LACCD Building Information Modeling Standards

(LACCD BIMS)

Version 4.3

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May 29th, 2019

DISCLAIMER

THE INSTRUCTIONS, STANDARDS AND GUIDELINES CONTAINED IN THE LOS ANGELES COMMUNITY COLLEGE DISTRICT BUILDING INFORMATION MODELING STANDARDS (LACCD BIMS) ARE FOR USE BY CONSULTANTS AND CONTRACTORS RETAINED BY THE LOS ANGELES COMMUNITY COLLEGE DISTRICT FOR LOS ANGELES COMMUNITY COLLEGE DISTRICT PROJECTS AND MAY NOT BE SUITABLE IN THIS, OR ANY MODIFIED, FORM FOR USE ON ANY OTHER PROJECTS OR FOR ANY OTHER PURPOSES AND ANY SUCH USE OR MODIFICATION IS AT THE SOLE RISK OF THE USER.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Overview

In conjunction with its Sustainable Building Program, the Los Angeles Community College District (LACCD) is committed to utilizing the tools of Building Information Modeling (BIM) to execute the design, construction and management of its new High Performance buildings. The LACCD BIM Standards have been developed to define a process and establish requirements, procedures and protocol for the utilization of BIM in the various stages of our projects. These Standards are based upon the National Building Information Standards (NBIMS) and reference the current technology Standards developed by the General Services Administration (GSA), the US Army Corps of Engineers (USACE), and Industry Foundation Class (IFC) by the International Alliance for Interoperability (IAI), and OmniClass Construction Classification (OmniClass) as developed by the Construction Specifications Institute (CSI).

1.2. Main Objectives of LACCD Building Information Modeling Standards

It is the intent of LACCD BIM Standards to facilitate the use of BIM technologies and workflow to achieve the following goals:

1. Develop high performance buildings using sustainable design concepts.
2. Facilitate a collaborative project environment between all stakeholders from project inception to completion
3. Execute coordinated project documents using the 3D modeling and parametric features of BIM
4. Improve system coordination and the execution of design intent in the field to streamline construction processes and minimize change orders
5. Incorporate as-built BIMs, including infrastructure and building systems, in to District-wide Geographical Information System (GIS)
6. Collaborate with District-wide Facility Management to incorporate as-built information in to facility management tools and software
7. Establish a technology platform and provide continuous support to incorporate future technologies
8. Use BIM as Information and Communication tools for shared governance, students, facility directors and staff, and the community

1.3 Reference to other LACCD Standard Documents

The LACCD BIM Standards reference requirements and guidelines outlined in other LACCD Documents and should be read in conjunction with these documents which include:

a. LACCD CADD Standards 4.1
b. Sustainable Design Standards
c. Owner Project Requirements
d. DES-0002–B BIM360 Milestone Submittal Checklist
e. DES-0002-D BIM Asset Data for Design and As-Built Documentation - New Construction and Renovation
f. DES-0002-E Parameter ID Definitions for the BIM Asset Data Matrix DES-0002-D Spreadsheet
g. BIM-Specific Requirements and Matrices (Two-Page BEP Summary, Uses of BIM Matrix, Quality Control Strategy Matrix, Roles And Responsibilities Matrix)
h. LACCD Revit Template Files 2016 (for teams using Revit 2016) (see APPENDIX - Technical Footnotes & Diagrams, item e)
i. DES-0002-G Digital Archiving Checklist
j. DES-0002-H BIM Scope of Services Breakdown
k. DES-0002-I BIM Scope Cost Breakdown

2.0 BIM PROJECT REQUIREMENTS

2.1. Summary

Mandatory BIM Project requirements shall include the modeling, visualization, documentation and analytic processes of the building design, as shall assist in validating the scope and cost of the project.

The principal objective of using BIM is to improve the quality of design solutions and the exchange of information between the parties. This requires collaboration between the Design Build Entity, project management team, campus facilities teams, and LACCD.

2.2 Technology Platform and Software

LACCD accepts true 3D solid modeling, object oriented software applications that comply with current industry interoperability standards and are able to be used in a collaborative environment. The models and analyses shall be used in support of the decision making process for high performance building design.

All software platforms used for LACCD projects MUST be compliant with:

- Most current version of Industry Foundation Classes (IFC) file format
- Commercially available collaboration software that provides interoperability between the different software applications (e.g. NavisWorks or equal)

Approved BIM Software for LACCD Projects*:

Software	Available
Authoring – (Architecture, Structural)	Revit Architecture, Bentley BIM, ArchiCAD, Tekla or equal
Authoring - MEPF Equipment	Revit MEP, Bentley BIM, ArchiCAD, or equal
Authoring - MEPF Distributions	Revit MEP, AutoCAD MEP, Bentley BIM, CAD-Duct, CAD-Pipe, AutoSprink, PipeDesigner 3D or equal
Authoring - Civil	Bentley Inroads and Geopak, Autodesk Civil 3D
Coordination	NavisWorks Manage, Bentley Navigator Clash Resolution, Tekla BIMSight
4D Scheduling**	Synchro, Vico, NavisWorks Simulate, Primavera, MS Project, Bentley Navigator
Cost Estimate	Innovaya, Vico or equal
Energy Analysis	Green Building Studio, IESVE, Trace 700, eQuest and EnergyPro or equal
Specifications	E-Specs or equal
Model Checking Validation, IFC File Optimizer	Solibri or equal
Water Management	Bentley WaterGem

* Software other than those listed below may be used subject to the above compliance requirements and approval by LACCD Staff.
**Software should link a Primavera or MS Project schedule to model

- **MEPF Equipment** is defined as model objects used for building performance calculations, such as Title 24 Energy Regulation, and as required in sections 2.3.5 and 2.4.1.2. MEPF Equipment (including, but not limited to: Light Fixtures, Air Handling Units, Chillers, VAV boxes, Plumbing Fixtures, etc.) is required to be created by true 3D solid modeling, object oriented software applications, such as Revit MEP.

