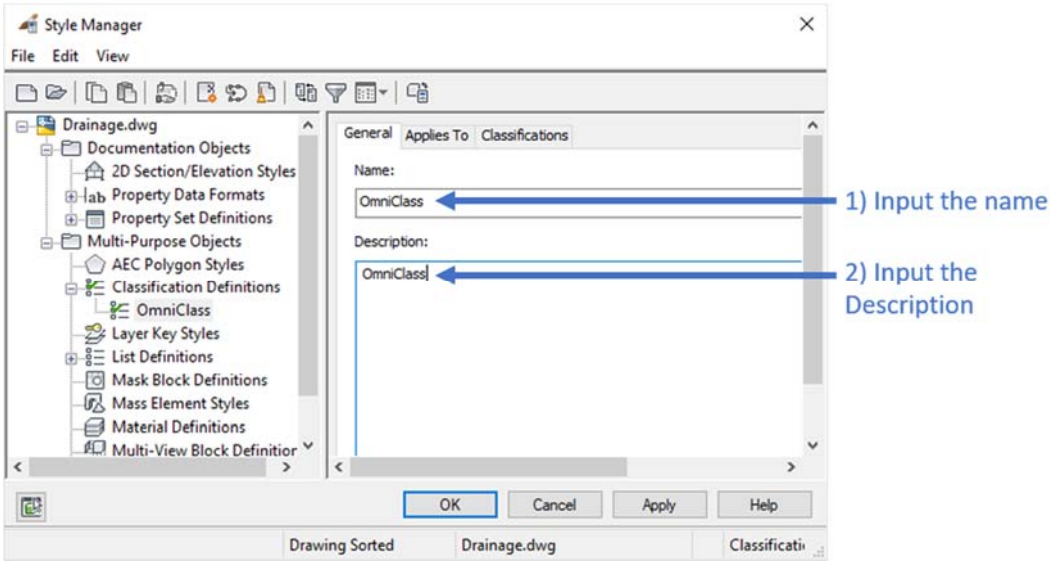
b) In **Style Manager**, right click **Classification Definitions** under **Multi-Purpose Objects**, then click **New** to create new classifications.

Figure App VI-18 Step b of Setting up OmniClass information under Style Manager for Civil 3D BIM Objects



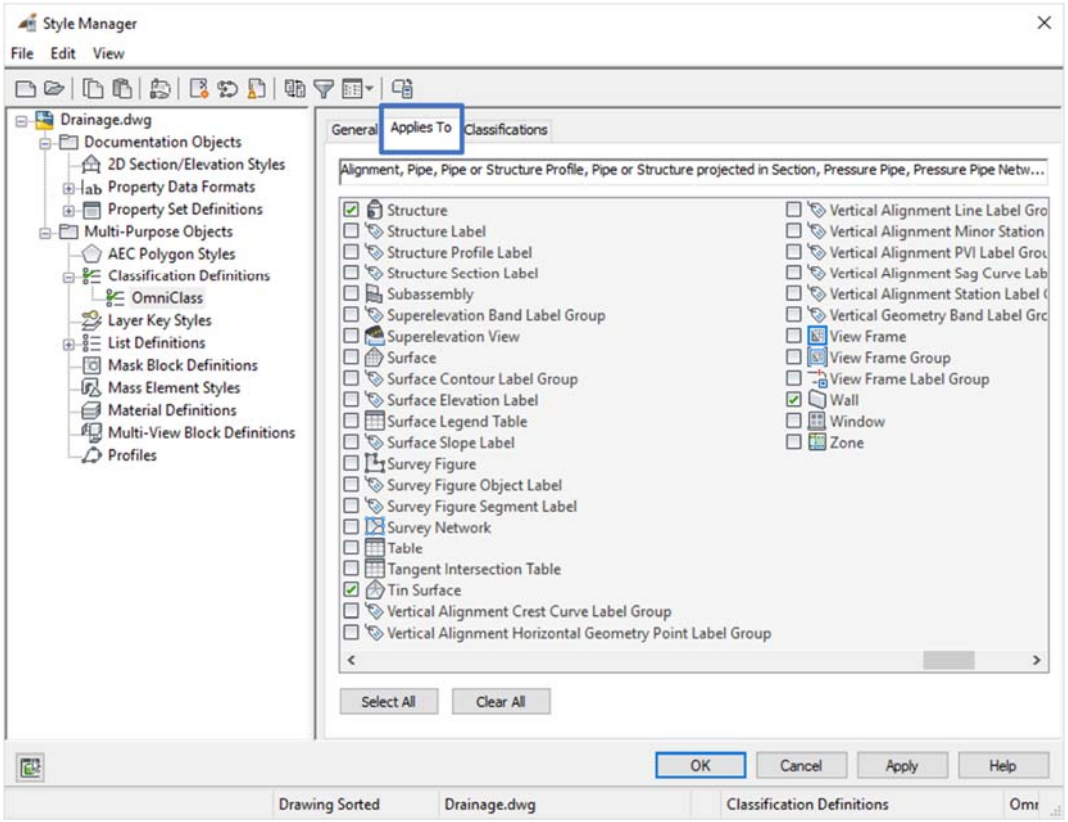
c) On **General** tab, enter the **Name** and input the **Description.**

