International BIM Object Standard

Guidance Notes - Consultation Draft

Introduction

These guidance notes are to assist the reader in understanding the intention of the International BIM Object Standard clauses and give some assistance as to how to implement in some common BIM applications.

Where possible ISO and IFC are the base definitions for BIM concepts but the terminology used for the same or similar concepts varies widely across the industry and different BIM platforms. These guidance notes explain the rationale behind some of the decisions made and assists the reader to translate terminology to their particular environment.

1 General Requirements

1.1 General

1.1.1 Object designation

a) A ***generic object*** is intended for use in stages of design when the finalized solution has not yet been 100% resolved. A ***manufacturer object*** is intended to represent an obtainable product provided by a manufacture or supplier. The term 'manufacturer object' is also synonymous with proprietary object or product object.

The term ***object*** is also synonymous with entity, construction entity and construction element.

b) Libraries provide two types of BIM objects, these being ***layered objects*** and non-layered ***component objects***; they can be found in both generic and manufacturer form.

Component objects: Comprise doors, windows, sanitary ware, furniture, etc. These objects can be further defined as static objects or parametric objects, the difference being that a static object will be available in one size, whereas a parametric object will be available in a range of predetermined sizes (or else the size can be determined by the designer). These objects can be held outside the model and be imported into it.

Layered objects: Comprise walls, floors, ceilings, roofs, etc. These objects are typically constructed from a number of layers and do not have a fixed geometry; this is defined by the designer, e.g. a concrete floor layer thickness may be determined by the designer's structural calculations. The thickness of the object layers may also be determined by manufacturers, e.g. an insulation board may be available in a set number of thicknesses. Typically these objects are system objects that come with the BIM Platform. The object itself cannot be added into the model but the definitions of the layers can be imported in to create a specific object.

Layered objects may comprise single or multiple products, for example:

- A single product layered object could be a composite insulation board with facings and core or a concrete slab.
- A multiple product layered object could be an external wall, consisting of brick, cavity, insulation and blockwork. In this example the insulation from the example above has been included in the multiple layer build-up.

The BIM platforms used by designers handle multiple layered objects differently. Some platforms will have the capability to model multiple product layered objects; others will not have this capability and the layers will have to be modelled individually.

Typically, layered objects will be delivered in a ***container*** file. This can host the layered object and variations of the layered object, and the designer can select as required. For example, the manufacturer of the composite insulation board described above will deliver all product variances in one ***container*** file.

1.1.2 Assembly

a) ***Component*** and ***layered objects*** can be aggregated together to form an ***assembly***, e.g. a room. An ***assembly*** is a '*group of components or types to enable the reuse of standardized design or specification*

elements improving productivity of design and delivery as well as providing a location to hold specifications and lessons learnt in a simple and useable way'. Source PAS 1192.

Assembly objects refer to separated objects combined into a group and then managed as a group in the model or ***object library***. The assembled group of objects may only have ***metadata*** for it as a group; can have additional ***metadata*** relating to the group; or just have the ***metadata*** of the constituent objects. Examples might be an accessible toilet which is an assembled group containing a toilet, handrails, cubical walls, and a door. Each of these objects will have their own ***metadata***, but the assembly could have ***metadata*** giving the overall size, the standard it complies with or the like.

Care must be taken when an ***assembly*** is made up of multiple objects where each material has performance criteria that may be unrelated to the ***assembly*** as a whole.

b) To aid understanding of the context in which a product can be used and ***object*** may be shown within an ***assembly***. For example, a manufacturer's wall insulation BIM ***object*** may be shown within a generic wall build-up, even if the insulation manufacturer does not supply any other objects within the wall. The accompanying objects forming the wall ***assembly*** should have a minimum graphical detail equivalent to a ***generic object*** e.g. the brick outer leaf, and block inner leaf would have a minimum graphical detail equivalent to a ***generic object***.

Construction Operation Building information exchange (COBie), Industry Foundation Classes (IFC) and all BIM authoring tools offer the capability to group components into functional systems. 'Building Information Modelling. The Digital Plan of Work & Assemblies' (March 2013 V7-1) states that there are various methods used:

- Assigning a System to an Attribute of a Component.
  - Component 'Light Fitting LF 001' has a property 'Circuit' set as 'Ground Floor lighting'.
- Assigning the Component to a previously defined Layer to reflect the System.
  - Layer 'Ground floor lighting' contains Component 'Light Fitting LF 001'.
- Assigning a Component to previously defined System.
  - System 'Ground Floor Lighting' includes Component 'Light Fitting LF 001'.
- Using Components whose assignment to a System is unambiguous.
  - For example IfcLightFitting may implicitly imply 'Lighting Installation'.

In some instances, when aggregated together to form an ***assembly***, some component information may become irrelevant, e.g. a door handle that comes as part of an overall door ***assembly***.

Component assemblies are documented using the aggregation relationship between IFC elements.

Type assemblies for construction are documented using the IFC Material Layer relationship between Material Layer Set and IFC Materials, which includes layer thickness. Note: Material Layer Sets contain Materials, so only one level is possible.

When either type of ***object*** is placed into a model, it becomes an instance of the ***object*** and users can set values specific to that instance.

1.2 Graphical detail

The term 'graphical detail' refers to the extent of geometric/shape/visual detail included in a BIM ***object***. The term is synonymous with graphical 'level of' detail.

The BIM ***object*** graphical content is for architecture and engineering visualisation/documentation deliverables purposes, not for the manufacturing process. The ***object*** should have appropriate graphical

detail and not include more detail than is either required or is useful, or that will compromise the BIM when used in practice. The principle of not modelling parts of a ***product*** that will not be seen should be followed.

In some instances, 3D geometry may not be required or appropriate. An example of this is in modelling a metal window: the outer profile of the frame will be modelled but not the intricate internal framing members; these may be represented using 2D line work incorporated into the ***object***.

Consideration should be made to parts of objects that will not be modelled. Examples are fixings such as screws and bolts: these are too small to model currently as the usability of the ***object*** will be compromised if there is too much detail.

PAS 1192-2 requires that the minimum level of detail needed by the (project) team or the employer for each model's purpose shall be defined. It notes that it is wasteful to the supply chain to deliver a greater level of detail than is needed and which may also overload the IT systems and networks available.

PAS 1192-2 gives a suggestion for the '*levels of model definition for building and infrastructure projects*' for various project stages (Brief, Concept, Design, Definition, Build and commission, Handover and close-out, and Operation and in-use). As it is not known at which stage of a project's lifecycle a library object will be used, a more generalized approach has been taken in this standard.

The graphical detail within an ***object*** can also depend upon the construction discipline. Objects such as pipes and ducts may only need to be characterized by extent (such as a bounding box) and key connectivity. Also, the amount of information included or perceived to be included in a particular type of model or drawing will determine how it might be used by others, and care should be taken that this is not beyond its intended use. For example, an early stage model that shows all pipe and duct sizes may imply that the engineering calculations have been progressed to a stage to support those conclusions, when in fact the modeller has simply selected detailed objects from a library as an indication of the eventual design.

1.2.1 Generic objects

Generic objects should be graphically broadly similar to the AIA level of development 200-350

1.2.2 Manufacturer objects

Manufacturer objects should be graphically broadly similar to the AIA level of development 350.

1.2.3 Dimensions

A ***generic object*** should have nominal values (synonyms for nominal are typical, average or expected). A ***manufacturer object***, on the other hand, should contain actual dimensions that are representative of physical and functional characteristics of obtainable products.

While dimensions are generally a drafting issue there inclusion in ***metadata*** provides key information for specification, costing, and the like. When they are added ensure that they are accurate and necessary. Irrelevant or inaccurate information won't assist the process.

1.3 Object type

1.3.1 Identification

The term 'Object type' is also known in other publications as 'Object class', 'template', 'style', 'functional type', 'library part' or 'subtype'. To exchange information about a building using common and understood rules, the IFC specification developed and maintained by buildingSMART International as its 'Data standard' and registered with ISO as ISO 16739 should be used.

The ***IfcTypeObject*** defines the specific information about a ***type*** that is common and shared by multiple object occurrences; it is represented by a set of ***property set*** definitions. Types can also have shape representations and associated quantity and property sets. The type is further developed through its ***PredefinedType***. For example, this could be 'IfcDoorStyle'. This equates to two hierarchical levels of IFC, the first being ***IfcTypeObject*** (e.g. IfcDoor) and the second being ***PredefinedType*** (e.g. IfcDoorStyle).

The IfcDoorStyle defines a particular style of doors which may be included in the spatial context of the building model through single or multiple instances of IfcDoor. A door style defines the overall parameters of the door and refers to the particular parameter of the lining and one (or several) panels through the IfcDoorLiningProperties and the IfcDoorPanelProperties.

When a particular object type is not available within the ***schema***, a proxy can be used. The IfcBuildingElementProxyType defines a list of commonly shared ***property set*** definitions of a building element proxy and an optional set of ***product*** representations. It is used to define an element specification (i.e. the specific ***product*** information that is common to all occurrences of that ***product*** type).

Objects are usually created using the correct tool within the proprietary ***BIM platform*** (i.e. wall tool, slab tool). Where an object is created using other tools, the ***type*** must be defined. For example, when using a stair tool, perhaps the correct shape needed for landings, etc. cannot be achieved; these could be drawn using a slab (for example), but then the type must be categorized correctly (i.e. stair). Types may also define the default display of the object when it is loaded into a project: for example, line weight, line colour, line pattern and material assignment.

Compliance check

Is the ***object*** appropriately assigned to an object class and mapped to the appropriate ***IfcTypeObject***, and ***PredefinedType***?

Functional Type = Door mapped to IfcDoorStyle. DOOR
Functional Type = Window mapped to IfcWindowStyle. SKYLIGHT

Functional Type = Door mapped to IfcWindowStyle
Functional Type = Window mapped to IfcDoorStyle

Example: Predefined Type – IfcCovering

Type	Predefined Type

IfcCovering CEILING
CLADDING
FLOORING
INSULATION
MEMBRANE
ROOFING
SLEEVING
WRAPPING
NOT DEFINED
USER DEFINED

a & b) When using IfcBuildingElementProxyType, nominate the PredefinedType as USERDEFINED to indicate that the object is not using a predefined type in the IFC schema. The ObjectType value must also be set to be the type name nominated.