- **MEPF Distributions** is defined as the as-built fabrication runs of plumbing pipes, mechanical pipes, conduit, fire sprinklers and mechanical ducting created in fabrication models. This can be created by (true 3D solid modeling) object oriented software, such as Revit MEP, or by (object enabled 3D surface model) fabrication software, such as AutoCAD MEP, Autodesk CAD-Duct, AutoCAD Developer CAD-Pipe, AutoCAD Developer AutoSprink, Trimble PipeDesigner 3D, or equal.

2.3 Application of BIM

BIM output can be utilized in a variety of ways to provide stakeholders with a greater understanding of how a building is to be used, designed, and constructed. As such, the expectation shall be that the BIM shall serve as a virtual representation of the actual building where traditional 2D documentation (i.e. plans, elevations, sections, schedules, 3D perspectives, isometrics, and details) are extracted and fully coordinated with the concurrent model.

The various applications in which BIM shall be utilized for all LACCD BIM projects shall be as follows:

2.3.1 Pre-Design and Programming

For each campus, The District shall develop Programming Requirements which shall define space and adjacency requirements to be adhered for individual projects. These requirements shall be based upon the campus Education Master Plan and Facility Master Plan, and shall reference the Owner's Basis of Design and Sustainable Design Guideline Documents. As-Built Records of Existing Facilities, and, BIM /GIS mapping of campus shall be included in this documentation and provided to project teams for their use during the RFP phase. Where possible, all programming and as built data provided by the campus shall be in a format that is fully translatable to an IFC Compliant BIM Authoring Tool and shall be expected to be incorporated by the Design Build Entity in to their design processes for reference and verification purposes.

2.3.2 As-Built Asset Data

Teams should "begin with the end in mind" in relation to parameter metadata within model objects. As defined in sections 2.3.4, 2.3.5, 2.4.1.2, 2.4.1.4 and 2.4.7.2e, model objects must contain asset data encompassing three categories:

- **Description Metadata** – completed by 100%DD
- **Performance Metadata** – completed at 100%DD, Installation and Construction Substantial Completion
- **M&O Metadata -** completed at Installation or Construction Substantial Completion

The full list of the required Asset Data for each BIM object in a project can be found within the following spreadsheet:

- DES-0002-**D** BIM Asset Data for Design and As-Built Documentation - New Construction and Renovation

A full description of the specific metadata used by LACCD - including parameter naming, parameter units and parameter examples for the Asset Data defined in form DES-0002-D can be found in the following spreadsheet:

- DES-0002-**E** Parameter ID Definitions for the BIM Asset Data Matrix DES-0002-D Spreadsheet

It is suggested that the teams utilizing Revit organize and "code" the Asset Data using the objects' **keynote parameter**. It is also suggested that the teams utilize the Revit template file titled "LACCD Revit Template File V1" to organize model objects and schedule asset data using the template's pre-made Revit schedules. See APPENDIX - Technical Footnotes & Diagrams, item e for additional explanation and information.

2.3.2.1 COBie

Teams will be required to utilize the COBie data format for adding some of the description and performance metadata in the model objects as defined in DES-0002-D and DES-0002-E.

The Design Build Entity will be required to utilize the COBie data format for adding M&O metadata of MEPF equipment utilized by the LACCD Facilities Group as defined in DES-0002-D and DES-0002-E.

The Design-Build Entity will also be responsible for the export of the description, performance, and M&O metadata of MEPF equipment from the model to a COBie-compliant excel file.

2.3.3 Site Conditions - Existing Conditions and New Construction

For new construction and renovation projects, the modeling of the project site (excluding landscaping) and basic massing of adjacent existing structures is required. Depending upon the project site, a BIM site model of the site may be obtained from LACCD. If no existing site models are available, the Design-Build Entity shall develop this model as a part of the scope of work.

For renovation projects, the modeling of project buildings shall be performed based upon District provided as-built information, with field verification or electronic measurements conducted by Design Build Entity to validate the level of accuracy.

For all existing conditions to be directly impacted, altered, or to be demolished by a proposed renovation, the Team shall model those conditions to the appropriate level of detail that will clearly demonstrate the design intent to building stakeholders, other Project Team Members, and construction trades directly involved with executing this scope of work.

Proposed site conditions shall reference campus benchmarks, and reference existing surveys and GIS mapping systems for accuracy. New site and utility conditions shall be modeled in 3D, and shall coordinate system and spatial models three dimensionally. In cases where landscape features may directly impact utility and structural systems, those features (i.e. vegetation, irrigation) shall be modeled with accurate size and clearance zones.

2.3.4 Architectural Model - Spatial and Material Design Models

The Architectural Spatial model evolves during the design process, and the information modeled by the Design Team Entity in BIM shall be further refined as a project progresses toward construction. In the early phases of design, an Architectural BIM Model may be as simple as a massing model validating program requirements, basic geometries, building orientation to climate and site conditions, and adjacency to the surrounding building s for contextual impact.

As the design progresses, design solutions shall be clearly documented and delineated by the Design Build Entity in the building information model. Likewise, as materials and components are selected, generic assemblies shall be assigned material properties, sizes, track LEED values, and other specific component information to clearly define various building features such as walls, floors, roofs, doors and windows. Program space requirements shall be modeled in the spatial model and validated using schedules and other validation tools designated by the District for the specific project.

2.3.5 System Models - Structural and MEPF design

Each building system shall be organized as a separate model linked to a common origin point or campus benchmark for efficient and accurate coordination purposes. Similar to the spatial models, the level of detail in these models shall evolve as design progresses such that these systems are accurately modeled, and include sufficient quantity, location, performance, clearance, asset data, and LEED requirements as part of the BIM.

Design Build Entity representatives responsible for multiple systems may include those systems in a single file with each system clearly identified, as long as each system is able to be extracted independently for systems coordination.

For building performance calculations, systems must be further broken down in respect to their locations by the Design Build Entity - specifically individual rooms, spaces, or zones associated with a system or systems.

To do this, the architectural model and drawing sheets assign '**rooms**' for both schedule and areas. The mechanical, electrical and plumbing model assigns '**spaces**' to the corresponding room areas. The assigning of '**spaces**' creates a volume to track the location of equipment and fixtures.