Figure App VI-19 Step c of Setting up OmniClass information under Style Manager for Civil 3D BIM Objects



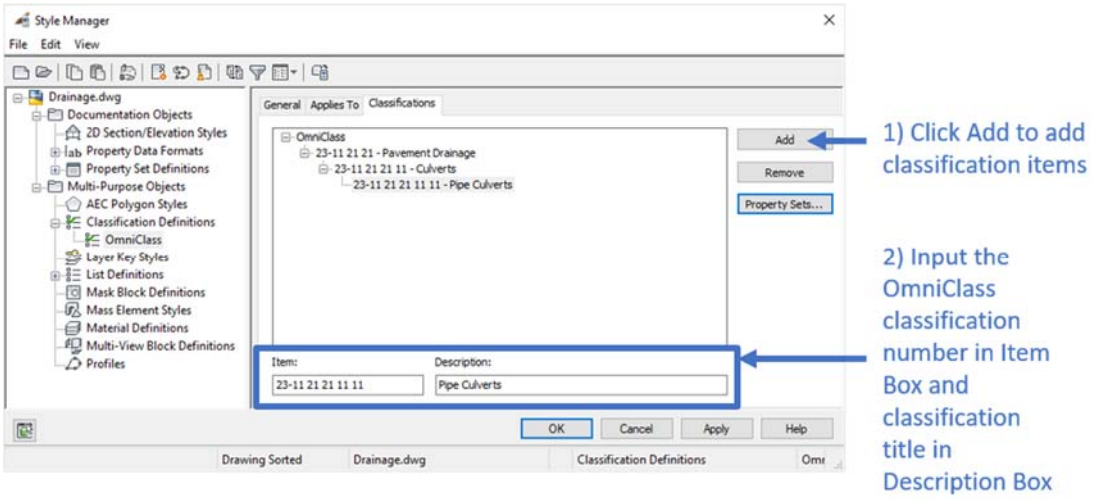
d) On **Applies To** tab, select the BIM object with the OmniClass information.

Figure App VI-20 Step d of Setting up OmniClass information under Style Manager for Civil 3D BIM Objects



e) On **Classification** tab, click **Add** to enter classification items which are **Item** and **Description** ("Item" is equivalent to OmniClass classification number while "Description" is equivalent to OmniClass classification title). Click the **OK** button when classification information is entered.