1.3.2 Parametric objects

Objects can be modelled with parametric capability to allow for the one modelled ***object*** to represent multiple products by varying the parametric parameters.

A modelled ***object*** could be assigned multiple ***IfcTypeObject*** designations. To allow for meaningful IFC export each potential occurrence of a different ***IfcTypeObject*** for that one parametric object should be drafted as a new individual ***object*** and assigned the relevant ***IfcTypeObject*** and ***PredefinedType***.

Consideration should also be given to the parametric capability of the ***object*** within each ***IfcTypeObject***, to allow for variants of the same ***IfcTypeObject*** to be exportable through IFC.

It is generally recommended to not rely on highly parametric objects when exporting through IFC is required.

1.3.3 IFC export

BIM platforms generally allow the user to identify a model subset (or filter) when exporting to IFC by exporting only the layers that are currently visible in the ***BIM platform*** and allowing users to export only the parts of the model relevant to the purpose of the export.

In order to do this, objects must be categorized correctly. Some ***BIM platforms*** automatically assign IFC information based upon the IFC ***schema*** while others require additional properties (e.g. Autodesk® Revit® IfcExportAS and IfcExportType).

If you know the intended target of the IFC export it is worth communicating with the recipient party, or conducting small test exports, to ensure that all of the required information is included.

ISO 29481-1:2010 states that '*Generally, software solutions do not support the entirety of a schema such as IFC; they support an industrially relevant subset which is generally termed a view definition. Software may be certified in terms of how well it supports a view definition. That is, a view definition provides a relationship between the whole schema and the software solution that implements it*'.

Since 1996 there have been six principal ***schema*** releases: IFC1.5.1, IFC2.0, IFC2x, IFC2x2, IFC 2x3 and IFC4. Currently, buildingSMART recommends that IFC2x3 is the best choice to implement: it has the broadest coverage of support of all published IFC releases. The IFC2x3 coordination view is the most widely implemented model view definition (MVD) by software vendors.

http://www.buildingsmart-tech.org/implementation/faq/faq-ifc-implementation

For further information on currently certified software and the software certification scheme, see the buildingSMART website.

http://www.buildingsmart.org/compliance/certified-software/

MVD's IFC2x3:

- IFC2x3 Coordination View Version 2.0.
- IFC2x3 Structural Analysis View.
- IFC2x3 Basic FM Handover view.

MVD's IFC4:

- IFC4 Reference View Version 1.0.
- IFC4 Design Transfer View Version 1.0.

IFC2x3 relates to ISO/PAS 16739:2005 while IFC4 relates to ISO 16739:2013. Supplementary information from IFC4 can be used in addition to IFC2x3 as long as this is not to the determent of IFC2x3. If IFC does not support a specific need that you have, buildingSMART first recommends consideration of whether:

- There is the need for an ***object*** (with representations and relationships to other objects in the model); or
- There is the need for further properties.

'For example, an airflow application models spaces and cracks. Spaces are already part of the IFC schema, but there is no representation of a 'crack'. However any crack is in reality associated to a physical object, a wall, door or window. Hence a property set can be defined to hold the properties of the crack, such as the length, average width, and perhaps also the airflow rate expected for a given pressure. As another example, perhaps your building proposal includes an artistic sculpture in the courtyard. This is clearly not a simple property of the courtyard, and the IFC model supports proxy objects. These function as objects but make no assertion as to their function or role. The application should offer the user the facility to classify or describe the object in detail'.

2 Information requirements

2.1 General

2.1.1 Property assignment

A ***type*** property is applicable to many occurrences of its use, whilst the value assigned to in instance property applies to only a single occurrence. The term instance is sometimes referred to as a component.

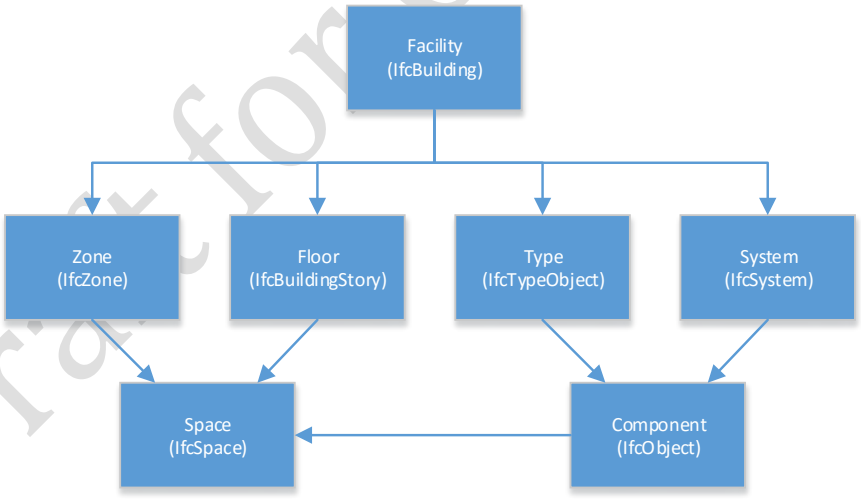
Example:

Configuration (Doorset arrangement indicating number of door leaves and operation) = ***Type*** – Single leaf, single action.

DoorNumber (Project door number) = ***Instance*** (component) – wouldn't be completed until in the project environment.

In some ***BIM Platforms*** objects can be built using basic elements like slabs, walls, roofs, etc. with the resulting ***object*** having nothing to do with the elements that it is made from. For example a table could be made using a slab and walls. As the ***object*** is representing a table, the properties assigned to it should be for a table, not those required for slabs or walls.

Where the ***BIM Platform*** supports properties against a ***type*** of object (Family in Autodesk® Revit®), the properties that are common across all instances of this ***object*** in the model should be assigned as ***type*** properties. Properties that are unique to the ***object*** instance like serial numbers are instance properties.



2.1.2 Facilities management properties

COBie - Construction Operation Building information exchange - is defined and maintained–by buildingSMART Alliance and buildingSMART UKI.

http://www.buildingsmartalliance.org/

A good explanation of COBie has been provided by Antony McPhee on his blog 'PracticalBIM' at http://practicalbim.blogspot.com.au/2016_03_01_archive.html

COBie is a subset of ISO 16739 IFC, documented as a buildingSMART model view definition (MVD) which includes operational information. An MVD defines a subset of the IFC ***schema*** that is needed to satisfy one or many exchange requirements of the architecture, engineering and construction (AEC) industry. Exchange requirements are covered in the Information Delivery Manual (IDM). Together with the IFC ***schema*** subset, a set of implementation instructions and validations rules (called MVD Concepts) is published. MVDs are either defined within buildingSMART International, or by other organizations and interest groups. MVD's for IFC2x3 include:

- IFC2x3 Coordination View Version 2.0 (replaced IFC2x3 Coordination view as of Jan 2010).
- IFC2x3 Structural Analysis View.
- IFC2x3 Basic FM Handover View.

The COBie spreadsheet is a mapping of the ***FM Basic Handover Model View Definition (MVD)*** as documented in the COBie responsibility matrix:

http://projects.buildingsmartalliance.org/files/?artifact_id=4093.

The aim of COBie is to capture data relating to ***manageable assets*** for the owner/operators, with equipment and product assets being described and captured in the ***Type*** and ***Component***. As such, the published mapping from the FM Handover MVD to the COBie spreadsheet systematically excludes ***component*** occurrences that represent the building structure and ***component*** occurrences that are not associated with a ***type***.

There are a number of ways in which information for a COBie deliverable can be produced. These include, but are not limited to, the direct creation of a COBie spreadsheet from the ***BIM platform***. Objects may contain the relevant COBie properties. Alternatively, COBie information can be produced from an IFC file, using IFC to COBie translation tools and settings, based upon properties as defined by buildingSMART IFC2x3 Basic FM Handover View. Whichever method is chosen, the properties should be consistent and not contain a hybrid of the two.

A COBie deliverable can be extracted from IFC if the data is structured and exists within the file. Likewise, COBie information could also be pushed into an IFC file if the information is structured and exists within the file. The total COBie deliverable is provided by a range of companies and comes from many sources, and not all information will be able to be populated from the ***BIM platform***. The BIM ***object*** should include COBie properties that do not include parametric behaviour, graphical or stylistic information.

The COBie deliverable requires that ***object*** types and components have an identifier (ExtIdentifier). This is sometimes generated upon the creation of a COBie deliverable and is automated by the software application (along with ExtSystem and ExtObject, indicated as purple on the COBie spreadsheet). Within IFC, IfcGloballyUniqueId 'GlobalId' holds an identifier that is unique throughout the software world; this is required for all IFC object instances and is mapped to COBie ExtIdentifier.

2.1.3 Completed values

Values associated with certain properties will be dependent upon the stage of the project. For example, the property 'InstallationDate' would not have a ***value*** associated with it when the object is created as this information would not be known until the product had been installed in the real world. Some values such as 'AssetIdentifier' will be completed at handover stage when the asset is made available for use or occupation.

In the case of ***generic objects***, properties such as 'Manufacturer' would be unknown. Some values might not be necessary for ***generic objects***; however, some may have suggested values with technical guidance on these options.

When adding properties to objects make sure that the correct ***datatype*** is assigned to that property ***field***, i.e. numeric or alphanumeric, and if entering values into the ***property*** fields ensure the correct ***datatype*** has been entered.

2.1.4 Units of measurement

a) Guidance to be drafted

b) Metric units are taken from the International System of Units (SI), which is based on the international System of Quantities adopted by the General Conference on Weights and Measures (CGPM). Included are names and symbols, a series of prefixes and rules for use.

Generally do not include units within the property value field, unless required. See guidance to clause 2.2.2 (b).

c) If no measure is given then a unit count should be assumed. In the case of materials and layered constructions, a unit volume or area should be assumed, e.g. m^3 or m^2.