In the case of a mechanical System (ex. defined by an Air Handing Unit), the associated mechanical equipment (to include VAV, reheat, and diffusers) are assigned to a System through metadata properties. Once a System is defined, the **Zone** defining elements (ex. VAV, sensors, and thermostats) are assigned to a specific **Zone** through metadata properties. Finally, mechanical equipment (ex. diffusers, return) which occupies a specific '**space'** coincides with the metadata properties that assign both **System** and **Zone**.

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2.3.6 5D Estimation / Model-based Quantity Take-off

Quantities shall be directly derivable from the model by LACCD at 50%DD and be represented in model schedules such that the following take off can be extracted:

- Square feet (rooms, GFA, walls, glazing, slab penetrations, etc)
- Linear feet (columns, walls, framing, etc)
- Counts (MEP equipment, air terminals, etc)

2.3.7 Energy Consumption Simulation and Life-Cycle Cost Analysis

All new construction needs to be designed in a way that energy and material use can be greatly reduced and then measured and verified by facilities management teams once it is occupied. As such, energy simulation shall be based upon information extracted directly from BIM technology and validated by energy modeling, whole building commissioning requirements and LEED Certification.

Exporting to gbXML – Design Build Entity shall utilize energy modeling and sustainable design software that extracts BIM data to gbXML format for analysis. Reference section 2.2 for approved BIM Authoring Tools.

2.3.8 Design Visualization

Design Visualization tools refer to animations, fly-throughs, static 3D renderings, 4D, and 3D Physical Models exported directly from a BIM Authoring Tool. Design-Build Teams shall provide a model which will support the creation of quality design that illustrate building spaces, their use and organization, to assist stakeholders in making decisions throughout the design duration.

2.4 Modeling Requirements

2.4.1 General

1. The BIM shall be used for all site and building systems design, development, and analysis, including but not limited to architectural, structural, mechanical, electrical, plumbing, and fire suppression.

2. BIM Technology shall be used by the Design Build Entity to develop and establish building performance, and the Basis of Design in accordance with Owner Project Requirements (OPR). The model shall be interoperable with analytic tools including but not limited to building envelope, orientation, daylighting, energy consumption, building management system (BMS), building automation systems (BAS), renewable energy strategies, life cycle cost analysis, and spatial requirements.

3. Use BIM authoring software element libraries when creating model objects. Model objects shall contain parts and components assigned to appropriate Families and Categories as opposed to simple 3D Geometry (i.e. walls, doors, windows, railings, stairs, furniture)

4. Model objects/elements shall contain object parameters and associated description and performance asset data (Description Metadata and Performance Metadata) applicable to building system requirements. These elements shall contain data at a level such to support the analytic process - including size, material, location, mounting heights, performance parameters and system information where applicable. As an example, a light fixture may contain parameters such as energy output requirements, user illumination levels, description, floor level, space name, bulb life, ID tag, etc. See Section 2.3.2 for additional asset data information and DES-0002-D for a full list of BIM asset data for design and as-built documentation.

5. Some model objects/elements shall also contain object parameters and associated asset data applicable to Maintenance and Operations by facilities (M&O Metadata). These elements shall contain data at a level to support the maintenance of facilities – including manufacturer, model number, installation date, warranty start and warranty duration. For example, a light fixture may contain parameters such as component name, make, manufacturer, model number, installation info, warranty info, replacement cost, etc. See Section 2.3.2 for additional asset data information and DES-0002-D for a full list of BIM asset data for design and as-built documentation.

6. The Native Authoring BIMs created in design shall be used as basis for the creation of As-Builts and creation of fabrication models generated by sub-contractors. Design Build Entity shall be required to provide Fabrication 3D Files as part of their Submittals.

7. The Design Build Entity team shall utilize model geometry and extract graphical information for generating construction administration documents from the Project BIM, i.e. RFI's, Directives, Bulletins, Change Orders. Construction team shall record as-built conditions in the 100% CD DSA-Approved Native-Authored BIM as a part of progress submissions and final delivery to LACCD.

8. LEVEL OF DEVELOPMENT

    i. BuildLACCD is following the BIM Forum Level of Development Specification
        1. Version 2018
        2. www.bimforum.org
    ii. Deliverables
        1. Design Phase Models
            a. **LOD 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.
            b. BIMForum interpretation: The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modeled information such as notes or dimension call-outs. The project origin is defined and the element is located accurately with respect to the project origin.
        2. Construction Phase Models
            a. **LOD 350** The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, location, orientation, and interfaces with other building systems. Non-graphic information may also be attached to the Model Element.
            b. BIMForum interpretation. Parts necessary for coordination of the element with nearby or attached elements are modeled. These parts will include such items as supports and connections. The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modeled information such as notes or dimension call-out
    iii. Reference the complete 2018 LOD Specification available for download via the bimform.org website.

2.4.2 Types of Model Elements

Model elements shall be derived from the following sources:

1. Manufacturer's Model Elements - elements created by and acquired from manufacturers. It is the author's responsibility to display the appropriate level of detail for the design element. Embedded performance data shall remain for analysis and specification purposes.

2. Custom Created Model Elements - model elements created by the model author must utilize appropriate BIM Authoring tool templates to create custom elements. Custom models components need to be assigned as a part and part of a family or group (no generic models).

3. District Provided Model Elements (District Standards) - model elements created by district appointed specialists, containing the minimum standards set forth in this document.

2.4.3 Model Geographical Location

Location of the project origin shall be defined and aligned for all models. Base models shall show the project origin and dimensionally tie its location to either a single common origin point or to a permanent campus monument.

Project Locations dimensionally tied to permanent campus monuments shall use the State Plane Coordinates System, California Zone 5, NAD 83, and NAVD 88.

Project North and True North shall be accurate and easily identifiable in all models and drawing deliverables.

