2.3.2 Element Attribute Dictionary (See Appendix C)

The Element Attribute Dictionary is a specification of the Airport's naming conventions for model elements and element attributes to manage its facilities across their life cycle. The EAD also specifies patterns for element names and an enumerated list of attribute values that must be verified by the project teams for compliance with the Airport's acceptance criteria (Appendix C).

Content data authors shall coordinate with the Airport through partnering, to specify and create data for building spaces, installed building systems and components using the terminology specified in the Element Attribute Dictionary. In cases where the dictionary does not provide Airport standard terminology, content authors should work with the Airport to add new model element definitions into the dictionary.

The EAD is a working document. It specifies model elements and attribute sets independent of how they are implemented in a given BIM authoring system. Additionally, it provides standards for how model element names can be implemented in Autodesk Revit so that element data can be exported from building information models for consumption by the Airport's CMMS and other target systems. **Figure 05** illustrates the structure of the Element Attribute Dictionary.

Project teams must coordinate the data requirements with the most up to date version of the Appendices. The Airport recommends the inclusion of the following activities as part of the EAD development process:

- Define the scope for model elements and attribute sets that the project will deliver, based on the Airport's business goals outlined in Part One of this guide. At a minimum, the content author must populate the attributes outlined in the Equipment Inventory Specification Document 01 78 23.23.
- Define model element names per the Airport's requirements (Appendix C.1)
- Develop data view definitions for data collection that are specific to project milestones and content author (see Appendix C.3 for an example)
- Normalize attribute sets across model element types
- Develop and implement a data collection workflow, incorporating industry best practices
- Incrementally populate data views for verification by the Airport
- Develop and implement the workflow to self-audit and report quality model data iteratively as part of regular model coordination and for each milestone defined by the data views