Suggested units are:

Length - mm
Width - mm
Height - mm
Perimeter - mm
Diameter - mm

Thickness - mm
Area - m^2
Volume - m^3
Weight - kg

NOTE: ISO 15686-4 provides information and guidance on the use of standards for information exchange for service life planning of buildings and constructed assets.

2.1.5 Unit symbols

ISO 80000-1 gives general information and definitions concerning quantities, systems of quantities, units, quantity and unit symbols, and coherent unit systems, especially the International System of Quantities (ISQ) and the International System of Units (SI).

Compliance check

Are base unit symbols to-ISO 80000-1?

Name	Symbol
Metre	m
Kilogram	kg
Kilowatt	kW

Name	Symbol
Metre	M
Kilogram	KG
Kilowatt	KW

2.1.6 Hard coded performance properties

Hard coded properties are fixed data or properties in a ***BIM platform*** that cannot be altered. Where these allow for tasks such as performance analysis and calculations of a specific functionality, they should be completed with a ***value***, if known and available.

Hard coded properties may already be assigned to the properties of a predefined category of object and may not be able to be deleted.

Other software (such as performance analysis software) may rely on these ***hard coded*** properties upon export and that is the primary reason for why they should be retained.

2.1.7 Dimensional properties

The intention of a BIM ***object*** is to imply a ***product*** rather than manufacture or fabricate it, dimensional information should be limited to define the nominal model geometry and imply the ***product***, whilst at the same time provide sufficient information relating the operation and installation spatial requirements for that ***object***.

2.2 Values

2.2.1 General

BIM objects may have a number of ***variations*** and options from which the designer will be required to make a selection. How this is best achieved will be dependent upon the individual ***BIM platform***. Not all attributes require completion when the ***object*** is placed in a project model. The extent of completion should be defined by the project's requirements and its stage. Not all ***property*** values require an absolute numerical value but, if not, they should have 'maximum', 'minimum' or 'in the range of'.

A BIM ***object*** may be highly configurable with parametric features and ***component*** (instance) properties, which require the designer to make decisions, making the ***object*** very flexible. For example, an ***object*** that could be fabricated in any size may have ***component*** (instance) properties for height and width.

A BIM ***object*** with multiple options may be developed as individual objects that are then embedded into the overall BIM ***object***, for example a window could be made up of frame, mullions and glass.

Where the ***BIM platform*** allows, a catalogue that will load multiple versions of a BIM ***object*** can be very efficient in presenting many possible product variations, or predefined types. This is typically done through a text-based file.

Ensuring that any dimensional properties are linked (parametric properties) to the graphical representations that they relate to will reduce errors of having a different ***value*** in the ***property*** than that indicated by the geometric model.

2.2.2 Property values

a) When a property requires a mixture of both numbers and characters, an alphanumeric datatype must be used. So if it is required to have units within the property value, the datatype must be assigned as alphanumeric.

Compliance check

Property Name	Datatype	Example Value
ModelNumber	Text	Powerglide 320

Property Name	Datatype	Example Value
ModelNumber	Number	Powerglide 320

b) Generally, ***property*** units are not stated within the ***value*** as they are implied by the ***property***. Where a unit is given, it should be separated from the ***value*** by a space. It is not practical to add the unit to the ***property*** name as many properties are ***hard coded*** or belong to a ***schema*** such as IFC where the ***property*** name shall not be changed.

Compliance check

Property Name	Example Value
Output	10 kW
Voltage	230 V
OperatingTemperature	70°C
RecycledContent	50%

Property Name	Example Value
Output	10kW
Voltage	230V
OperatingTemperature	70 °C
RecycledContent	50 %

c) To maintain consistency in the presentation of information and for scheduling purposes.

Compliance check

Do the values have a consistent approach to capitalization and adopt sentence case? Has text formatting such as bolding or italics been omitted?

Brackets: Four brackets and fixings
Material: PVC-U
MinimumClearance: 220 mm clearance either side

Brackets: 4 brackets And fixings
Material: UPVC
MinimumClearance: 220 MM Clearance Either Side

d) To maintain consistency in the presentation of information, ***property*** values should not end in a full stop.

Compliance check

Is the ***property*** value free of full stops?

Grade: Highly vandal resistant

Grade: Highly vandal resistant.

2.2.3 Dependence

Formulae can be used to derive other pieces of information and populate other ***property*** values.

Compliance check

If a ***value*** is dependent upon other properties, has the ***property*** value been expressed as a formula?

PropertyName	**Value**
Height	= DoorOpeningHeight + 180
LeafHeight	= DoorOpeningHeight – OpeningHeadTolerance – Undercut

Property Name Value

Height	2100
LeafHeight	2080

2.2.4 Product variants

a) BuildingSMART defines an IfcPropertySingleValue as 'a property ***object*** which has a single (numeric or descriptive) ***value*** assigned'.

Compliance check

Have the properties been completed with a single ***value***?

Property Name	**Example Value**
Description:	Manufacturer 'A' door
PanelThickness:	0.12

Property Name	**Example Value**
Description:	Manufacturer 'A', 'B' and 'C' door
PanelThickness:	0.12, 0.15, 0.18

b) BuildingSMART defines a list ***value*** as 'a property that has several (numeric or descriptive) ***value*** assigned, these values are given by an ordered list'. The order in which the values appear is significant: each ***value*** in the list is unique and all list members should be of the same type.

Compliance check

Have the properties been completed with suggested values forming a list?

Are the listed items separated from each other using a comma and space?

Property Name	**Example Value**
HeatOutput:	1.6 kW, 1.75 kW

Style: Basalt, Bracken, Brindle, Buff

Property Name **Example Value**

HeatOutput: 1.6 to 1.75kW

Style: Basalt; Bracken; Brindle; Buff

c) BuildingSMART defines a bounded ***value*** (range) as 'a property ***object*** which has a maximum of two (numeric or descriptive) values assigned, the first ***value*** specifying the upper bound and the second ***value*** specifying the lower bound'.

Compliance check

Have the properties been completed with values that contain a bounded ***value*** (range)?

Property Name **Example Value**

HeatOutput: 1.6-1.75 kW

TemperatureRange: -50 to +25°C

Property Name **Example Value**

HeatOutput: 1.6 to 1.75kW

TemperatureRange: -50 - 25°C

d) BuildingSMART defines an enumerated ***value*** as 'a property ***object*** which has a ***value*** assigned which is chosen from an enumeration'.

Compliance check

Have the properties been completed with a list of enumerators?

Are the items in the values separated from each other using a comma and space?

Property Name **Example Value**

DamperBladeActionEnum Parallel, Opposed, Other, Unset

Property Name **Example Value**

DamperBladeActionEnum Parallel or Opposed or Other or Unset

2.3 Set grouping and usage

2.3.1 Groups

Different ***BIM platforms*** use different terms for similar concepts around the concept of groups, properties, and ***property sets***. The standard looks to follow the IFC usage of these terms. The use of 'Set Grouping' in the context of clause 2.3 means a group or collection of ***property sets***. If properties appear in more than one set, say IFC and COBie, this clause establishes which ***property*** should be used.

Autodesk® Revit® assigns properties to a Display Group, which determines how properties are displayed in the user interface. These display groups are not user editable so do not provide a suitable replacement for property sets. Within an Autodesk® Revit® shared parameter files, the 'Group' column relates to what IFC would call a ***property set***, so Autodesk® Revit® does provide a relationship between a ***property*** and its set. Other than this, property sets do not feature in the Autodesk® Revit® user interface. IFC, Graphisoft® ArchiCAD®, Nemetschek® Vectorworks® & Bentley® AECOsim® and others support displaying properties in their property sets.

Most objects can have properties attached to them that have little or no relationship to other objects. The IFC model differentiates between attributes that are directly attached to the ***object*** as attributes of the entity, and properties, grouped in a ***property set*** and assigned to the ***object*** by a relationship. The latter is the more flexible way to extent applicable properties.

Furthermore, these properties are evolving over time, and may be specific to particular regions, countries, or projects. The IFC ***schema*** supports storing and transmitting these properties in named sets. It recommends property sets as part of the IFC Specification already, but regional adoptions and applications may define more. The Model Support Group (MSG) has published an XML ***schema***, called Property Set Definition (PSD) ***schema*** to define the properties and property sets.

2.3.2 Occurrence

An ***object*** should not have duplicate properties (same GUID or name used more than once) and where possible it should avoid having properties that have different names for the same values.

Adding IFC2x3, FM Handover/COBie or some user-defined property sets to an ***object*** may duplicate some properties that are already included by the ***BIM platform***. These could be ***hard coded*** properties, or properties required by some other process or function (like analysis tools). If the ***BIM platform*** or add-on tools allow the properties to be mapped, either in the user interface or during the export process, then any duplicated properties that are required should be mapped to a single occurrence of that ***property***.

Some BIM platforms allow for the use of formulas that copy the ***value*** from a ***hard coded*** property to a different ***property***. This may not always be possible with every ***BIM platform***.

In Autodesk® Revit® for example, mapped properties are displayed in grey with a note stating which ***property*** they are mapped to and the value ***field*** is deactivated. This can be seen in the example included in the guidance to clause 2.4.4.

Compliance check

Does the BIM ***object*** only include one occurrence of a ***property*** and ***value***?

Property Name	Description	Example value
AcousticPerformance	Acoustic performance according to national building code.	50 dB

Property Name	Description	Example value
AcousticPerformance	Acoustic performance according to national building code.	50 dB
AcousticPerformance	Acoustic performance characteristic.	50 dB

2.3.3 Order of priority

The BIM object should include a single property based upon the order in clause 2.3.3. Duplicated properties can lead to inconsistencies in structured data.

2.3.4 Identical property information

Compliance check

Does the BIM ***object*** only include one occurrence of a ***property*** and ***value***?

Property Name	Description	Example value
IsExternal	Is object located externally	Yes

Property Name	Description	Example value
External object	Is object located externally	Yes

2.3.5 Precedence

Where possible it is best to avoid duplicating properties at different levels (i.e. ***type*** and ***component***) within the ***object*** structure.

In Autodesk® Revit®, only ***object*** level parameters can be included in schedules therefore it is best to only use parameters on the ***assembly*** when other options are not practical.