For additional information, reference Technical Footnote 1 and the LACCD CAD Standard 3.0, Section 8.0. “Setting the Origin”[1]

2.4.4 Program Spatial Requirements

a) Spatial data should be generated by the Design Build Entity and associated with bounding elements (walls, doors, windows, floors, ceilings, slabs).
b) Space and Area schedule data must be dynamically updated from the model geometry.
c) Schedules must track both program square footage and actual square footage.
d) LACCD Spatial Requirements must be validated using BIM Technology.

e) Each space shall include the following spatial information:
   Space Type – Omniclass (Table 13)
   Space Number
   Space Name
   Space Description

2.4.5 Construction As-Built BIM and Record As-Built BIM

Construction As-Built BIM
The 100% CD DSA-Approved Native-Authored Design BIM must be updated continuously by the Design Build Entity throughout the construction phase to create the Construction As-Built BIM, and validated before closing up spaces (i.e. installing ceiling tiles). The Construction As-Built BIM must also incorporate all field changes - including, but not limited to: RFIs, Fabrication models, Revision Addenda, and CCDs for creation of the Record As-Built BIM. Both the Construction As-Built BIM and the Record As-Built BIM must be maintained in their native-authored file formats. See Technical Footnotes Item C for additional technical specifications.

Record As-Built BIM
At completion of construction, the Design Build Entity shall update field design changes via RFI's and change orders, and verify completeness and accuracy of Construction As-Built BIM relative to design intent, and progress of the schedule. This final submission by the Design Build Entity is the Record As-Built BIM. Any associated plans, elevations, details, shop drawings or other documents related to the Record As-Built BIM must also be updated as part of the Design Build Entity Record Documents deliverable. Both the Construction As-Built BIM and the Record As-Built BIM must be maintained in their native-authored file formats. See Technical Footnotes item C for additional technical specifications. See Technical Footnotes Item C for additional technical specifications.

1. Design Build Entity shall make the continuously updated native-authored As-Built BIM and make it available to BuildLACCD for review for the duration of construction. Payment for progress on Construction As-Built BIMs shall be based on model reviews on a monthly basis (unless specified differently in BIM Supplementary Conditions).
2. Within 30 days of Substantial completion, Design Build Entity shall submit the completed Construction As-Built BIM to the LACCD and Design Team for final review and approval. The Construction As-Built BIM shall include the following:
    a. As-built conditions relative to design intent and construction means and methods.
    b. Native-authored file formats and all associated and linked files for all:
        1. Authoring models generated by the Design Build Entity
        2. Fabrication models of MEPF System Distributions as defined in Section 2.2.2
    c. Fully assembled and coordinated master model
    d. Full description of how to reassemble the model and how to extract 2D documentation. Please include: file names, model links, software names and version numbers where applicable.
    e. As-Built models shall include object parameters (Description Metadata and Performance Metadata), and associated asset data applicable to Maintenance and Operations by facilities (M&O Metadata), as defined in Sections 2.3.2 and 2.4.1.5 and spreadsheets DES-0002-D and DES-0002-E.
    f. As-Built models shall include Space Names and Space Numbers (matching Room Names and Room Numbers) – to identify locations for equipment. Space Names and Space Numbers shall be created in individual models (such as M,

E, and P models) to identify locations of affiliated equipment as defined in spreadsheets DES-0002-D and DES-0002-E.

3. In addition to the components & elements that directly comprise the work, the Design Build Entity As-Built BIM must accurately identify modeled work related to the Design Build Entity BIM scope - including the following, but not limited to:
   a) Housekeeping & equipment pads
   b) Bracing, including earthquake & sway braces
   d) "No-fly" zones, using distinguishable solid objects in the model, for:
      i. Clearances required for access, installation, maintenance, codes, etc.
      ii. Elevator or other hoist way shafts
      iii. Other critical spaces as required
   e) Access panels

2.5 Drawing Requirements (CAD Files)

Drawing Requirements pertain to standards for output of models such as file naming, line work, font styles, title blocks, symbols, text styles, printing requirements, and other LACCD standard content.

In addition to these BIM Standards, all LACCD Projects shall refer to the LACCD CAD Standards 4.1 for drawing requirements.

2.6 Model and Electronic File Ownership

1. Construction VDC and Fabrication 3D Files shall become the property of District and transmitted along with the As-Built Drawings upon Final Completion.
2. Any electronic files provided by Architect or District on the Project may not be used wholly or in part for any purpose other than the preparation of Shop Drawings or construction coordination for the Project.
3. Copying or distribution of any electronic media file in whole or in part to parties other than a party to the Project is not allowed.

3 BIM PROCESS AND IMPLEMENTATION

3.1 General

The project BIM Implementation Plan, defined below in Section 3.2, is intended to be used as a guideline to incorporate BIM as an integral part of LACCD's design, construction and facilities management processes. These standards shall be considered Project BIM requirements for implementation of BIM processes. Any deviations to the guidelines outlined herein must be documented by the applicable Design Build Entity, and then reviewed and approved by LACCD in writing prior to commencement. As technology progresses, LACCD will work with Design Build Entity to update these requirements accordingly. Additional BIM requirements may be included in the Service Agreements, General Conditions, or Supplementary Conditions, at the discretion and approval of LACCD Program Manager.

3.2 BIM WORKFLOW PROCESS

3.2.1 BIM Workflow Summary

a. Design Phase

1. Resolution of Spatial Conflicts: During coordination meetings, the Design Build Entity will electronically identify, track and publish interference reports between all trades. All interferences will be resolved interactively by the Design Team facilitated with the use of coordination software.
2. Prior to each scheduled coordination meeting, an updated clash report will be issued by Project Team BIM Facilitator to track the progress of coordination, analyze conflicts and help facilitate issue resolution prior to construction.
3. Spatial models are to be clash minimized in preparation for the construction coordination phase.
4. Building Performance and Energy Modeling – Design Build Entity shall regularly update energy models using BIM Data as reference. Information generated from Design Energy models shall be integrated into design models as appropriate to achieve building performance and energy efficiency goals of the project.

