LACCD Building Information Modeling Standards

(LACCD BIMS)

Interim Version 2.0

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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, and the upgrade of its existing facilities and infrastructure to achieve a carbon neutral footprint for its nine campuses. The LACCD BIM Standards for Design-Build Projects have been developed to define a process and establish requirements, procedures and protocol for the utilization of BIM in the various stages of our design-build 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), 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 to achieve a net zero energy use for our buildings
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. Utilize 4D Technology and Process to better manage transition from design to construction and virtually simulate construction processes with various trades to avoid conflicts in the field
6. Utilize 5D technology and processes to develop building life cycle costs projections, and more accurate project cost estimates
7. Incorporate as-built BIMs, including infrastructure and building systems, in to District-wide Geographical Information System (GIS)
8. Collaborate with District-wide Facility Management to incorporate as-built information in to facility management tools and software
9. Incorporate submission of the BIM as a requirement for Division of the State Architect (DSA) electronic review and approval
10. Utilize real life projects and current BIM technology as tools and case studies to establish education curriculum, and prepare students for the current job market
11. Establish a technology platform and provide continuous support to incorporate future technologies
12. Use BIM as Information and Communication tools for shared governance, students, facility managers and staff, 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 CAD Standards 3.0
b. Sustainable Design Standards
c. Owner Project Requirements

2. 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 incorporating BIM is to improve the quality of design solutions and the exchange of information between the parties. This requires cooperation between the design build team, project management 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 – Design (Architecture, Structural)	Revit Architecture, Bentley BIM, ArchiCAD, Tekla or equal
Authoring - MEPF (design & construction)	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 (spatial conflict, clash detection)	NavisWorks Manage or Bentley Navigator
4D Scheduling	Synchro, Vico, NavisWorks Simulate, Primavera, MS Project , Bentley Navigator
Cost Estimate	Innovaya, Vico or equal
Energy Analysis	Green Building Studio, IES, Ecotect, Hevacomp, TAS, 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.

Traditional 2D documentation shall be prepared with approved IFC Compliant BIM Authoring Software and, as such, the expectation shall be that plans, elevations, sections, schedules, and details are fully coordinated with the concurrent building model. All other documents are to be submitted per the contract requirements of the District.

2.3 Applications of BIM

BIM output can be utilized in a variety of ways to provide stakeholders with a greater understand of how a building is to be used, designed, and constructed. 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 Teams in to their design processes for reference and verification purposes.

2.3.2 RFP Competition (Design-Build Projects only)

As a major component of the RFP competition phase of each project, all competing project teams shall participate in a BIM Charette where teams will be asked to incorporate District provided As-Built Information, Programming Requirements, and Sustainable Design Guidelines, in to a conceptual design model. Final competition submittals shall be executed in an IFC Compliant BIM Authoring tool with deliverables as defined by the District prior to the competition phase. Examples of these deleiverables may include massing studies, design visualization renderings, 3D models, and preliminary building performance and cost estimating analysis.

- Programming shall become the basis of massing diagrams in BIM, and shall be validated by an approved format pre-determined by the District.
- As-Built Documentation shall be referenced and modeled using BIM and GIS oriented mapping to establish proper orientation and location for the building

2.3.3 Site Conditions - Existing Conditions and New Construction

For new construction and renovation projects, the modeling of the project site and the existing structures, shall be included in the BIM requirements. Depending upon the project site, a model of the site may be obtained from the LACCD Vault or commissioned by an external consultant using an approved IFC Compliant, 3D Site and Utility Modeling BIM tool.

For all projects, the modeling of existing buildings shall be performed based upon Disctrict provided as-built information, with field verification or electronic measurements conducted by Project team to validate the level of accuracy.

For all existing conditions to be directly impacted, altered, or to be demolished by a proposed renovation, Project Designers 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 change.

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. Where other systems are directly impacted by landscape features (i.e. vegetation, irrigation), those elements shall be modeled with correct size and clearance requirements in BIM.

2.3.4 Architectural Model - Spatial and Material Design Models

The Architectural Spatial model evolves during the design process, and the information modeled 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, and building orientation to climate and site conditions.

As the design progresses, design options shall develop and need to be clearly documented and delineated in the BIM 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

With current technology, building systems are best organized as separate BIM models linked to a common 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 performance, clearance, and LEED requirements as part of the BIM.

2.3.6 Cost estimation (Design-Bid-Build Projects Only)

Cost estimation shall be prepared from the Project Team's BIM Process

2.3.7 4D Scheduling and Sequencing

The construction planning process mandates the sequencing of activities in space and time and accounting for constraints such as procurement lead time/logistics, resources, spatial constraints, and weather among others.

Traditional scheduling methods do not address the spatial aspect to the construction activities nor are they directly linked to a design or building model. Traditional bar charts or Critical Path Method Network Diagram can be difficult to understand or interpret. Having the ability to watch the elements of a design come together onscreen gives the design and construction team improved accuracy in construction sequencing.