2.4 Property and property set naming

2.4.1 General

By prefixing with the corresponding parent property, the information can be sorted logically.

Compliance check

Does the BIM ***object*** include ***property*** names entered as PascalCase (the first letter of each word being capitalised and with no spaces between each word) and prefixed with the corresponding parent ***property*** where a parent-child relationship occurs?

- SubFrame
  - Material
  - Fixings

SubFrameMaterial:
SubFrameFixings:

MaterialSubFrame:
FixingsSubFrame:

2.4.2 Suffix

If the ***BIM Platform*** supports parameters on materials, such as Autodesk® Revit®, these need a means to identify them from properties on families (or the like) so are named with a suffix '_mtrl'.

Compliance check

Is the BIM ***object*** a material?
Do all ***property*** names within the BIM ***object*** end in '_mtrl'?

Author_mtrl:
ManufacturerURL_mtrl:

Author:
ManufacturerURL:

2.4.3 Boolean data

A Boolean ***datatype*** is a ***datatype*** that can only provide two possible values, for example TRUE or FALSE. Some BIM platforms use a similar concept of YES or NO. Where the ***property*** requires a Boolean value, the ***property*** shall be named so that a TRUE or FALSE, or YES or NO value is required, for example 'IsExternal' is an indication whether the element is designed for use in the exterior (TRUE) or not (FALSE). If the value is TRUE then this implies that it is an external element and faces the outside of the building.

2.4.4 Mapping hard coded properties

Consistency is fundamental for information within the ***object*** to be correctly exported and used in other applications. Where a ***hard coded*** property does not conform to the naming conventions in section 5 then these should be mapped as per the requirements of clause 2.3.2.

Using ***hard coded*** properties in the ***BIM Platform*** can be advantageous as they can contain look up values or data validation logic that is coded into the software. For example in Autodesk® Revit®, Type Mark could be used for the Reference field to provide the "Reference" IfcIdentifier or Mark can be used for numbering as it checks for duplicate values and could provide "Tag" IfcIdentifier.

Compliance check

Are non-conforming naming conventions mapped to the correct ***property***?

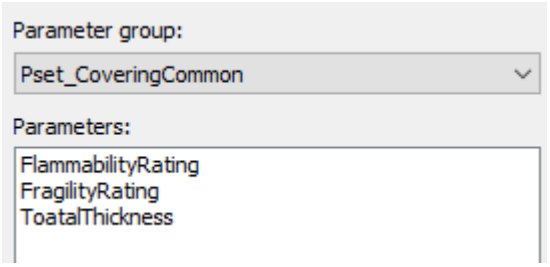
Name: Fire Rating = FireRating

Name: Fire Rating = Fire Rating

Identity Data		
URL		=
Model		=
Manufacturer	info@style-partitions.co.uk	=
Keynote		=
Fire Rating	n/a	= FireRating
Description	Sound insulating, semi automatic moveable wall for demanding environ	=
Cost	0.00	=
Assembly Code	C1020500	=
Type Comments		=

2.4.5 Property set naming

For Autodesk® Revit®users, a ***property set*** is the Parameter group in the shared parameter file and properties are Parameters as shown in this user interface:



Some example schema differentiators are:

Pset_ DoorCommon (IFC)
Pset_TankTypePressureVessel (IFC)
NBS_Data (The NBS UK)
NATSPEC_Data (NATSPEC Aus)
WRAP_EnironmentalImpacts_UK (BRE UK)
BRE_ImpactDeclaration_UK (BRE UK)
BRE_ImpactDeclaration_France (BRE UK)

2.5 IFC Property sets

2.5.1 Common property sets

An ***IfcTypeObject*** defines the specific information about a ***type*** and can be further represented by a set of ***property set*** definitions. For example, IfcBoilerType can be further defined by Pset_BoilerTypeCommon which includes common attributes (properties) for boilers.

Example of expected IFC Common properties: Pset_BoilerTypeCommon

Property name	Property Type	Example Value
PressureRating	SingleValue (Pressure Unit)	0
OperatingMode	(EnumeratedValue)FIXEDTWOSTEPMODULATINGOTHERNOTKNOWNUNSET	UNSET
HeatTransferSurfaceArea	SingleValue (Area Unit)	0
NominalPartLoadRatio	BoundedValue (Range)	0.0, 0.0
WaterInletTemperatureRange	BoundedValue	0.0, 0.0
WaterStorageCapacity	SingleValue (Volume Unit)	0
IsWaterStorageHeater	SingleValue (Boolean) TRUE / FALSE	FALSE
Weight	SingleValue (Mass Unit)	0
PartialLoadEfficiencyCurves	ListValue (User Defined) 1 2 3	0
NominalEfficiency	ListValue (User Defined) 1 2 3	0
HeatOutput	ListValue (User Defined) 1 2 3	0
OutletTemperatureRange	BoundedValue (Range)	0.0, 0.0

NominalEnergyConsumption	SingleValue (Power Unit)	0

Compliance check

Does the ***object*** include relevant IFC common ***property sets*** for the occurrences of the associated ***IfcTypeObject*** where available?

Type: IfcDoorStyle
Predefined Type: DOOR
Pset_DoorCommon

Property Name
Reference
FireRating
AcousticRating
SecurityRating
IsExternal
Infiltration
ThermalTransmittance
GlazingAreaFraction
HandicapAccessible
FireExit
SelfClosing
SmokeStop

Type: IfcDoorStyle
Predefined Type: DOOR

Property Name
Reference
AcousticRating
FireRating
Combustible
SurfaceSpreadOfFlame
ThermalTransmittance
IsExternal
LoadBearing
Compartmentation
PitchAngle

2.5.2 Proxy

When a particular ***property set*** is not available within the ***schema***, a proxy can be used. The Pset_BuildingElementProxyCommon defines properties that are common or useful to a wide range of application types.

Compliance check

Does the ***object*** include the 'Reference' ***property***?
Has the 'Reference' ***property*** been completed with an identifier of Reference ID for the specified type in this project?

Reference: Widget type A-1

Reference: User to populate

2.5.3 IFC4

A ***property set*** relevant to the IFC ***PredefinedType*** may not be available within the IFC2x3 ***schema***. In some cases a relevant ***property set*** has been implemented within IFC4. Exercise caution for the following reasons:

- In IFC2x3 the only available predefined Pset for IFCBoilerType is Pset_BoilerTypeSteam; in IFC4 Pset_BoilerTypeWater has been added.
- In IFC2x3 NominalEfficiency and HeatOutput are in Pset_BoilerTypeCommon; in IFC4 these have been removed and added to Pset_BoilerTypeWater.
- In IFC2x3 property data types Pset_BoilerTypeCommon, NominalEfficiency and HeatOutput are IFCListValues; in IFC4 Pset_BoilerTypeWater these are now IFCPropertyTableValues.

2.6 COBie properties

COBie is not a mandatory requirement for government projects in many countries, but developing an international object metadata standard that did not consider COBie was not considered a sensible idea. Therefore the standard has included COBie as a requirement for objects being created for a public ***object library*** and situations where COBie is a project/client requirement.

Construction Operations Building information exchange (COBie) was devised by Bill East of the United States Army Corps of Engineers, and has been adopted by a number of government departments around the world, primarily in the UK and US. It is a data format that allows for sharing a subset of building information for the operation of an asset.

It helps with the capture of product information, warranties, spare parts and maintenance requirements through the design and construction process.

The most common means of delivering and working with this information is a standardised spreadsheet though more technologies are developing to automate the creation and use of COBie information.

COBie is limited in its use to facilities, the ***schema*** was not developed to address all construction projects and hence not all ***products***. It is not particularly well suited to projects of a linear or horizontal nature, such as transport, water, power, maritime, etc.

In countries using COBie they typically require "Data Drops" where the project team agree in the BIM Execution plan that certain properties within the COBie ***schema*** will be completed at different phases in the design and construction process. The idea being, that as decisions are made about the ***products*** being used, the properties relating to those decisions are completed. This might be a type of ***object*** at concept phase, then a capacity at design stage, then a manufacturer and model number during construction documentation, then a specific serial number at the commissioning stage.

2.6.1 Requirement

Refer to guidance to clause 2.1.1 for explanation of ***component*** and ***type***.

Managed assets are generally discrete manufactured, manufactured-to-order, or engineered-to-order ***products***. These ***products*** are those appearing in Operations and Maintenance manuals.

A list of type and component assets included within the COBie ***schema*** export and therefore defined as ***managed assets*** can be found on the 'Type Assets' and 'Component Assets' sheets of the COBie responsibility matrix:

http://projects.buildingsmartalliance.org/files/?artifact_id=4093.

This list does not --nor was never intended to -- include site-built or site-adapted building elements such as structural elements or flow transport elements such short as ducts, pipes, or wires.

It is recommended that COBie properties be included on objects even if COBie is not a project/client requirement. As it is not known what information may be required by facilities managers in the future and it would also mean that objects created now would not need to be modified later for use on a future project where COBie may be requirement.

2.6.2 Type properties

As per the requirements of clause 2.4.4 it is best practice to map relevant ***hard coded*** properties to the corresponding COBie properties, such as NominalLength and NominalHeight, etc.

It is a requirement of the COBie ***schema*** that 'n/a' is completed as a ***value*** for all COBie ***type*** properties where the ***value*** is as yet unknown or is not relevant to that ***object***.