b. Construction Phase

1. Design Build Entity shall be required to participate in regular coordination meetings with all other parties participating in the BIM efforts to review conflicts and clash reports, and to jointly develop solutions for spatial conflicts. Design Build Entity shall include the CPT/PMO team at coordination meetings, as needed or at the request of the CPT/PMO team.
2. Construction Trades noted in Section 3.2.4.c shall generate fabrication models using Design BIMs that have been issued for construction.
3. Design Build Entity shall provide accurate Fabrication 3D Files in advance of the scheduled dates for fabrication and installation to allow for simultaneous coordination & analysis of all building systems.
4. The Design Build Entity's Fabrication models shall be coordinated with the design BIM that is based on DSA approved design. Prior to fabrication and construction the Design Build Entity shall report any potential discrepancies to the design model to Design Team in the form of a RFI. Clash reports may also be issued by the Contractor as background information for RFIs and submittals.
5. As part of the requirement for as-built deliverables, the Design Build Entity shall continually update the Construction BIMs with as-built conditions, including changes to MEPF systems. Concurrently, Design Build Entity shall update Design Record BIMs based on documented design changes in the field.

3.2.2 Design Build Entity Collaboration Procedures

The success of a BIM enabled project delivery process is highly dependent upon the level at which the entire project team can communicate and work collaboratively for the duration of the project. This section documents the recommended collaboration procedures for effectively managing this process.

a. Coordinated Insertion Point – Prior to the start of design in BIMs, Design Build Entity's BIM Facilitator shall work with project teams to establish a geospatially coordinated insertion point for all disciplines to begin their models. ***See Section 2.4.5 of BIMS and Section 8.0 of CAD Standards for additional information on how to establish insertion points.***

b. Points of Reference– The Design Build Entity's BIM facilitator will provide a 3D grid for incorporation into the spatial coordination model. This will provide the viewer with a quick point of reference when navigating through the model. If room information is easily translatable to the coordination model, this should also be incorporated.

c. Project BIM Kickoff and Standards Orientation – Upon award of a project, LACCD shall facilitate a Design BIM Standards Kickoff Orientation with the Design Team to review the following:

1. LACCD BIM Standards and Workflow process
2. Statement of Owner's Project Requirements
3. All data developed during the project validation phase
4. Asset Data requirements

BIM Standards will also be reviewed with selected Design Build Entity prior to the start of construction as part of the Construction BIM Standards Kickoff.

d. Third party involvement – The Design Build Entity is encouraged to seek involvement of selected third parties, such as DSA reviewers, local utility companies and other stakeholders that may benefit from a visual review of the coordination model.

3.2.3 3D-Models, Formats and Model Structures of Coordination Models

The 3D models shall consist of 3D objects and solids (not lines or wire frames) that closely represent the actual dimensions of the building elements and the equipment that will be installed on the project. In the Design Model, reasonable abstractions can be made (i.e. pipe fittings do not need to be modeled), and shall be coordinated with the Builder to ensure meaningful coordination and clash detection.

Before coordination modeling begins, the construction BIM Facilitator will work with team to develop a structure and features of the files that are to be submitted (Documents: File Structure, Modeling Scope Matrix). Typically, BIM Coordination requires the following model structure and features:

1. Design Build Entity shall follow LACCD File Naming requirements as documented in Section 2.6.4.6
2. For buildings with a larger footprint or multiple floors, team may wish to create a single coordination. One file for each floor (or zone) of one floor and trade (e.g. 4 floors, 2 wings per floor, and 5 trades => 40 files)
3. For trades, the 3D representations of each floor may be relative to a 0'-0" FFEL as long as all trades agree on the same protocol. The BIM facilitator will adjust the elevations of the architectural and structural elements to 0'0".
4. All other trades will be modeled at the correct elevation (not all floors modeled at the same elevation).
5. All elements of the building must be represented in only one file and should be modeled by their specific trade. For example, the Architectural model provided for 3D coordination should not include any of the structural elements contained in the structural model. Lights should be modeled by the electrical engineer, not the architect.
6. The Architectural ceilings should contain openings for lights, registers, fire sprinkler heads, smoke detectors, exit signs, etc. as required.
7. All models should include separate 3D representations of required clearances and/or access requirements for equipment access, light clearances, overhead cable tray access, etc. These clearance/access models should be in a separate layer(s) for each trade clearly labeled as such.
8. The granularity of elements in the model has to correspond with the sequence of the installation at the site (e.g. not one wall element for the entire floor).
9. All 3D model files submitted for clash detection must be "clean" – with any extraneous 2D references and/or 3d elements stripped from the models.
10. Once a conflict or discrepancy has been sufficiently resolved, the BIM Facilitator will update all related models, model views, and clash reports to reflect these changes. Design Build Entity may be required to implement revisions / solutions in a revised model and re-submit.
11. When emailing notification of file uploads or for any other email correspondence pertaining to this project, all email subject line headings must be prefaced with the acronym for the Project Name.
12. For ease of identification during the 3D Coordination process, the following trades will be represented in these assigned colors:

Trade colors for Coordination Software

- **Fire Protection: red** - RGB: 255, 0, 0
- **Plumbing: magenta** - RGB: 255, 0, 255
- **HVAC Duct: blue** - RGB: 0, 0, 255
- **HVAC Pipe: lime green** - RGB: 0, 255, 0
- **Electrical: cyan** - RGB: 0, 255, 255
- **Pneumatic Tube: dark green** - RGB: 0, 76, 0
- **Concrete: gray** - RGB: 128, 128, 128
- **Structural Steel: maroon** - RGB: 127, 0, 0
- **Architectural: white** - RGB: 255, 255, 255
- **Security: pink** - RGB: 255, 127, 255
- **AV: orange** - RGB: 255, 62, 0
- **Low Voltage: brown** - RGB: 127, 63, 0
- **Fire Alarm: purple** - RGB: 102, 0, 204
- **Specialty: User Defined** (provide RGB settings for approval)

** Additional trades or systems that may be required shall be identified in the BIM Execution Plan(s) and designated a color to be used for coordination for the duration of the project.*

3.2.4 Collaboration in the Installation Planning Process

During shop drawing preparation phase. To optimize field installation, the BIM Facilitator will coordinate with affected trade sub-contractors to coordinate locations for proposed installation of systems within the coordinated spatial model. Subcontractors will be expected to have individuals attend who can actively engage in the planning process, and be capable of addressing and resolving conflicts and the cost/schedule implications they may have.