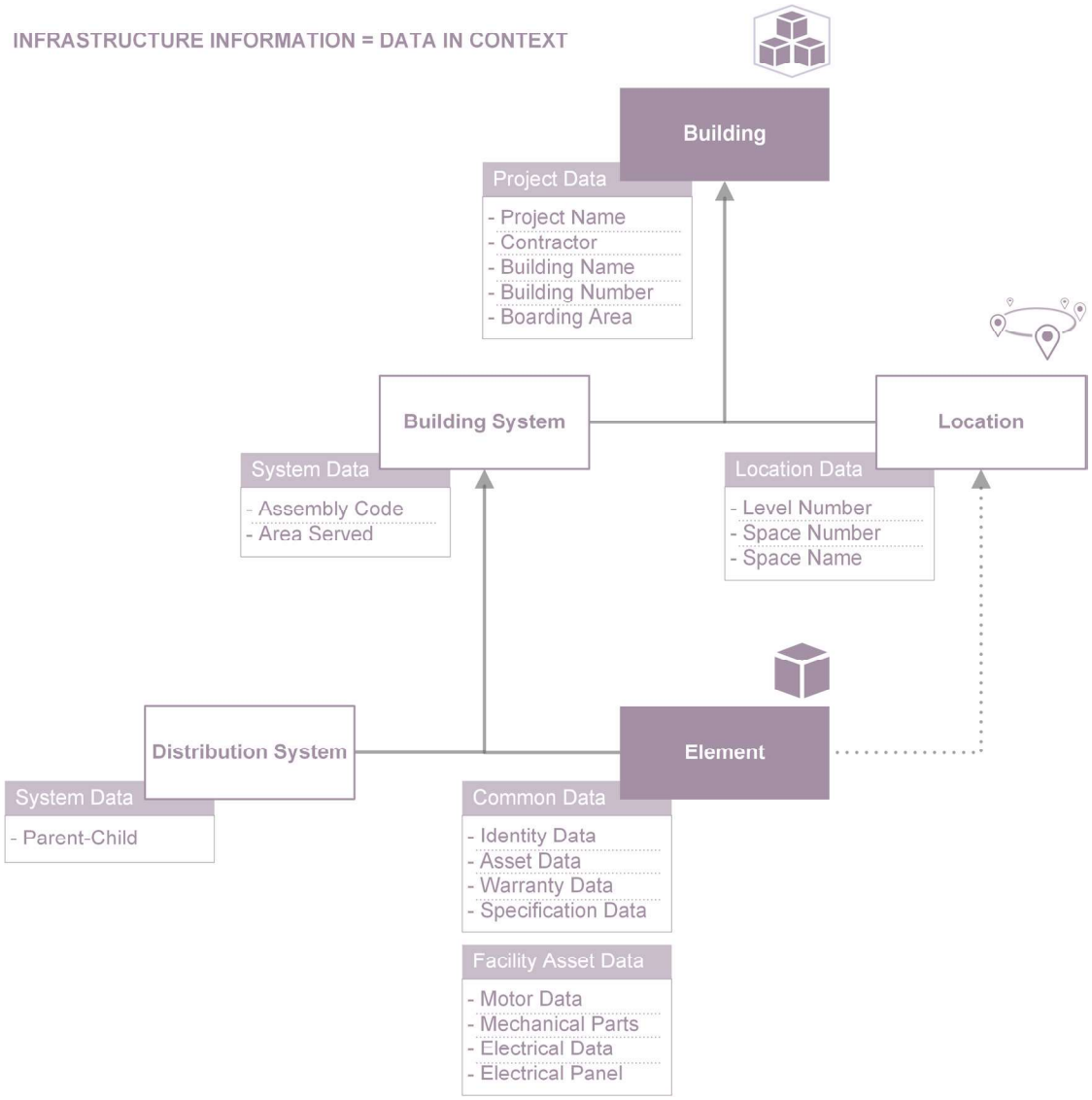


Figure 05. Element Attribute Dictionary Structure

2.3.2.1 Attribute Sets (See Appendix C.2)

The ***Common Attribute Set*** specifies the minimum Data View Definition for each model element, which the Airport requires for stakeholder use cases. In addition to the minimum requirements, model element attributes that serve specific Airport stakeholder business cases are captured in a growing list of data views. For example, the SFO Equipment Inventory Spreadsheet collects information that is specific to equipment tracked in the Airport's CMMS and is utilized by Maintenance personnel to service equipment. The Element Attribute Dictionary specifies this information through additional attribute sets such as the Facility Asset attributes.

The link between the concepts explained above is illustrated in **Figure 06** below.