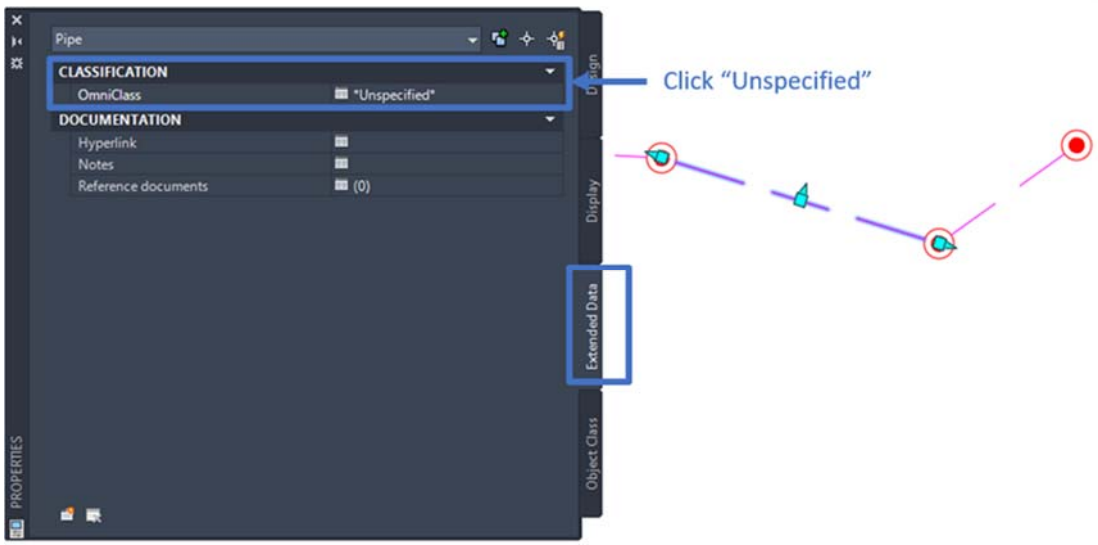
Figure App VI-21 Step e of Setting up OmniClass information under Style Manager for Civil 3D BIM Objects



3.6.2. Apply OmniClass classification number to Civil 3D BIM objects

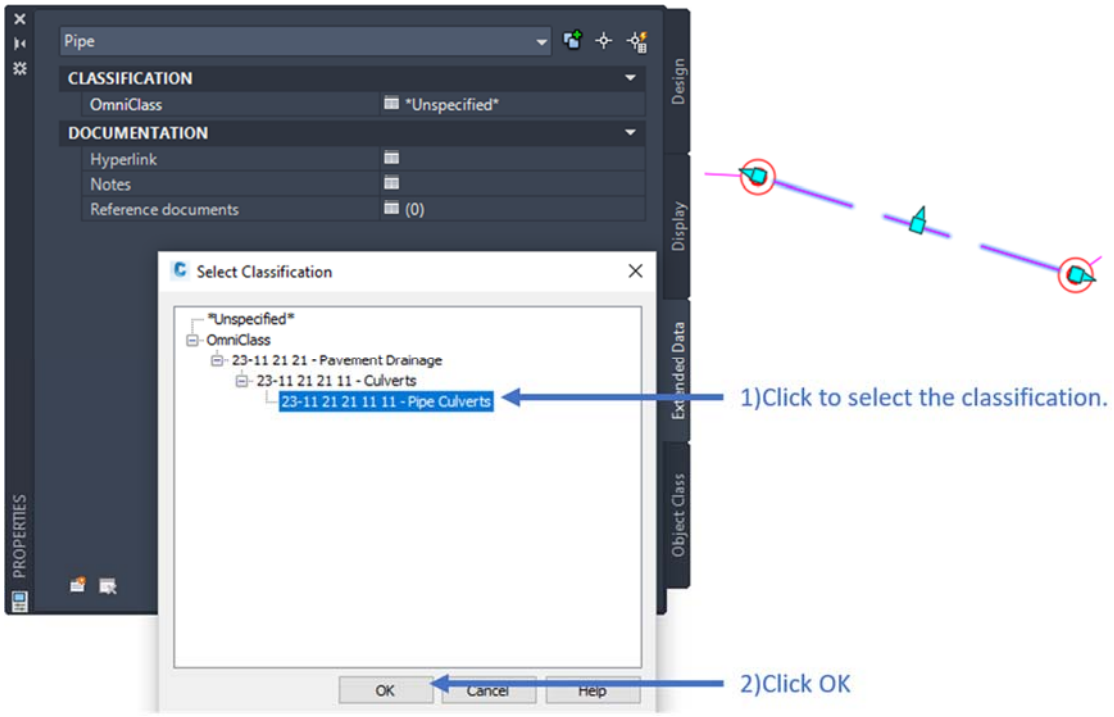
a) Select the BIM object, in the **Extended Data** tab of **PROPERTIES** Palettes, click "**Unspecified**".