Property name	**Property requirement**	✓	✗

Name	Does the ***object*** include the 'Name' ***property***? Has the 'Name' ***property*** been completed with a unique human-readable text name? Does the human-readable text name identify the ***object*** within the ***BIM platform***? Does the name of the ***object*** begin with a signifier of the ***product*** type that would be recognizable to a facility manager outside the context of the specific design?	Folding doorset	Object1
Category	Does the ***object*** include the 'Category' ***property***? Has the 'Category' ***property*** been completed with an appropriate classification?	L8732:Mirrors	Category:Mirrors
Description	Does the ***object*** include the 'Description' ***property***? Has the 'Description' ***property*** been completed with a short text description? Does the short text description represent the ***product*** itself?	External single flexible door	For use on hospital projects
AssetType	Does the ***object*** include the 'AssetType' ***property***? Does the 'AssetType' contain either 'Fixed' or 'Movable' as a ***value***?	Fixed	User to populate
Manufacturer	Does the ***object*** include the 'Manufacturer' ***property***? Has the 'Manufacturer' ***property*** been completed with the organization that manufactures or assembles the item?	email@sikasarnafil.com	User to populate
ModelNumber	Does the ***object*** include the 'ModelNumber' ***property***? Has the 'ModelNumber' ***property*** been completed with a number representing the manufacturer assigned product/item/unit number?	XYZ 320	Building Bricks Ltd

WarrantyGuarantorParts	Does the ***object*** include the 'WarrantyGuarantorLabor' ***property***? Has the 'WarrantyGuarantorLabor' ***property*** been completed with a valid email address?	support@email.com	ABC Boiler Ltd
WarrantyDurationParts	Does the ***object*** include the 'WarrantyDurationParts' ***property***? Has the 'WarrantyDurationParts' ***property*** been completed with the time duration corresponding to the units defined in 'WarrantyDurationUnit' for the period of the parts warranty?	5	Five years
WarrantyGuarantorLabor	Does the ***object*** include the 'WarrantyGuarantorLabor' ***property***? Has the 'WarrantyGuarantorLabor' ***property*** been completed with a valid email address?	support@email.com	ABC Boiler Ltd
WarrantyDurationLabor	Does the ***object*** include the 'WarrantyDurationLabor' ***property***? Has the 'WarrantyDurationLabor' ***property*** been completed with the time duration corresponding to the units defined in 'WarrantyDurationUnit' for the period of the labour warranty?	5	Five years
WarrantyDurationUnit	Does the ***object*** include the 'WarrantyDurationUnit' ***property***? Has the 'WarrantyDurationUnit' ***property*** been completed with a ***value*** corresponding to a unit of time?	Year	12 months
ReplacementCost	Does the ***object*** include the 'ReplacementCost' ***property***? Has the 'ReplacementCost' ***property*** been completed with an indicative cost for unit replacement in the project/local currency?	150	Refer to manufacturer's website
ExpectedLife	Does the ***object*** include an 'ExpectedLife' ***property***? Has the 'ExpectedLife' ***property*** been completed with the time duration corresponding to the units defined in 'DurationUnit'?	10	Ten years

DurationUnit	Does the ***object*** include the 'DurationUnit' ***property***? Has the 'DurationUnit' ***property*** been completed with a ***value*** corresponding to a unit of time?	Year	Five years
WarrantyDescription	Does the ***object*** include the 'WarrantyDescription' ***property***? Has the 'WarrantyDescription' ***property*** been completed with a description of the warranty content and any exclusions?	On-site ABC123 roofing warranty	Included
NominalLength	Does the ***object*** include the 'NominalLength' ***property***? Has the 'NominalLength' ***property*** been completed with the nominal length of ***product***?	2000	2 metres
NominalWidth	Does the ***object*** include the 'NominalWidth' ***property***? Has the 'NominalWidth' ***property*** been completed with the nominal width of ***product***?	7000	7 m
NominalHeight	Does the ***object*** include the 'NominalHeight' ***property***? Has the 'NominalHeight' ***property*** been completed with the nominal height of the ***product***?	400	900 m
ModelReference	Does the ***object*** include the 'ModelReference' ***property***? Has the 'ModelReference' ***property*** been completed with the name of the manufactured item as used by the manufacturer?	ABC Glide master	01
Shape	Does the ***object*** include the 'Shape' ***property***? Has the 'Shape' ***property*** been completed with the characteristic shape of the ***product***?	Rectangular	200 x 200 x 200 mm

Size	Does the ***object*** include the 'Size' ***property***? Has the 'Size' ***property*** been completed with the characteristic size of the product?	3000 x 2200 mm	0.00
Color	Does the ***object*** include the 'Color' ***property***? Has the 'Color' ***property*** been completed with the primary ***product*** colour?	Red	Powder coated
Finish	Does the ***object*** include the 'Finish' ***property***? Has the 'Finish' ***property*** been completed with the characteristic or primary finish of the ***product***?	Satin	Blue
Grade	Does the ***object*** include the 'Grade' ***property***? Has the 'Grade' ***property*** been completed with the standard grading(s) to which the ***product*** corresponds?	Highly vandal resistant	Yes
Material	Does the ***object*** include the 'Material' ***property***? Has the 'Material' ***property*** been completed with the characteristic or primary material of the ***product***?	Aluminium	User to Populate
Constituents	Does the ***object*** include the 'Constituents' ***property***? Has the 'Constituents' ***property*** been completed with details of any distinguishing aspects of the ***product***?	Tamper-resistant locking screws, rubber noise isolation mounting	User to populate
Features	Does the ***object*** include the 'Features' ***property***? Has the 'Features' ***property*** been completed with details of the features relevant to the ***product***?	Remote controller	User to populate
AccessibilityPerformance	Does the ***object*** include the 'AccessibilityPerformance' ***property***? Has the 'AccessibilityPerformance' ***property*** been completed with accessibility issue(s) which the ***product*** satisfies?	To ISO 123456	User to populate

SustainabilityPerformance	Does the ***object*** include the 'SustainabilityPerformance' ***property***? Has the 'SustainabilityPerformance' ***property*** been completed with the relevant sustainability issue(s) which the ***product*** satisfies?	Permits maximum BREEAM points	User to populate
CodePerformance	Does the ***object*** include the 'CodePerformance' ***property***? Has the 'CodePerformance' ***property*** been completed with relevant code compliance requirements?	ISO 19712-3-2007 rated 5 for durability, stain resistance, cigarette burns	Must conform to all relevant standards

Category: In COBie this is synonymous with Classification. ISO/CD 12006-2 states that the purpose of classifying is to distinguish between objects in a collection based on properties of interest.

The categorisation (classification) system used should be the one agreed for the project; generally dictated by the asset owner or asset operator. This field is populated as per the COBie convention, a single text string with the classification number, a colon, and the classification name, so while it may contain the same information as the classification properties defined in clause 2.7.2 it is entered differently, as a requirement of the COBie schema.

AssetType: Used for accounting purposes. Fixed equipment relates to assets which are usually attached and integral to buildings' functionality; for example heating, plumbing and ventilation systems. Movable (US spelling – COBie requirement) assets are those such as furniture and equipment that are not part of the building.

Manufacturer: The term 'manufacturer' may also be used to refer to products that are supplied and identified by the supplier or that are assembled offsite by a third party provider. Given in the form of an email address (COBie requirement).

If mapping a ***hard coded*** Manufacturer field for use as the COBie Manufacturer ***property***, then it should be populated with the manufacturer email, as per the COBie requirements.

NominalLength / NominalWidth / NominalHeight: 'Typical' is a representative ***value*** of the ***property*** between min. and max. 'Nominal' is the nominal representation ***value*** of the ***property***, often mentioned in catalogues. It is best practice to map this ***property*** value to the geometry so information is not duplicated and the data is coming from-one single source.

Color: Even if a manufacturer and model number has been identified, the ***product*** may come in a range of colours, upon which the selection has yet to be confirmed and may be populated at a later stage in the project timeline.

2.6.3 Component properties

It is a requirement of the COBie ***schema*** that 'n/a' is completed as a value for all COBie ***component*** properties where the ***value*** is as yet unknown or is not relevant to that ***object***. Properties that require a date ***value***, where unknown, are to be completed with the default ***value*** '1900-12-31T23:59:59' to inform users of the date format that must be entered when the ***value*** is known.

Refer to the guidance to clause 2.1.1 for explanation of ***component***.

Property name	**Property requirement**	✓	✗
SerialNumber	Does the ***object*** include the 'SerialNumber' ***property***?	n/a	user to populate
InstallationDate	Does the ***object*** include the 'InstallationDate' ***property***? Has the 'InstallationDate' ***property*** been completed with the default ***value*** of '1900-12-31T23:59:59'?	1900-12-31T23:59:59	user to populate
WarrantyStartDate	Does the ***object*** include the 'WarrantyStartDate' ***property***? Has the 'WarrantyStartDate' ***property*** been completed with the default ***value*** of '1900-12-31T23:59:59'?	1900-12-31T23:59:59	n/a
TagNumber	Does the ***object*** include the 'TagNumber' ***property***? Has the 'TagNumber' ***property*** been completed with 'n/a'?	n/a	occupier to complete
Barcode	An alphanumeric default value 'n Does the ***object*** include the 'Barcode' ***property***? Has the 'Barcode' ***property*** been completed with 'n/a'?	n/a	User to populate
AssetIdentifier	Does the ***object*** include the 'AssetIdentifier' ***property***? Has the 'AssetIdentifier' ***property*** been completed with 'n/a'?	n/a	Text

2.7 General

The General ***property set*** (clause 2.7) includes properties required for the identification of the type, such as Name, classification and revision.

BIM objects require sufficient information so that they can be identified. This will mean both human-readable information such as descriptions, product numbers and classification information, as well as computer-readable information such as Globally Unique Identifiers (GUIDs).

ISO 15686-4, clause 4 defines the data requirements to identify the ***product***. Required data includes:

- The ***product***, initially as an abstract library type and latterly as an instantiated occurrence.
- The identity of the ***product***, including its name, description and other properties that make it uniquely identified.
- The source of the ***product***, in terms of the originating organizations, author, and any reference documents.
- Optionally, classification and grouping of the product according to local practice which aids in the searching and the reporting of the product.