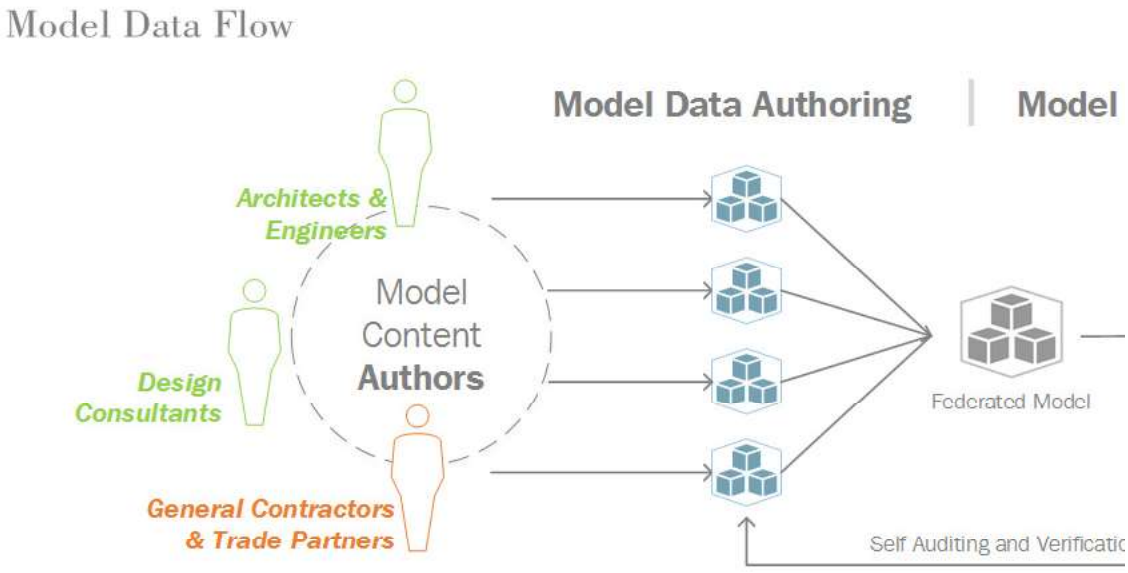


Figure 06. Model Data Development and Management Infographic

2.3.2.2 Data View Definitions (See Appendix C.3)

Data View Definitions are filtered views of the Element Attribute Dictionary that define the data relevant to project team member's scope of work at specific project milestones.

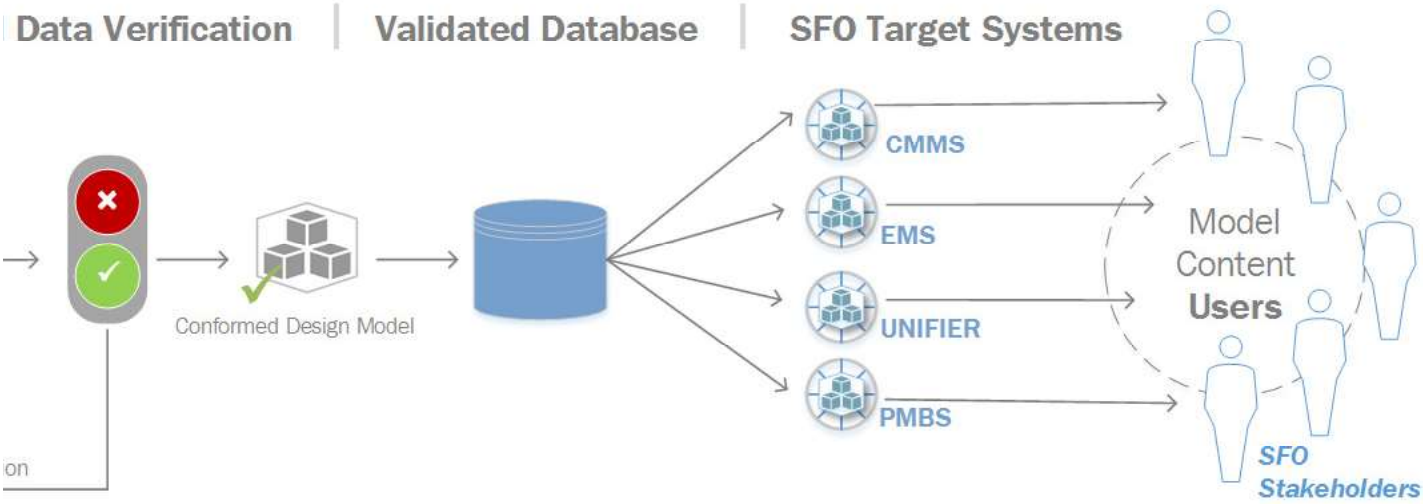
Data view definitions help each project participant understand what data they are responsible for delivering and when they need to deliver it. The data views can be aligned with project milestones, coordination schedules, submittal schedules or other logic that works for the project team, based on the delivery method, team organization etc.

The Airport will partner with the project teams through a series of project engagement meetings to define the data views in a DVD matrix. The DVD matrix is designed to serve as a decision-making tool for the project teams, and a communication tool between the project teams and the Airport to establish a baseline of expectations at each milestone.

This also helps in maintaining the momentum for data collection and verification.

The baseline expectation established for each data view can be encoded in data verification tools that project team members should run regularly at project milestones. The views establish a technical foundation for developing incremental and continuous data development and acceptance test processes, which will lead to high quality data at project handover.

Project teams will need to coordinate with the Airport to validate and extend the element attribute dictionary and data views upon project setup. They should implement the naming conventions and develop data acceptance tests to continuously self-audit and self-report model conformance according to the Airport's requirements.