Figure App VI-22 Step a of Applying OmniClass Classification Number to Civil 3D BIM Objects



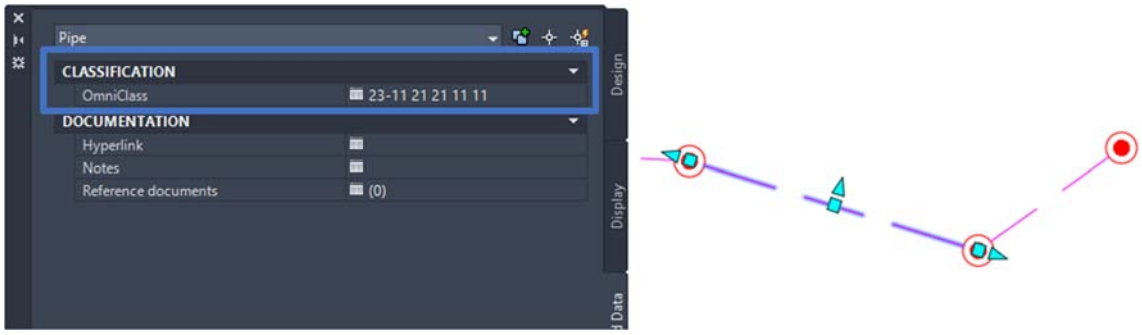
b) In the **Select Classification** dialog, select the pre-defined classification information, then click **OK**.

Figure App VI-23 Step b of Applying OmniClass Classification Number to Civil 3D BIM Objects



c) After the selection, the OmniClass classification number is shown as below Figure.

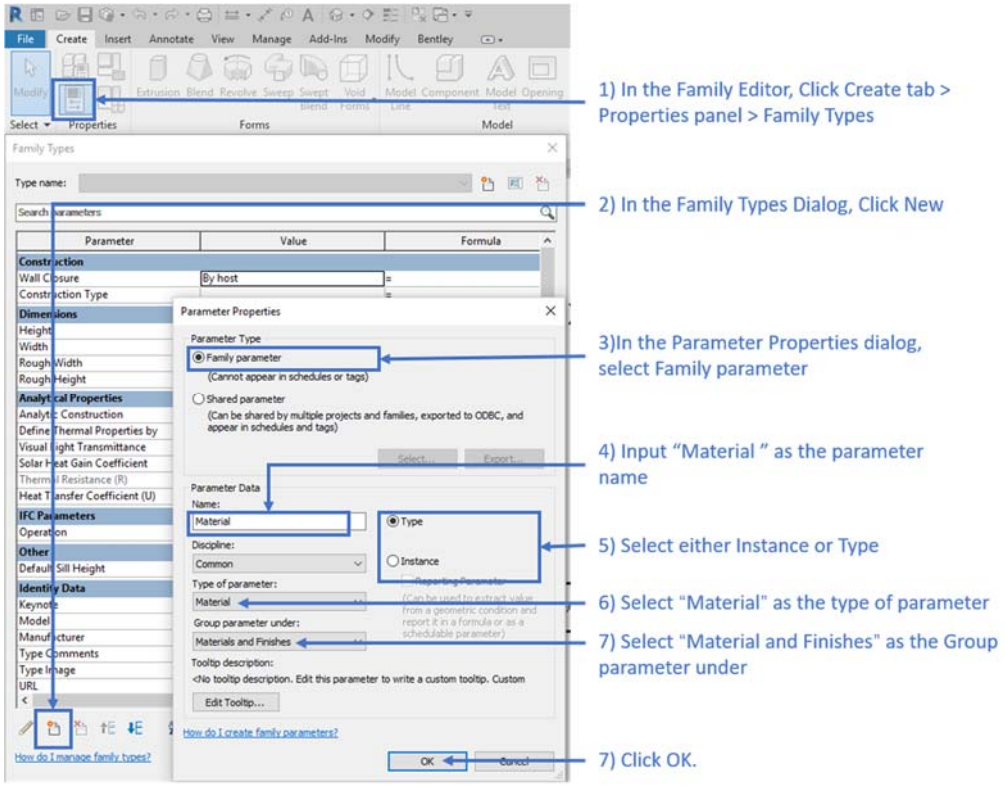
Figure App VI-24 Step c of Applying OmniClass Classification Number to Civil 3D BIM Objects