Prior to installation, the BIM Facilitator will conduct installation meetings with affected trade sub-contractors using the coordinated spatial model.

Design Build Entity shall be required to participate in regular coordination meetings with all other parties participating in the BIM efforts to review conflicts and clash reports, and to jointly develop solutions for spatial conflicts. Contractor shall include the CPT/PMO team at coordination meetings, as needed or at the request of the CPT/PMO team. Necessary rerouting shall be agreed to by the CPT/PMO team and the Design Build Entity.

3.2.5 Digital Fabrication

Digital Fabrication allows for more accurate and efficient installation in the field, but requires a more collaborative effort between Design Build Entity, and tradesmen to ensure that the deep knowledge and associated efficiencies of the fabricator are embedded into the construction model. See Section 2.2.1 and 2.2.2 for additional fabrication definition.

As part of the Design Build Entity's submittal for each, the following construction trades shall provide 3D fabrication models with 3D model objects:

1. Mechanical System Ducting
2. Plumbing Systems and Piping (excluding Plumbing Fixtures)
3. Electrical Conduits
4. Curtain Wall systems
5. Building Envelope Systems (i.e. rain screens, pre-cast panels)
6. Casework and furniture systems (furniture vendor models must be used when available)
7. Fire Sprinklers (excluding FP equipment)
8. Any additional fabrication models generated by subcontractor

3.2.6 Coordination of entire building

The BIM Facilitator will assemble a composite model from all of the model parts of each design discipline for the purpose of performing a visual check of the building design for spatial and system coordination.

Vertical shafts should also be reviewed to ensure that adequate space has been allocated for all of the vertical mechanical systems and that all of the shafts line up floor to floor.

3.2.7 Clash detection and reporting

1. Coordination software will be used for assembling the various design models and for providing a report and view list of design coordination issues. The Design Build Entity, including BIM Facilitator and Discipline BIM Lead Modelers, will review the model and the Clash Reports in coordination meetings on a regular (weekly) basis.
2. The report will be reviewed by the team members and agreed upon solutions will be implemented per an agreed upon schedule. This process will be repeated throughout the design phases until all spatial and system coordination issues have been resolved.
3. During the construction phase, the Design Build Entity shall utilize the fully coordinated and consolidated design BIM to verify the accuracy of certain fabrication models (ref. Sec 3.2.7). Prior to each fabrication submittal for approval, fabrication contractors shall submit their models to the BIM facilitator for integration with the Design Model.
4. Internal Clash Resolution – Design Build Entity representatives who are responsible for multiple scopes of work are expected to coordinate the clashes between those scopes ***prior*** to providing those model to the VDC Manager for spatial and system coordination.

3.3 Project BIM Work Plan (BIM Execution Plan)

Design Build Entity shall be required to submit to LACCD for approval, a Design / Construction BIM Execution Plan. The BIM Execution Plan (BEP) is the Design Build Entity's strategy for using Building Information Modeling to execute project deliverables. The team will also outline how they will complete all meetings, milestones, model reviews, and all other procedures outlined in the BIM Standards.

The BIM Execution Plan shall be provided, for review and approval by District, within 30 days of award of contract.

The “BIM Execution Plan” shall contain the following:

3.3.1 Preliminary BIM Execution Plan – already completed as part of the proposal (see form “BIM-Specific Proposal Requirements and BIM Matrices”) This includes:

1. Two-page written narrative describing approach to BIM Execution Plan
2. Description of uses of BIM on project
3. BIM Quality Control: responsible parties and software to be used
4. BIM Trades breakdown: responsible parties and software to be used

3.3.2 Detailed BIM Execution Plan – outlining the Design Build Entity’s BIM strategy. This includes:

1. Proposed strategy for utilizing BIM during design
    a. Strategy for updating and coordinating design changes during construction using BIM
    b. Work flow and software to analyze and verify energy and sustainable strategies
2. Proposed strategy for utilizing BIM during construction including:
    a. Proposed use of digital fabrication to validate constructability of design
    b. Updating as-built conditions and integrating of Record information in to Record BIM
3. Proposed BIM Software to be used
4. File formats to be used for project submittal and file exchange
5. File exchange protocol
6. Strategy for establishing and managing shared file server (ref. 3.2.2.a)
7. Design Build Entity’s representatives qualifications and experience in BIM, and a list of individuals with relevant experience assigned to the following roles:
    a. Virtual Design and Construction Manager (ref. Section 3.4.1)
    b. Lead BIM Technicians for all major trades (i.e. Architect, Civil, MEP, Structural)
    d. BIM Managers for all applicable trades
    e. Lead Fabrication Modelers for trades noted in section 3.2.4.
8. Project Schedule including the following:
    a. Progress BIMs per Design Document Submission Standards
    b. Proposed BIM Workshops and Training integrated in to project schedule
    c. Documentation of any proposed deviation from BIM Standards for LACCD consideration
    d. Roles and Responsibilities Matrix including all major design and construction disciplines.

Figure 2 – Sample of Project BIM Work Flow Diagram

3.4 BIM Roles and Responsibilities

It is the responsibility of all Design Build Entity representatives to have or obtain, at their cost, the trained personnel, hardware, and software needed to successfully complete the BIM scope for the project. Equipment used by the subcontractors during the on-site coordination meetings must meet the requirements of the software being implemented so as not to cause delays in modeling and redraw. Individuals assigned to the following project roles shall have the minimum qualifications and responsibilities outlined below.