2.3.3 Building Level and Space Numbering

The Airport's space numbering convention shall be followed on all Airport projects unless otherwise specified by the SFO Project Manager. The purpose of this space numbering convention is to standardize all spaces within both the physical and virtual environments. This convention provides a universal numbering system that is to be applied consistently to Airport's spaces. Refer to the SFO Building Level and Space Numbering Guidelines in the Attachments.

2.4 Verification

One of the Airport's goals for BIM is the delivery of standardized and consistent information. Without a standardized approach to authoring file names, element names, geometry and attributes, outputs from models developed for different projects will be inconsistent. Errors must be identified early to avoid unnecessary revisions.

2.4.1 Model Data Verification

The project team shall develop a model data test plan based on distinct tests for the data view definitions that are required for each milestone. The test plan shall be incorporated into the project BIMx plan. The data verification tests shall check:

- Conformance to element name definitions in the Element Attribute Dictionary
- Existence of attributes that are bound to element instances in the model
- Conformance to the attribute name definitions in attribute sets
- Conformance to acceptable attribute values for attributes that have a testable name pattern or enumerated list of values in the Element Attribute Dictionary

For example: The space numbering criteria is specified in the SFO Building Level and Space Numbering Guidelines to conform to the pattern: <BuildingNumber>.<BoardingArea>.<Level Number>.<Space Number>.

The data acceptance tests must check for conformance with the pattern for the space number as well as define a pick-list for acceptable values for individual attribute fields for Building Number, Boarding Area, Level Number and Space Number.

The tests may be implemented in a model checking software application that is approved by the Airport. Project team members that author BIM content shall run acceptance tests based on data verification rules approved by the Airport. Project teams will be responsible for running tests as frequently as necessary to achieve appropriate data conformance results at each project milestone.

The Airport recommends that the project teams run tests as a regular activity associated with the model coordination processes until all tests indicate conformance to Airport requirements for model submission. The Airport will also spot-check the models at major milestones to ensure data conformance.

The Airport will partner with the project teams to define and implement the process and expectations of model data verification through spot-checks.

2.5 Additional Standards

The Airport's existing standards that may be related to BIM are included in the Appendix of this document. The additional SFO standards are attached for informational purposes as applicable to a specific project. The additional standards not created by SFO are available online.

- Revit Standard
- GIS Standard
- CAD Standard
- Building Level & Space Numbering Guidelines
- Sheet Numbering Guidelines
- Pennsylvania State University BIM Execution Plan Template
- Laser Scanning Standards (LoA) from USIBD

Bibliography

Project BIM Execution Plan Template

The Airport requires consultant teams to use the Pennsylvania State University BIM Execution Plan Template found at http://bim.psu.edu. When applicable, the SFO BIM Guide appendices are to be used in lieu of the Pennsylvania State University BIM Execution Plan Templates. The sections listed in Part 3 of the BIM Guide are intended to provide teams with content suggestions for completion of this template.

The Pennsylvania State University BIM Execution Plan template for use by SFO project teams is referenced as:

Computer Integrated Construction Research Program. (2013). "BIM Planning Guide for Facility Owners." Version 2.0, June, The Pennsylvania State University, University Park, PA, USA.

Laser Scanning Standards – USIBD Level of Accuracy Specification

For more information on the industry standard surrounding laser scanning, please visit: http://www.usibd.org/resources/usibd-standard-documents-version-1_0

The Construction Specification Institute. (2010).

UniFormat: A Uniform Classification of Construction Systems and Assemblies. Alexandria, VA, USA. Retrieved from http://www.csinet.org/uniformat

The Construction Specification Institute. (2016).