3.7. Creation of Material Attribute in Revit

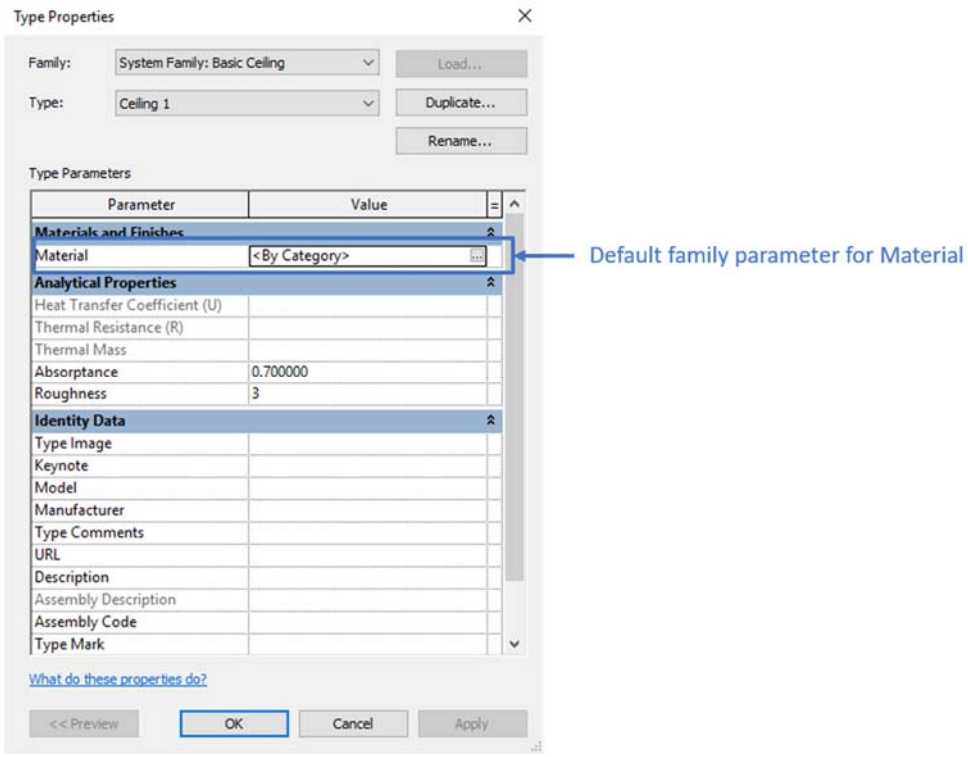
3.7.1. In Revit, Family parameters for loadable families can be added as material attributes in the **Family Editor**. Key steps for adding a material attribute are described as follows:

Figure App VI-25 Adding Material Attributes to Family Parameters for Loadable Families



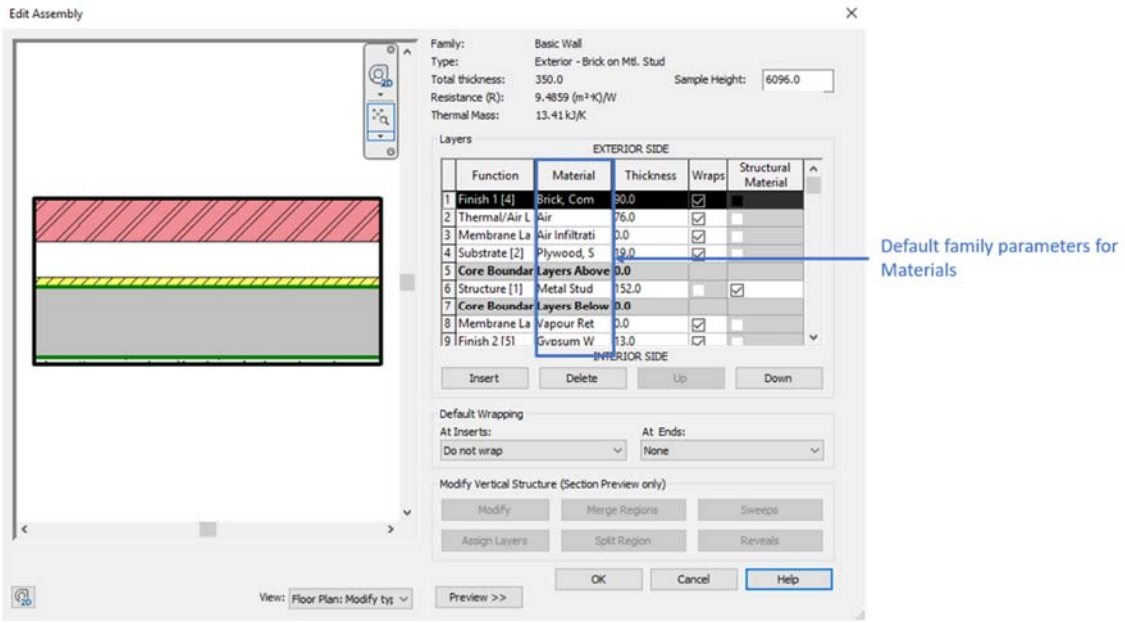
3.7.2. For Revit system families (e.g. basic ceilings, ramps), material should be set using the built-in "Material" parameter in the **Type Properties** dialog under **Materials and Finishes**. Refer to the figure below for details.