2.7.1 General properties

Property name	Property requirement		
Author	Does the ***object*** include the 'Author' ***property***? Has the 'Author' ***property*** been completed with the name of the person, organization or library provider that authored the ***object***?	Company	info@ABC.com
AuthorURL	Does the ***object*** include the 'AuthorURL' ***property***? Has the 'AuthorURL' ***property*** been completed with a valid URL to the person, organization or library provider that authored the ***object***?	http://www.company.com	info@ABC.com
ProductInformation	Does the ***object*** include the 'ProductInformation' ***property***? Has the 'ProductInformation' ***property*** been completed with a hyperlink? Does the hyperlink resource provide details of further ***product*** information?	http://www.company.com/HandDryer	User to populate
ManufacturerURL	Does the ***object*** include the 'ManufacturerURL' ***property***? If product is a manufacturer product has the 'ManufacturerURL' ***property*** been completed with a valid hyperlink? Does the hyperlink refer to the manufacturer's website?	http://www.company.com	http://wwww.company.comm

ManufacturerName	Does the ***object*** include the 'ManufacturerName' ***property***? If product is a manufacturer product has the 'ManufacturerName' ***property*** been completed with the name of the organization responsible for manufacturing the ***product***?	Company	http://www.company.com
Revision	The BIM ***object*** should carry a 'Revision' ***property*** that indicates the issue sequence of the contained information. This would be completed at a project level.	A	n/a
Version	'Version' represents the sequence in which the ***object*** was published/amended/revised within an ***object library*** environment, not within a project model.	1	A

Author: The author is defined as the originator of model files, drawings or documents.

ISO 15686-4 states that an authoring person and/or organization should be associated with products. If using IFC, IFCOwnerHistory can associate a person, an organization or both with any ***product***.

ProductInformation: Not all information is required to be placed within the ***object***. It is sometimes better to link to an external source (such as a manufacturer's website). Documents are '*Information for use in the briefing, design, construction, operation, maintenance or decommissioning of a construction project, including but not limited to correspondence, drawings, schedules, specifications, calculations, spreadsheets*'. Source PAS 1192-2

Revision: The BIM ***object*** should carry a 'Revision' ***property*** that indicates the issue sequence of the contained information. This would be completed at a project level.

Version: 'Version' represents the sequence in which the ***object*** was published/amended/revised within an ***object library*** environment, not within a project model.

2.7.2 Classification properties

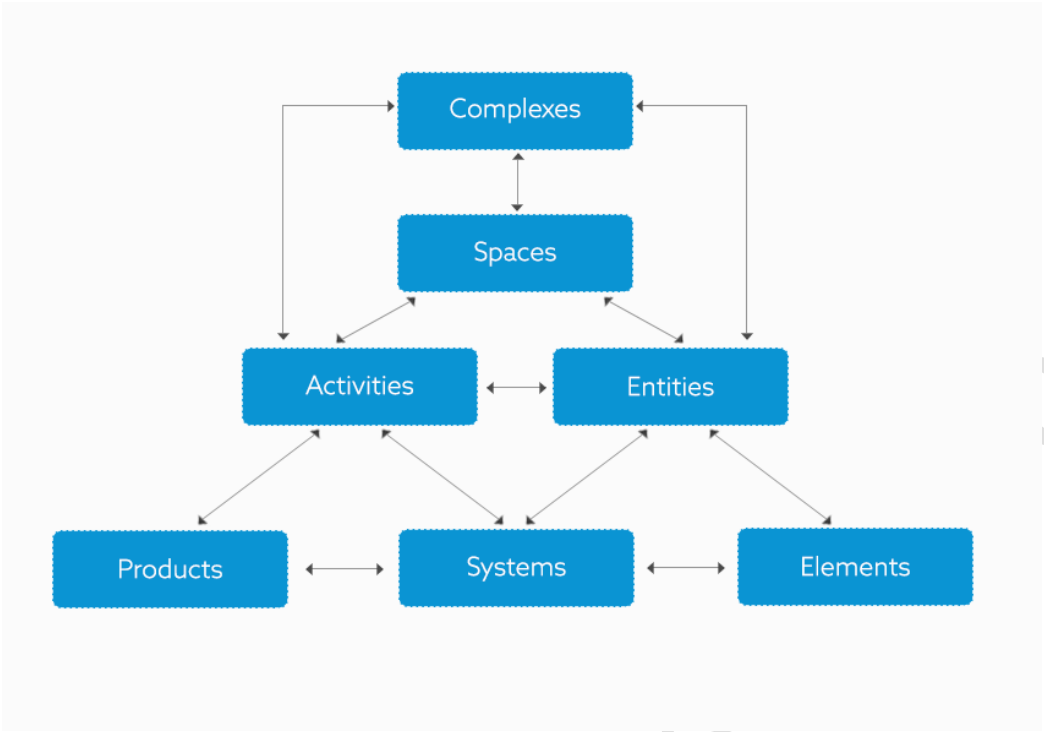
PAS 1192-2 defines classification as the '*Systematic arrangement of headings and sub-headings for aspects of construction work including the nature of assets, construction elements and products*'.

Different jurisdictions and different projects may require the use of different classification systems. This standard has included Uniclass2015 so that all objects from all jurisdictions have at least one common classification assigned to them.

As an ***object*** can be used to represent a wide range of ***products***, clause 2.7.2 allows for the choice of classification from the Uniclass2015 table appropriate for the element.

More information on the Uniclass2015 tables and classification codes can be found here: https://toolkit.thenbs.com/articles/classification#classificationtables.

ISO 15686-4 states that one or more classification systems can be associated with a ***product***.



2.7.3 Specification properties

Specific specification information can be referenced by the BIM ***object*** by including the properties included in clause 2.7.3. Replace <SpecificationSystemName> with the name of the specification system being referenced.

The specification clause number (<SpecificationSystemName>Reference) and the specification clause title (<SpecificationSystemName>Description) can be assigned to the object.

2.7.4 Multiple specification systems

Multiple specification systems can be referenced by the one BIM ***object***.

2.8 User defined data

2.8.1 Container

Properties added to objects that would not be contained within the IFC, COBie or General property sets (see clause 2.3) should be added to a User defined data ***property set*** named in accordance with clause 2.4.5.

This clause provides for adding extra properties to objects with the properties being grouped into sets that give the properties context. In Autodesk® Revit® a ***property set*** is the Parameter group in the shared parameter file and is different to the Display Group. In other BIM Platforms, they are generally shown as property sets. See also the guidance to clause 2.4.5.

2.9 Supplementary

2.9.1 Additional properties

a) ISO 15686-4 provides information and guidance on the use of standards for information exchange for service life planning of buildings and constructed assets and their components, as well as the required supporting data.

b) A ***property set*** may exist that is relevant to the IFC ***PredefinedType*** and may be included. If none are available within the IFC2x3 ***schema***. In some cases a relevant ***property set*** has been implemented within IFC4. Exercise caution when using an IFC4 ***property set*** as discussed in the guidance to clause 2.5.3.

c) Guidance to be drafted.

d) An example may be to include properties that relate to specific items included within the schedules of the specification system being used. This would allow automatic completion of specification schedules from the data included in the BIM ***object***.

e) Manufacturers may have ***product*** properties which are not already been covered within the General, IFC or COBie property sets recorded within the ***object***.

Information within the BIM ***object*** may not just be graphical. For example, performance information such as G-Values, R-Values and U-Values would be represented as non-graphical or non-geometric information.

f) See guidance to clause 3.5.1.

g) Each ***material*** or ***product*** should carry relevant and applicable information about the ***product***, while the ***assembly*** as a whole should carry relevant and applicable information about the performance of that ***assembly*** where the ***BIM platform*** allows. When constituent parts are aggregated into an ***assembly***, the relevance of some constituent parts may be diminished: for example, a door handle that is only available in one selection type and forms part of an overall door system.

In Autodesk® Revit®, only object level parameters can be included in schedules therefore it is best to only use parameters on the assembly when other options are not practical.

3 Geometry requirements

3.1 General

3.1.1 Model performance

The ***object*** should be modelled with graphical detail that will not compromise the BIM when used in practice. Follow the principle of not modelling elements of a ***product*** that will not be seen.

The intention of a BIM ***object*** is to imply a ***product*** rather than manufacture it, fabricate it or be an exact photorealistic representation of it.

3.1.2 Object modelling requirements

a) Objects should be created at a scale of 1.1. Many problems that arise during construction can be traced to errors and ambiguities of dimensions, particularly when information is entered incorrectly. Dimensions added as text that are unrelated to the geometric object can also cause errors (see clause 3.1.2 (e).

b) An insertion point is the point at which the ***object*** is placed into the project environment (usually indicated by the cursor position). Depending on the ***object*** type, the insertion point may vary from ***object*** to ***object***. For example, for doors and windows the insertion point will be central so the content parametrically expands outwards. Ensure that the default insertion point used when creating the ***object*** is appropriate for the ***object*** and is consistent for similar types of objects.

If the ***BIM Platform*** allows for a different ***object*** origin to the insertion point, it is best to model objects with an origin of 0,0,0.

c) Guidance to be drafted.

d) Where a manufacturer states restrictions on certain criteria of a ***product***, these should, if appropriate, be built into the ***object***. An example of this would be if a door manufacturer has a limitation on the size of the door it can produce: this limitation should be built into the ***object*** where the ***BIM platform*** will allow.

It is not recommended to produce highly parametric objects, as some of this functionality may be lost when exporting the object to IFC (see guidance to clause 1.3.2).

e) Dimensions should be derived automatically using ***associative dimensioning*** functions within the ***BIM platform***. By entering dimensions as 'text' there will be no direct relationship with the geometry as the dimensions are purely graphical characters.

f) If a drawing label refers to the same information as contained in the object ***metadata*** they must match. If not a user reading the drawing will get different information to another reading the ***metadata*** or using software that reads the ***metadata***. Ideally the label should be linked to the ***metadata***.