MasterFormat: Master List Numbers and Titles for the Construction Industry. Alexandria, VA, USA. Retrieved from http://www.csinet.org/masterformat

Omniclass™

The OmniClass Construction Classification System (known as OmniClass™ or OCCS) is a classification system for the construction industry. Retrieved from http://www.omniclass.org/

BIM Forum LOD

The Level of Development (LOD) Specification is a reference that enables practitioners in the AEC Industry to specify and articulate with a high level of clarity the content and reliability of Building Information Models (BIMs) at various stages in the design and construction process. Retrieved from http://bimforum.org/lod/

The National BIM Standard-United States® (NBIMS-US™)

The National BIM Standard-United States® (NBIMS-US™) provides consensus based standards through referencing existing standards, documenting information exchanges and delivering best business practices for the entire built environment.
Retrieved from https://www.nationalbimstandard.org/

Referenced Specification Sections

00 73 87 - BIM Requirements

01 31 19 - Project Meetings

01 33 00 - Submittals

01 78 39 - Project Record Documents

01 78 23.23 - Equipment Inventory

Appendices - BIM Integration Team | BIT@flysfo.com

Appendix A – BIM Execution Plan Framework

Appendix B – Model Progression Specification

Appendix C.1 – Element Attribute Dictionary: Family Naming Conventions

Appendix C.2 – Element Attribute Dictionary: Attributes Set

Appendix C.3 – Data View Definition example

Appendix D – Coordinate Systems

Attachments

Revit Standard – Stephanie Jaeger | Stephanie.Jaeger@flysfo.com

GIS Standard – Jason Hill | Jason.Hill@flysfo.com

CAD Standard – Anna Lam | CADStandard@flysfo.com

Building Level & Space Numbering Guidelines – Josephine Pofsky | Josephine.Pofsky@flysfo.com

Sheet Numbering Guidelines – Stephanie Jaeger | Stephanie.Jaeger@flysfo.com

Appendix A – Project BIM Execution Plan Checklist

What is it?

A BIM Execution Plan, also referred to as a BIMx Plan, is a comprehensive document which outlines the protocols and procedures that the design and construction team must follow to ensure successful utilization of BIM and VDC practices. The BIMx Plan must address workflows required to communicate between the various application platforms, incorporate the requirements of appropriate Airport end-users and address the capabilities and workflows required to integrate with other existing systems.

When is it needed?

The project BIMx Plan shall align with the specific project contract delivery method and the organization-wide use cases set forth in this document. The BIMx Plan shall be created by the project team before any modeling begins. If the project delivery method is Design Build, the BIMx Plan must encompass both design and construction procedures and be submitted to the Airport for review. If the project delivery method is a Design, Bid, Build, or CMGC, the design team and the builder can both submit separate BIMx Plans, but it is recommended that these teams collaborate around a single document. The builder must submit their BIMx Plan before distribution of subcontractor RFP. BIM Execution Plans created by project teams shall meet the requirements of this SFO BIM Guide so models and databases created by project teams meet SFO goals.

The Airport understands that this is a living document and will evolve throughout the project's life cycle, but it is vital to establish baseline requirements to which everyone must adhere. Any revisions made to the BIMx Plan must be submitted to the Airport for review and approval prior to distribution. The use of a change log is required for submission to the Airport for review. All BIMx Plan drafts will be collaboratively developed with the BIM Integration Team (BIT) using the template provided by the airport and submitted as a Microsoft Word document with the "Track Changes" feature enabled.