3.4.1 Design Build Entity's BIM Facilitator

As part of the execution of the Design BIM Work Plan, Design Build Entity shall assign an individual to the role of BIM Facilitator. The individual shall have at least 3 years of BIM experience and shall have relevant proficiency in proposed BIM Authoring and Coordination Software. This individual and their qualifications shall be approved by LACCD and shall serve as the main point of contact with LACCD and the Project Team for BIM related issues. Assigned responsibilities shall be as follows:

1. Ensure compliance with Design BIM Work Plan
2. Coordinate Project-wide training sessions with LACCD BIM Coordinator
3. Coordinates software training and establishes protocol for efficient use of software
4. Coordinate set up of shared file server with LACCD and Design Build Entity IT staff.
5. Assembles consolidated composite design model for coordination meetings
6. Provide Modeling Quality Control / Quality Assurance Check of Design BIMs.
7. Facilitates use of consolidated composite design model in design coordination meetings
8. Ensures that BIMs are used appropriately to test design requirements / criteria
9. Interfaces with Design Build Entity BIM and IT representatives to ensure software is installed and operating properly
10. Interfaces with software developers to provide feedback and bug reports
11. Facilitates BIM Technical meetings with Lead BIM Technicians
12. Ensure Design Build Entity understands, supports, and meets LACCD Vision and Main Objectives for BIM **(ref. Section 1.2)**
13. Ensure the shared origin and geo-reference points noted in Section 2.4.5 are distributed and used by ALL team members.
14. Prior to and during Construction, interface with Design Build Team and/or Campus IT to establish and maintain shared portal access and permissions
15. Prior to commencing construction, ensures Sequencing and Scheduling is integrated with Construction As-Built BIM
16. Ensures design changes in the field have been documented and are updated in the Design Teams' Record Native As-Built BIM in a timely manner
17. Prior to approval and installation, work with Lead Fabrication Modelers to integrate 3D fabrication models with updated design composite model to ensure compliance with design intent
18. Coordinates update of as-built conditions in the Construction As-Built BIM
19. Ensures the record documentation noted in Document Submission Process and Standards is properly linked to Record As-Built BIM for final submittal to LACCD
20. Coordinates software training and establishes protocol for efficient use of software for Construction Team

21. Ensures Construction Team has necessary hardware and BIM Software properly installed and accessible on site, for project use prior to the start of pre-construction activities.

3.4.2 BIM360

1. Milestone submittals shall be uploaded to BIM360 for review and acceptance by BuildLACCD.
2. Any deficiencies with the BIM submittals will be noted in a review provided by BuildLACCD, uploaded to BIM360 and made available to the Design Build Entity.
3. Milestone submittal schedule and required uploads are outlined in Form DES-0002-B.

4. QUALITY ASSURANCE AND VALIDATION

4.1. INTRODUCTION

The purpose of the Quality Assurance and Validation process is to ensure the Design Build Entity is using Best Practices in the development and file exchange of building information models. Quality Assurance is an ongoing process to be conducted by the Design Build Entity and validated by the College Project Manager at both project milestones and random intervals of the project to ensure that each BIM is being constructed in conformance with LACCD BIM Standards and is suitably modeled for its intended use. The goal is to detect and correct, any errors and deficiencies in the models early in the process such that these discrepancies to not result in unresolved issues during construction or any significant loss of data upon transfer of as-built models and record documents to the District for Operations and Maintenance use.

4.2. QUALITY ASSURANCE CHECKLISTS

LACCD has developed a series of checklists to assist project teams and College Project Managers with the quality assurance and validation of project building information models.

During Design, it shall be the Design-Build Entity's responsibility to submit completed copies of the **DES-0002 –B** at each project milestone in conjunction with project deliverables. **DES-0002 –B** is a Report deliverable based upon the BIM Quality Assurance and Validation Checklist.

During Construction, the **DES-0002 –B** and BIM Standards Validation Report will be maintained and updated and submitted to LACCD in concert with Construction update submission checks. It shall be the responsibility of the College Project Team to validate the overall completeness of the submission. The College Project Team and LACCD Program Management Office shall work together to validate the quality of the models submitted to ensure they are in compliance with Best Practices and LACCD BIM Standards referenced on the completed DES-0002 –B checklists as follows:

1. Develop and maintain a detailed BIM Work Plan for LACCD approval prior to Notice to Proceed
2. Verification and updates of assigned roles and responsibilities as documented in RFP and maintained throughout Design and Construction Process
3. BIM Quality Assurance and Validation Checklist - The BIM Quality Assurance and Validation Checklist is a step-by-step checklist to ensure Projects are conforming to LACCD BIM Standards and use best practices in the development and exchange of building information models. The checklist references specific sections of the LACCD BIMS, and shall be used as a tool to understand the requirements of the models at each project milestone.

For each trade, the trade's Lead BIM Technician shall coordinate with the BIM Facilitator to verify their respective section of the checklist at each project milestone. Any major discrepancies or conflicts should be resolved prior to submission to LACCD.

4.3 Model Based Reviews

At each project milestone defined in the Document Submission Standards, the Design Team shall prepare and make available to LACCD a coordinated model to be used for model based reviews. During Design Development, Project Teams may be asked to utilize perspective and walkthrough capabilities of the model with user groups, Facilities Directors, and other campus stakeholders to track design issues visible in the model.

Prior to submittal to DSA Submittal, Project Teams may be asked to schedule a virtual building walkthrough with CPTs, Facilities Managers, and LACCD BIM Technical Staff using the coordinated design model to demonstrate design, coordination, and equipment access issues have been fully resolved and meet Owner Program Requirements and Basis of Design.

4.4 LASER Scanning QAQC

1. BuildLACCD reserves the right to LASER scan the project site during any phase.
2. LASER scans will be used to confirm accuracy of AS-Built BIM models.
3. Tolerances will be expected to be as required or within code allowance for each component.
4. Discrepancies will be noted in feedback provided in BIM360 BIM submittals.

Glossary of Terms

AEC- abbreviation for Architecture, Engineering, and Construction

Building Information Modeling (BIM) model- A Building Information Model (BIM) is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward.

BuildingSMART Alliance- Organization established to coordinate the profound constructive changes coming to the fragmented real property industry in North America. The organization's collective goal is to establish open interoperability and full lifecycle implementation of building information models

Charrette - An intensive process that involves the collaboration of all project stakeholders at the beginning of a project to develop a comprehensive plan or design.