Figure App VI-26 Adding Built-in Material Attributes to System Families



3.7.3. For compound structures, which are system families composed of parallel layers (e.g. walls, floors, compound ceilings and roofs), material should be set using the built-in "Material" parameter for each compound structure layer in the **Type Properties** dialog under **Materials and Finishes**.

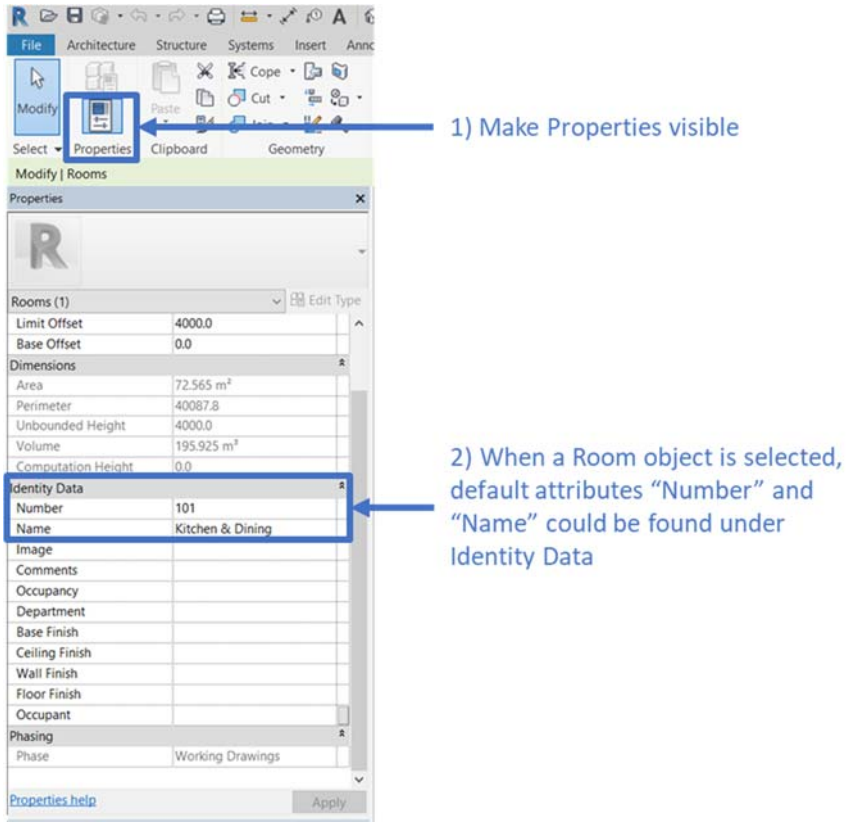
Figure App VI-27 Adding Built-in Material Attributes to Compound Structure System Families



3.8. Filling in Default Attributes under Room in Revit

In Revit, Room objects already contain Name and Number as default parameters. The location of these attribute on "**Properties**" tab are described as follows:

Figure App VI- 28 Filling in Default Attributes under Room in Revit



4. Types of BIM Model Attribute

Prior to the publication of this Guide, some WDs have already defined and implemented asset owner-specific attributes. A mapping approach is utilised to consolidate the information whilst allowing WDs who needs to keep their pre-defined attributes. Four different types of LOD-I attributes exist, with different degrees of the alignment. This section explains their definitions and harmonisation approaches.