If using Autodesk® Revit®, constrain dimensions and labels to a reference plane.

g) Guidance to be drafted

h) Guidance to be drafted

i) It is best practice to build objects that utilise only native BIM elements in their creation. Leaving DWG, DWF, or non BIM 3D content (e.g. Autodesk® 3DS® or Trimble® SketchUp® objects) or other non BIM content within the object will result in larger file sizes and/or poorer performing objects.

j) Guidance to be drafted

k) Guidance to be drafted

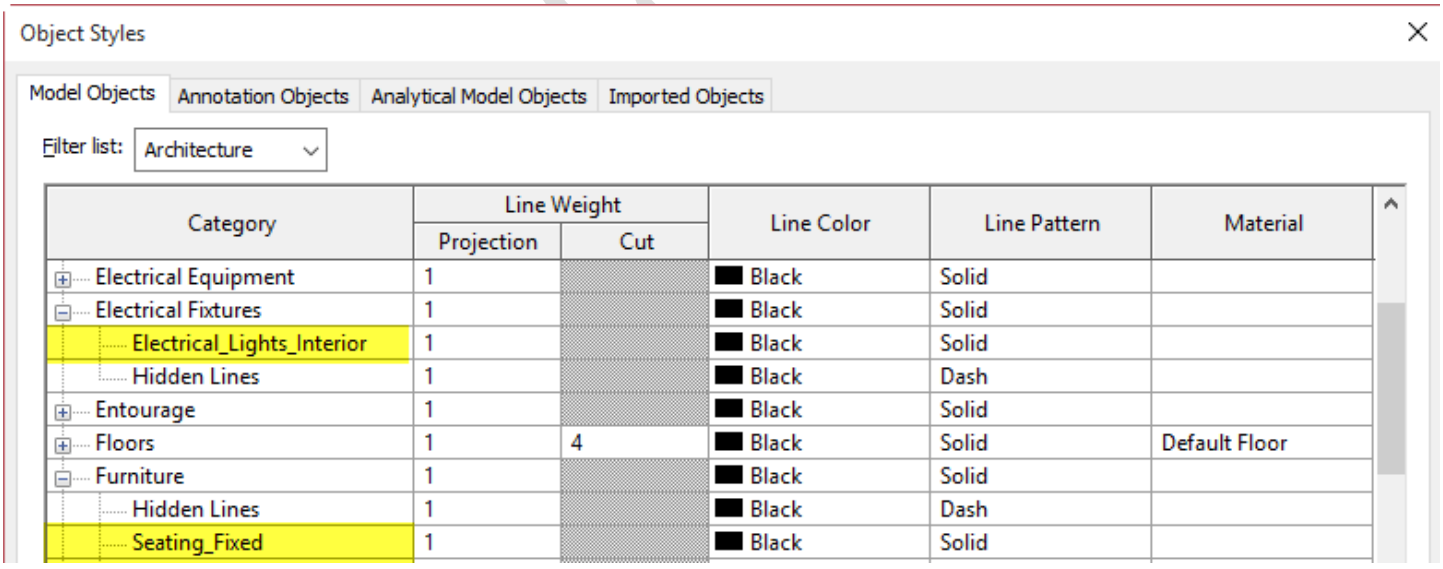
3.2 Graphical control

3.2.1 View management

Most BIM Platforms provide means for controlling the visibility of objects in groups allowing the user to easily switch on or off parts of the model to aid visibility and model performance. In Graphisoft® ArchiCAD® this is via Layers, Autodesk® Revit® uses Categories and Sub Categories, other BIM platforms support similar concepts. As these can be defined by users and are embedded in objects, importing objects into a model also brings them into the model. Naming these consistently reduces the chances of similar layers or sub categories being duplicated in the model.

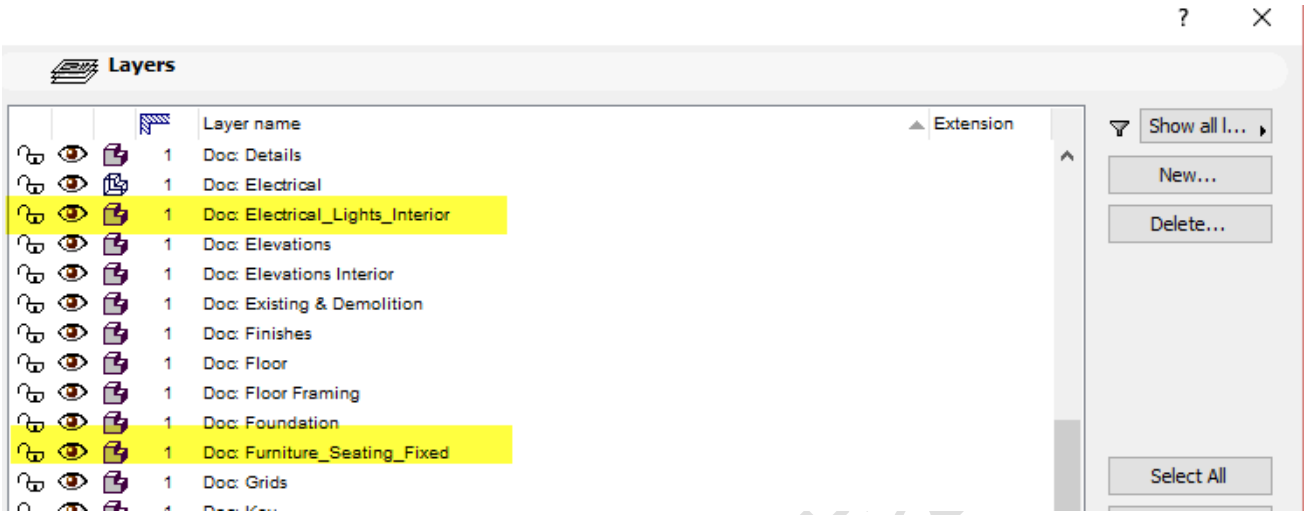
Note, only use <UsageSubGroup> or <Differentiator> if they are needed. The examples below include both of these but it would only makes sense to go to this level of breakdown if the model contained many similar elements that it required segmenting at this level.

Examples:
Autodesk® Revit®



Category	Line Weight		Line Color	Line Pattern	Material
	Projection	Cut			
Electrical Equipment	1		Black	Solid	
Electrical Fixtures	1		Black	Solid	
Electrical_Lights_Interior	1		Black	Solid	
Hidden Lines	1		Black	Dash	
Entourage	1		Black	Solid	
Floors	1	4	Black	Solid	Default Floor
Furniture	1		Black	Solid	
Hidden Lines	1		Black	Dash	
Seating_Fixed	1		Black	Solid	

Graphisoft® ArchiCAD®



Object ***variations*** or options should be modelled and categorized within the ***BIM platform*** to enable their visibility to be controlled easily.

Where clearance zones indicating space requirements for accessibility or specific activities such as maintenance access have been included, they should be modelled as a volume and categorized appropriately, with relevant controls to enable them to be hidden or revealed as required. These parameters should be named consistently to allow functionality to be developed to show all/hide all in a particular ***graphical view***.

3.3 Shape data

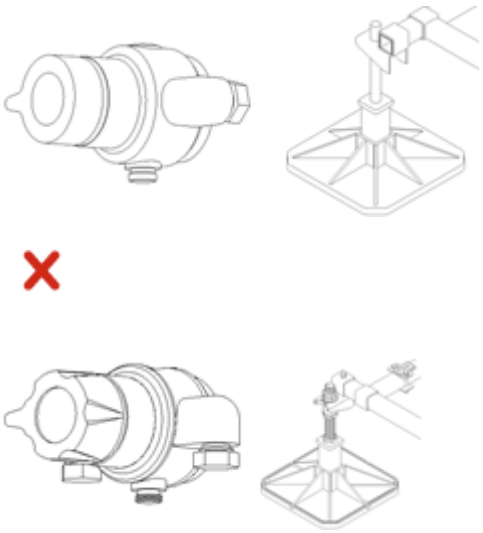
3.3.1 Shape modelling requirements

a) Geometric representation is also referred to as ***product*** shape.

Follow the principle of not modelling elements of a ***product*** that will not be seen.

b) If modelling a door, essential openings could be considered to be the main structural feature, for example. Modelling details such as architraves and mouldings will add to the visual effect but their structural value may be limited.

Compliance check



3.3.2 Fixed geometry

An ***object*** such as a WC, for example, that is only available in one size should be presented as a fixed form to reflect the real world selection and availability of the ***product***.

3.4 Symbolic data

3.4.1 Displaying objects

a) A ***convention*** is an accepted way of drawing an item which may have the nature of a ***representation***, a ***simplified representation*** or a ***symbol***.

A ***representation*** is a scale view of an ***object***, often also referred to as ***visibility*** or display. The terms 'Low/symbolic/simple/Course, Medium, High/detailed/fine/realistic' are often used as a substitute for 1:20, 1:50 and 1:100.

Ensure that objects support 2D detail at 1:100 as a minimum. If objects only support larger 2D scales, then any 1:100 views will be swamped with detail.

A ***simplified representation*** can reduce modelling authoring time and is most appropriate when a limited indication of the features of an ***object*** is required.

A ***symbol*** can be used where the size is not significant and a non-realistic indication of the ***object*** is appropriate. The ***symbol*** size and shape does not necessarily relate to size and shape of the ***object*** or to the scale representation. Regard should be given to the symbol's graphical detail, its intended representative scale and plotted output. A ***symbol*** can be added to a ***convention***, a ***representation***, a ***simplified representation*** or another ***symbol***.

b) The term ***line type*** is also synonymous with line pattern.

Lines, hatching, and fills are used to improve the users understanding and visualisation of the ***object*** in 2D and 3D. They also allow the ***object*** developer to differentiate different components that may make up the object.

It is preferable to use 'out of the box' fill or hatching patterns provided by the ***BIM platform*** being used. This avoids having multiple similar/identical patterns with different names within the model. When creating new fill or hatching patterns it is important to use a consistent naming convention similar to that used for the 'out of the box' patterns.

3.4.2 Supplementary symbolic data

a) Geometric shapes for ***information devices*** are limited and therefore could have more than one meaning. A geometric shape for an ***information device*** should not be used if its meaning is not determined by context and experience; for example, a window opening direction or a flow direction arrow. Source BS 1192-2.

b) Details can be used to convey relevant geometry that is not modelled in 3D; they can also be used to expand upon information. In addition, a detail may be used to model geometry to show specific placement requirements; for example, to show specific detailing requirements of a window when used in different wall constructions.

3.5 Spatial requirements data

3.5.1 Installation and maintenance

A description of a product's shape alone is not sufficient to check whether it is correctly installed. Products and equipment may require surrounding operation space or additional space requirements for transportation, installation and assembly.