Appendix B: Model Progression Specification

Delivery Method: Design-Build

In-House Projects Handover → *Capital Projects Handover*

	Existing Conditions Modeling, Cost Estimation, Phase Planning, Programming, Site Analysis, Design Reviews, Design Authoring, Energy Analysis, Structural Analysis, Lighting Analysis, Mechanical Analysis, LEED Evaluation, Code Validation						3D Coordination, Site Utilization Planning, Digital Fabrication, 3D Control and Planning		Record Model		Suggested BIM Use
	DESIGN						**BUILD**		**CONSTRUCTION CLOSEOUT**		Lifecycle Phases
Elements/System	**Classification**			**Schematic Design**		**Design Development**		**Construction Documents**		**Construction**		**Commissioning / As-Builts**		
	OmniClass Table 21-Elements	**MasterFormat / OmniClass Table 22 - Work Results**	**OmniClass Table 23-Products**	**LOD**	**MCA**	**LOD**	**MCA**	**LOD**	**MCA**	**LOD**	**MCA**	**LOD**	**MCA**	
Substructure	**21-01 00 00**													
Foundations	21-01 10	03 - Concrete, 31 - Earthwork	23-13 00 00: Structural & Exterior Enclosure Products, 23-39 00 00: Utility and Transportation Products	200	SE	300	SE	300	SE	300	SE	300	SE	
Subgrade Enclosures	21-01 20	03 00 00				200	SE	300	SE	300	SE	300	SE	
Slabs on Grade	21-01 40	03-Concrete, 07-Thermal & Moisture Protection, 31-Earthwork		200	SE	300	SE	300	SE	300	SE	300	SE	
Water and Gas Mitigation	21-01 60	31 - Earthwork, 33 - Utilities												
Substructure Related Activities	21-01 90	31 - Earthwork				200	SE	300	SE	300	SE	300	SE	
Shell	**21-02 00 00**													
Superstructure	21-02 10	03-Concrete, 04-Masonry, 05-Metal, 06-Wood, Plastics & Composites, 07-Thermal & Moisture Protection	23-13 00 00: Structural and Exterior Enclosure Products, 23-17 00 00: Openings, Passages	200	SE	300	SE	300	SE	300	SE	300	SE	
Exterior Vertical Enclosures	21-02 20	04-Masonry, 08-Openings, 09-Finishes, 10-Specialties	23-13 00 00: Structural and Exterior	200	ARCH	300	ARCH	300	ARCH	400	ARCH	500	ARCH	
Exterior Horizontal Enclosures	21-02 30	07-Thermal & Moisture Protection, 08-Openings	23-13 00 00: Structural and Exterior	200	ARCH	300	ARCH	300	ARCH	300	ARCH	300	ARCH	
Interiors	**21-03 00 00**													
Interior Construction	21-03 10	08 - Openings, 09-Finishes, 10 - Specialties	23-15 00 00: Interior & Finish Products	200	ARCH	300	ARCH	300	ARCH	300	ARCH	500	ARCH	
Interior Finishes	21-03 20	09 - Finishes	23-15 00 00: Interior and Finish			200	ARCH	300	ARCH	400	ARCH	500	ARCH	
Services	**21-04 00 00**													
Conveying	21-04 10	14 - Conveying, 41 - Material Processing & Handling, 34 - Transportation	23-23 00 00: Conveying Systems and Material Handling	100	ARCH	200	ARCH	300	ARCH	300	ARCH	300	ARCH	
Plumbing	21-04 20	22 - Plumbing	23-31 00 00: Plumbing Specific	100	PLUM	200	PLUM	400	PLUM	400	PLUM	500	PLUM	
HVAC	21-04 30	23 - HVAC	23-33 00 00: HVAC Specific Products	100	MECH	200	MECH	400	MECH	400	MECH	500	MECH	
Fire Protection	21-04 40	21 - Fire Supression	23-29 00 00: Facility and Occupant	100	FIRE	200	FIRE	400	FIRE	400	FIRE	500	FIRE	
Electrical	21-04 50	26 - Electrical	23-35 00 00: Electrical and Lighting	100	ELEC	200	ELEC	400	ELEC	400	ELEC	500	ELEC	
Communication	21-04 60	27 - Communications	23-37 00 00: Information and			200	LV	400	LV	400	LV	500	LV	
Electronic Safety and Security	21-04 70	28 - Electronic Safety & Security	23-29 00 00: Facility and Occupant			200	SEC	400	SEC	400	SEC	500	SEC	
Integrated Automation	21-04 80	25 - Integrated Automation				200	CONT	400	CONT	400	CONT	500	CONT	
Equipment and Furnishings	**21-05 00 00**													
Equipment	21-05 10 00	11 - Equipment	23-21 00 00: Furnishings, Fixtures and Equipment Products			200	ARCH	300	ARCH	300	ARCH	300	ARCH	
Furnishings	21-05 20	12 - Furnishings				200	ARCH	300	ARCH	300	ARCH	300	ARCH	
Special Construction & Demo	**21-06 00 00**													
Special Construction	21-06 10	13 - Special Construction	N/A			200	ARCH	300	ARCH	300	ARCH	300	ARCH	
Facility Remediation	21-06 20 00	02 - Existing Conditions	N/A											
Demolition	21-06 30 00	02 - Existing Conditions	N/A	200	ARCH	300	ARCH	300	ARCH	300	ARCH	300	ARCH	
Sitework	**21-07 00 00**													
Site Preparations	21-07 10 00	02-Existing Conditions, 31-Earthwork	23-11 00 00: Site Products											
Site Improvements	21-07 20	32 - Exterior Improvements		100	CE	200	CE	300	CE	300	CE	300	CE	
Liquid and Gas Site Utilities	21-07 30	33 - Utilities	23-39 00 00: Utility & Transportation			200	CE	300	CE	300	CE	300	CE	
Electrical Site Improvements	21-07 40	26 - Electrical, 33 - Utilities	23-35 00 00 : Electrical and Lighting											
Site Communications	21-07 50	33 - Utilities				200	CE	300	CE	300	CE	300	CE	
Miscellaneous Site Construction	21-07 90	31 - Earthwork	N/A			200	CE	300	CE	300	CE	300	CE	