4.1. Common Attributes

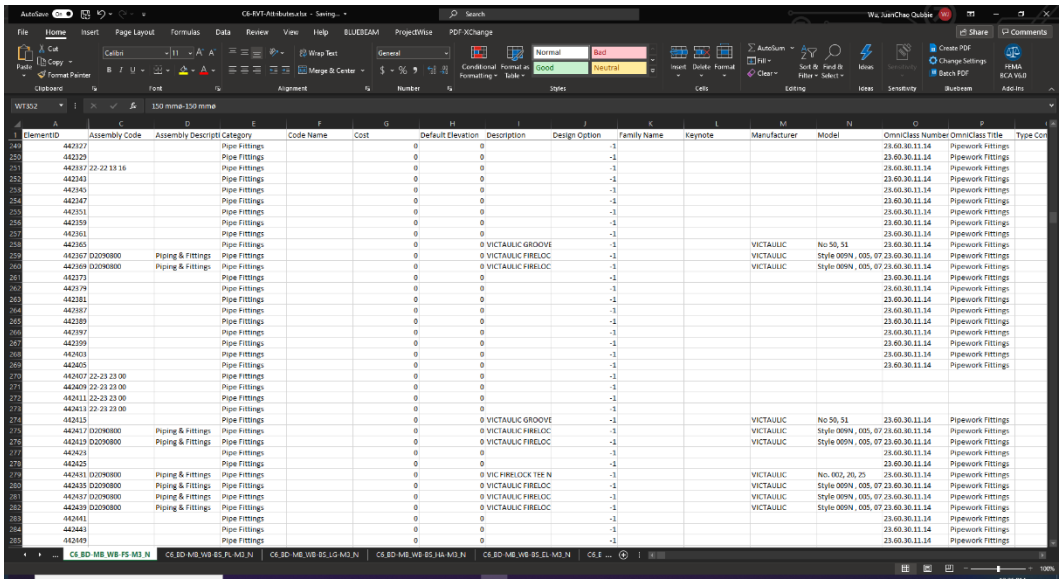
Common attributes are those with the same attribute names and GUID with those listed in Table App VI-1 of this appendix. This kind of attribute name are aligned, and the information could be stored with the same nature for ease query.

4.2. Common Attributes with Alternative Attribute Names

The common attributes with alternative attribute names are those who contain the same information as one of the common attributes with an alternative name as pre-defined by the WDs. Mapping is required to associate the WDs' attribute names with the common attribute. With mapping defined, naming of the attributes from different WDs but with the same nature could be mapped and stored for ease query.

For example, if multiple attributes meaning "Asset Code" exist with names such as DSD.Com.Asset Code, EMSD.Common.Asset Code, which could all be mapped into the same column in the tabular format. Refer to figure below for an example.

Figure App VI-29 Sample Tabular Format for Storing Attributes



4.3. General Attributes

The general attributes are those commonly adopted across more than one WD but without aligned attribute names. Similar to Section 4.2, review is required to group those attributes with similar nature, prior to map these attribute names into the same column of the tabular format.

4.4. Remaining Attributes

Remaining attributes are the attributes that not classified as the common attributes and general attributes. Those attributes are discipline-oriented and not necessary to be aligned. Thus, the remaining attributes list could be stored without alterations to maintain the completeness of the information.

5. Mapping and Extraction of Attributes from BIM Models

5.1. Extraction Method Overview

After attribute mapping, extraction of attributes from BIM models could be conducted through authoring software's built-in functions, scripts or plug-ins. The sections below describe principles of attribute extraction from Revit and Civil 3D.

5.2. Extraction of Attributes from Revit

The attributes in Revit can be exported to an external dataset in tabular format. The software default attributes and user defined attributes could be identified and extracted to tabular format. For example, Dynamo for Revit may be used to view and extract element parameters.

5.3. Extraction of Attributes from Civil 3D

For Autodesk Civil 3D, since COBie spreadsheet cannot be exported directly from Civil 3D currently, **Property Set** should be defined in Civil 3D in order to extract the attributes in IFC format. Refer to Section 3.4 for details on **Property Set**.