- Minimum operation space (clearance zones): That required for product to correctly function, including circulation and opening of doors, hatches, etc.
- Access space: That required for maintenance and operation of the ***product***. Maintenance includes, but is not limited to, cleaning, servicing, repairing and replacing parts of the asset.
- Placement and transportation space: That required for the largest single subassembly into which the ***product*** can be broken down to allow ingress to and egress from its place of installation in the built asset.
- Installation space: That required for on-site assembly, installation or de-installation of the ***product***.
- Detection zone space: That required for motion detection, functional coverage and sensor/ detector range.
- Zones for non-modelled applied finishes: That required for clash detection purposes and overall spatial coordination, which would not generally be modelled digitally, but will be in place on the installed ***product***. Applies to finishes, coatings, insulation or other components added to the object. E.g. generally ducts are shown as the sheet metal size but can have insulation applied to the outside which affects clearances.

Using a different material for the clearance space or using different geometry definitions ensures that these spaces are able to be identified digitally as separate to the core ***object***.

3.5 Surface and material data

Materials carry information regarding identity, performance and appearance. They can be used on their own, as finishes and coatings, as building products within an ***object***, or to represent an option within an ***object***. The extent of information for a material to be qualified, quantified and specified within a project environment will vary from a simple name and description through to detailed technical information.

Materials may be assigned a surface pattern, fill pattern, hatch pattern and specific line work for 2D representation to control the outward appearance of the ***product*** or product surface. They allow the designer to graphically determine and differentiate between different materials. Some materials may only be visible in a particular graphical view such as a section, e.g. cavity wall insulation.

3.6.1 Visual representation

Renderings are photorealistic outputs from the BIM which show a more accurate depiction of the material than the model view. ***BIM platforms*** allow for the configuration of the rendered appearance of the materials, such as transparency and reflectivity.

Image files can also be used to represent the material's appearance. Bitmaps and bump maps can give additional appearance of texture to image files. The image should be scaled correctly and allow for a repeated pattern.

The ***product*** surface is the coloured and textured outer boundary of the product's shape; its rendered appearance responds to relative lighting and viewing angles.

Materials may be assigned a specific colour or a designated render to control the outward appearance of the ***product*** or product surface. Simple representative colours help aid identification of the object within the model view (the model view appearance determines how the material looks as the designer is working within the ***BIM platform***) and can be representative rather than the colour which reflects the actual ***product*** colour. For example, within a multi-layered wall the designer can use colour to visually determine and differentiate the different materials within the wall build-up. This is just as effective as the use of hatch patterns.

The term *section* is sometimes referred to as a cut. The cutting plane is the imaginary plane through which the ***object*** represented is cut.

3.6.2 Generic object colour

Guidance to be drafted

3.6.3 Control and selection

Creating and assigning the material to the component (instance) or ***type*** provides the most flexibility for the designer.

3.6.4 Default materials

BIM platforms may include a number of default materials within an inbuilt library.

4 Functional requirements

4.1 General

4.1.1 Behaviour

a) An ***object*** shall reflect its real world relationship with associated objects. i.e. a door or a window will generally be related to a wall.

b) While ***object*** functionality can greatly aid the designer, this should not be to the detriment of the performance of the model when used within the project environment.

c) Careful consideration must be given to the use of a host, as this could potentially limit the objects use in the project environment. For example, a wall-based light fixture may also be used on a column.

4.1.2 Constraints

Constraints are useful in that they can limit selection criteria to those *variations* that are possible and available in the ***product***. Where a manufacturer states restrictions to certain criteria of the proprietary product, then these should, if appropriate, be built into the ***object***. An example of this would be if a door manufacturer has a limitation on the size of the door they can produce: this should be built into the ***object*** where the ***BIM platform*** will allow.

A ***constraint*** can be a 'Geometric constraint', whereby geometric properties are limited and controlled, e.g. a dimension can be constrained by fixed length or by range, or two lines can be constrained to be parallel. A ***constraint*** can also be an 'Information constraint', whereby non-graphical properties are limited, e.g. a product value can only be 'red'.

Whenever a ***constraint*** is used, it should not have a detrimental effect on the performance of the ***object***, or confuse or limit the ***object*** unnecessarily.

4.1.3 Associated objects

In an object-oriented world, objects have a relationship with other objects around them. Connections and associations, for example a WC object with connections to services, greatly aids the designer when it comes to analysis.

5 Metadata requirements

5.1 Naming conventions

5.1.1 Spelling

A consistent approach to spelling is important when it comes to scheduling of information in a consistent manner. For example, for COBie properties use the North American spelling, i.e. Color.

5.1.2 Composition

Naming conventions should be intuitive so that information can be found and retrieved. Spaces and punctuation are not helpful in the digital era and the use of special characters may mean different things and commands in in different software packages. A big difference from traditional CAD is that naming is visible from within the ***object*** and the project model. This offers the ability to provide search functionally and interactions with other databases.

Compliance check

Does the BIM ***object*** property name comprise A-Z, a-z, 0-9 characters?

ManufacturerURL

Manufacturer'sURL

5.1.3 Abbreviations

Values should avoid unnecessary abbreviations as they can lead to errors due to interpretation. However, due to character limitations within certain ***BIM Platforms***, abbreviations may be required. To aid readability, characters should have capital letters at the start of each abbreviation.

The BIP 2007 Guide to BS 1192, Appendix G gives examples of commonly used abbreviations.

Compliance check

Are abbreviated words of 7 characters or less? Are they an aid to readability?

Abbreviation	Definition
Brk	Brick
Curtn	Curtain
Shtng	Sheeting
SIPs	StructurallyInsulatedPanels
Thrmstc	Thermostatic

Abbreviation	Definition
Bed	Bed
Br	Bar
Extpolne	ExtrudedPolystyrene

5.2 File and BIM object naming

5.2.1 General

It is important that the BIM ***object*** and file name are unique, not only to avoid duplication of information but also to aid the export of information and its interpretation.

5.2.2 Name composition

Each of the three founding regions currently have a different opinion on how the file name should be composed and these are included in the relevant Part B's for each region. However, a file naming convention has been included in the Core standard as shown, so that future countries could adopt the Core standard without the need to produce a localised Part B if they did not require it.

We believe that <Source> should also be included within the file name composition in one of the two following configurations:

<Source>_<Type>_<Subtype/Product code>_<Differentiator>

Generic example: Door_Timber_2100x900

Manufacturer example: Bettadoors_Door_T523_2100x900

Or

<Type>_<Subtype>_<Source>_<Product code>_<Differentiator>

Generic example: Door_Timber_2100x900

Manufacturer example: Door_Timber_Bettadoors_T523_2100x900

We ask for your input here.

Some explanation behind the two schools of thought:

The difference between the two options is whether <Source> or <Type> is up front in the file names.

Having the manufacturer <Source> of the product up front in the file name, would sort manufacturer objects by who manufacturers them and generic objects by their type (as <Source> is not used for a

generic object), when searching for an object using a source that sorts the objects alphabetically by file name (e.g. file explorer/directory).

An argument against this option would be that when searching for an object, using a source that sorts the objects alphabetically by file name, all similar type objects would not be grouped together. Taking sinks as an example, having <Source> up front would group sinks made by different manufacturers in different locations in the list, based on the first letter of the manufacturer's name, and these would also be located in a different location to any generic sink objects. The argument being that if you were searching for a sink object, that it would be easier if they were all grouped together, so that you could browse the options available.

The counter-argument to this option is that if you were searching for an object, using a source that sorts the objects alphabetically by file name, it is likely that you are actually searching for an object you already have (i.e. have previously downloaded or created yourself) in your filing system. In which case it is likely that you are searching for a particular object rather than browsing to see which object might be suitable, which would generally be done using a different search method, such an object library web interface. In this case, being able to go directly to the object relating to the particular manufacturer you are looking for would likely be more advantageous than having to go through all of the similar type objects to find the manufacturer object you are looking for.

On the other hand having <Type> up front followed by <SubType> and <Source>, would mean that when searching for an object, using a source that sorts the objects alphabetically by file name, all similar type objects would be grouped together, making it easier to browse for a particular object type. The opposite arguments to those above would apply.

For the <Source> ***field*** it is best not to abbreviate manufacturer's names where practical.

5.2.3 Additional fields

If adding these additional fields refer to the requirements of Part B.

5.3 Naming of materials

5.3.1 Material name composition

It is important that the material name is unique, not only to avoid duplication of information but also to aid the export of information and its interpretation.

See previous guidance to clause 5.2.2.

5.3.2 Additional fields

If adding these additional fields refer to the requirements of Part B.

5.3.3 Material image file name

Having the material image name the same as the material name will aid use. The file extension (i.e. .jpg, .bmp, etc.) will identify that the file type is an image file.

5.4 Image tiling

5.4.1 Image shape

Guidance to be drafted.

5.4.2 Image quality

a) Guidance to be drafted.

b) Guidance to be drafted.

c) Guidance to be drafted.

Section 6 – PART B AUSTRALIAN REQUIREMENTS

6.1 Information Requirements

6.1.1 Suffix

It is proposed to include a suffix to all properties added to a user defined data property set. This is to identify where the properties have originated from. A suffix is not required to IFC or COBie properties as doing so would not follow the rules of those schemas.

This means that any property that does not have a suffix is a property that belongs to either the IFC property group, the COBie property group of the General property group (see clause 2.3). The general property group only includes properties defined in this standard that do not belong to either the IFC or COBie properties groups (clause 2.7 and clause 6.1.2).

6.1.2 Classification properties

To allow the addition of the CBI classification system to assigned to an object other than those required by clauses 2.7.2 and the COBie 'Category' (which possibly could be mapped from this or the Uniclass classification properties anyway depending on client requirements).

6.1.4 Facilities management properties

As COBie is not a requirement in NZ this allows for the capture of a minimum set of information suitable for Facilities Management. These requirements may change as a result of the LINZ / MBIE Asset Metadata Schema project currently underway.

6.2 Metadata Requirements

It is proposed that the CBI classification code be added to the front of files and materials as CBI is widely used as a classification method in New Zealand.