Component - In Triforma, components are materials that make up a part. For instance, a base plate part may consist of grout and steel plate components. A single component may be tied to many different parts. In Revit, components refer to model objects. Component data can be used for quantity take-offs, specification sections based on CSI format and even cost data.

CPT - College Project Team

Deliverable - A Deliverable is the product of engineering and design efforts. Typically, this would be the concept submittal and the corrected final design. A deliverable may have multiple phases.

Design Build Entity – As defined per California Education Code section 81700

Digital Data - Digital Data is defined as information, communications, drawings, or designs created or stored for the Project in digital form.

DSA - Division of State Architect

FF&E - Furniture, Fixtures and Equipment

G.I.S. - Geographic Information System- integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

GSA- General Services Administration

Industry Foundation Class (IFC) - IFCs are data elements that represent the parts of buildings, or elements of the process, and contain the relevant information about those parts. IFCs are used by computer applications to assemble a computer-readable model of the facility that contains all the information of the parts and their relationships to be shared among project participants. The project model constitutes an object-oriented database of the information shared among project participants and continues to grow as

the project goes through design, construction, and operation. The International Alliance for Interoperability (IAI) has created this IFC data exchange format.

IAI - International Alliance for Interoperability software companies, building product manufacturers, information publishers, owners, designers, and builders—in AEC and other industries whose goal is to develop a universal standard for information sharing .

Interoperability - refers to the exchange of information among project participants throughout the lifecycle of a facility by direct communication between software applications.

IPD - Integrated Project Delivery

LACCD - Los Angeles Community College District

Library - a repository tool for organization, location, and managing of BIM content

LOD - Level of Detail as it pertains to BIM

MEP – Mechanical; Electrical; Plumbing

MEPF - Mechanical; Electrical; Plumbing; Fire (Protection/Suppression)

Model File - pertains to any building information model where spatial or data information is stored

NBIMS - National Building Information Model Standard

OmniClass Classification System - otherwise known as OmniClass or OCCS, is an enterprise strategy for classifying the entire built environment. It is a multi-table classification system designed for use by the capital facilities industry.

Phase - A portion of work that arises from sequencing work in accordance with a predetermined portion of a Stage.

SDSFIE - Spatial **D**ata **S**tandards for **F**acilities, **I**nfrastructure, and **E**nvironment- developed for facilities, infrastructure, environment, and civil works by the SDSFIE Steering Group, which is comprised of members from the Armed Forces and the U.S. Army Corps of Engineers

Sheet File - A sheet file is a CAD file or Model that shows a selected view or portion of a Model File within a referenced border sheet. Sheet Files are used to generate the plotted construction sheets.

APPENDIX - Technical Footnotes & Diagrams

a. Finding the Revit Origin

Finding the Revit Origin and Guidelines for Sharing Coordinates of an existing site file in Autodesk Revit

Revit does have an origin but it is hidden by default.

LACCD can provide Campus Survey Civil CAD files to the teams. The files contain the Campus property line, as well as survey points representing Campus Monuments.

The survey's specific coordinate points should be linked "Origin to Origin" to the main Architecture Revit file.
To do this:

- Link the Civil CAD file provided by LACCD into the Architecture Revit file.
- In the Architecture Revit file, unclip the Project Base point and the Survey Point.
- Move the Survey Point in the Architecture Revit file to match Survey Point located in the linked Civil file.
- Set the Building Project Base point to 0,0,0
- Pin both points (survey point and Project Base point) into the Architecture Revit file, and always use the command "Collaboration" to monitor the survey point located in the Civil file.
- When setting the project base point (once a few walls are in place), make sure to modify the True North view

b. Not used

b. Suggested File Setup - for Construction As-Built and Record As-Built BIM Submissions

For As-Built submissions, LACCD recommends creating 2 separate Revit files for the Architectural Model, and possibly (depending on size and complexity of the project) creating 2 separate Revit files for each of the Trade's files:

- **BIM Asset file**: Contains the true solid 3D model and all M&O Asset data
- **BIM Plot file**: Contains all annotations, Dims, general notes, detailed views and title sheets. Is used as a tool to plot sheets and create Construction documents and deliverables.

These files can be built off of the template files defined in: APPENDIX - Technical Footnotes & Diagrams, **item e**:

- The **BIM Asset file** should be created from the "LACCD_ASSET" template
- The **BIM Plot file** should be created from "LACCD_PLOT" template

The benefits of working with two files (BIM Asset & BIM Plot) file vs. one single file:

- Reduced file size of Revit files
- Reduction of work sets
- More flexibility to have more than one BIM user to produce documents
- Clean, light, user-friendly files that include only the true model(s) while all information
- Sheets and notes are not interfering with the constructability of the model

c. LACCD Revit template files

LACCD provides two Revit project template files for teams:

- **LACCD_PLOT**: This template file includes all LACCD Annotation Standards, Dim Styles, Fonts, Legends, Object Style, Title Blocks, Tags and all other Aesthetical Standards. Use of this template ensures functionality and aesthetical consistency among all projects and campuses.

- **LACCD_ASSET**: This template file ensures consistency in Family Parameters to satisfy Metadata requirements per LACCD BIM Standards and Form DES-0002D: "BIM Asset Data for Design and As-Built Documentation ".Use of this template helps teams to more easily define the Asset Data which is required for model objects. It also contains more than 60 schedules linked to those model objects – to help teams (and reviewers) more easily identify if asset data is in compliance or is missing within their model.

The LACCD Revit template files are available at any time during the design or construction of the project, but it is suggested that the teams use the templates early in design. The LACCD_ASSET template will also greatly aid in the verification of the tagging of model objects (using the keynote parameter). A list of the keynotes associated with each model object is found in form “DES-0002-D BIM Asset Data for Design and As-Built Documentation - New Construction and Renovation”.

The Template files

- **LACCD Revit Template Files R16** (for teams using Revit 2016)

As noted in APPENDIX - Technical Footnotes & Diagrams, **item c**: a BIM Asset file should be created from the “LACCD_ASSET” template and a BIM Plot file should be created from “LACCD_PLOT“ template.