Notes:

1. The LOD and MCA values are rough assignments and are to be revised & confirmed by the Contractor per SFO contract requirements for a BIM Execution Plan.
2. The BIM use by phases are suggested values and are to be updated by Contractor per SFO contract requirements for a BIM Execution Plan.
3. The classification codes for OmniClass Table 22 (MasterFormat) are to be updated by Contractor to reflect project requirements.

OmniClass Table 21- Elements is based on the 2010 CSC/CSI UniFormat™

OmniClass Table 22 - Work Results is based in part on CSC/CSI MasterFormat™, 2011 Update

OmniClass Table 23 - Products, classifies products (materials, assemblies, and systems) intended for potential or actual use in any construction project. A single product will have a single location in this Table, whereas Table 22 - Work Results (or MasterFormat) may have more than one heading that references the same product in a number of locations, depending on its use within the facility.

Instructions:

1. Save As this document and review the fields. Note that this document currently shows the minimum requirements from SFO. Any changes must be called out and explained
2. Remove Lines of scope that are not applicable to your project
3. Expand the rows using the "+" signs on the left side of the chart. This will reveal the 3rd level of omniclass assets.
4. Enter the LOD for each phase as it applies to your project.
5. Highlight any LOD numbers that differ from the level 2 specification of that category.
6. Submit this specification as part of the review of your BIM Execution Plan.
7. Do not modify the graphic layout of this document. If necessary, you may make an additional MPS if required by your project team.

Level of Development (LOD) Definitions	
100	The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e., cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.
200	The Model Element is graphically represented within the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.
300	The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.
400	The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the Model Element.
500	The Model Element is a field verified representation in terms of size, shape, location, quantity, and orientation. Non-graphic information may also be attached to the Model Elements.

Model Content Author (MCA) Definitions	
ARCH	Architect
CE	Civil Engineer
ELEC	Electrical Engineer / Subcontractor
FIRE	Fire Protection Engineer / Subcontractor
LV	Low Voltage Engineer / Subcontractor
MECH	Mechanical Engineer / Subcontractor
PLUM	Plumbing Engineer / Subcontractor
SE	Structural Engineer / Subcontractor
SUB	Subcontractor

Note: In cells with two model content authors, the stakeholder highlighted in **bold** and underline is the primary model content author followed by the model content (data) supplier.
example: **ARCH**/SUB; Architect is the primary model content author and Subcontractor is the model data supplier

Refer 'Data View Definition' (Example) for minimum attributes required by phase and author