The primary elements LACCD requires for 4D simulation and sequencing shall be as follows:

Structural system	All structural framing components including foundations, grade beams, columns, load bearing walls, floor and roof decks and support
Exterior building envelope	Stud walls, Exterior Panels and assemblies, curtain walls, openings, glazing
Interior partitions	Main plumbing walls and wall assemblies
Mechanical system	Main Ductwork and Equipment, (Separated by floors)
Roof systems	Roof Assemblies, Major Equipment, Openings
Site work and ground plane	Excavation work, footings, foundations, on-grade Slab
Plumbing	Main Connection lines from site, main plumbing lines

The optimal process in 4D scheduling is to import schedule activity data from a scheduling application such as Primavera P3/P6 into a dedicated 4D scheduling application and “link” the activity data to the associated object in a 3D model. The result is a 4D model which provides a value advantage to the Design-Build Team for better visualization and coordination of the construction sequence for respective trades. Design-Builder shall link BIM to the approved construction schedule.

2.3.8 5D Estimation

LACCD will not require BIM based 5D Estimation at this time. We will address this requirement in later versions of this Standard as technology progresses.

2.3.9 Energy Consumption Simulation and Life-Cycle Cost Analysis

In order to achieve net zero energy goals for its campuses, all new construction shall need to be designed in a way that energy and material use can be greatly reduced and then measured and verified by a building’s users and facilities management teams once it is occupied. As such, energy simulation and life-cycle cost calculations 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 - Project teams 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.

2.3.10 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 team shall participate in providing the quality design visualizations that illustrate building spaces, their use and organization, to assist stakeholders in making decisions throughout the project duration.

It should be noted that even though the BIMs contain most of the source information needed for visualization, they may require further refinement in specific animation and visualization software to accomplish intended results.

2.4 Modeling Requirements

2.4.1 General

a. 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, etc.

b. During SD and DD Phases, BIM Technology shall be used to develop and establish building performance, and the Basis of Design in accordance with Owner Project Requirements (OPR). This 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.

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

d. Model objects shall contain IFC parameters and associated data applicable to building system requirements. These elements shall support the analytic process include size, material, location, mounting heights, and system information where applicable. As an example, a light fixture may contain several parameters such as energy output requirements, user illumination levels, make, model, manufacturer, bulb life

e. Sustainable design principles and LEED Credit Documentation shall be included in the BIM to analyze, document, and verify project LEED Certification Goals.,

f. Design-Builder 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.

g. DSA submittal drawings, calculations and analysis shall be extracted from the Project BIM.

2.4.2 Types of Model Elements

Model elements shall be derived from the following sources:

a. 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.

b. 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.

c. 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-based Quantity Take-off

LACCD will not require model based quantity take offs at this time. We will address this requirement in later versions of this Standard as technology progresses.

2.4.4 Specifications

LACCD will not require direct model linkage to specifications at this time. We will address this requirement in later versions of this Standard as technology progresses.

2.4.5 Model Geographical Location

All projects will be set to permanent campus monuments using State Plane Coordinates System, California Zone 5, NAD 83, and NAVD 88. For additional information, **reference CAD Standard 3.0, Section 8.0. "Setting the Origin".**

Revit Users: *Revit does have an origin but it is hidden.*

Revit's internal calculations do not like very large coordinate numbers. Thus, it is important to keep your Revit project near Revit's origin. (near means within 1 mile/1.6km) Revit's origin is near the center of the space made by the elevation symbols in the default template.

In the LACCD Template, we have located the origin in Revit relative to a 0,0,0 coordinate from AutoCAD and have crossed two pinned reference lines through its intersection. This should serve as the starting point for your first building. To check this intersection in Revit, go to ***Tools→Shared Coordinates→Report Shared Coordinates*** *and click on each* **reference plane.** *The horizontal reference planes should indicate a 0'0" location in the N/S direction, and the vertical a 0' 0" location in the E/W direction.*

The Rules for Sharing Coordinates of an existing site file in REvit
(source AUGI and Autodesk Revit Factory)

- ***Always*** *build your building near the starting point of the default template.*

- *Model it with Project North pointing directly up. (lay it out as you would have it appear on sheets)*
- *If you are using a dwg based site, Link your site file **Center To Center**.*
- *Move or rotate the SITE under your project until it is correctly positioned relative to the building. (do not move or rotate the project itself).*
- *Use the Acquire Coordinates tool and pick the site.*

This will set your project's shared coordinated to those of the dwg's wcs. True North will be the dwg's Y axis. Now your building knows where the dwg 0,0 is, but it can still record its own information in smaller numbers. It knows and can orient to either True North, or Project North. Once the shared coordinates are set, subsequent imports can be made origin to origin using shared coordinates.

Project Coordinates *origin can't be moved. This is not a problem unless you have more than one coordinate system that you need to work with on your project. When the project only needs one 0,0 point, you can locate Shared Coordinates to align with the coordinates in question*

***NOTE:** if the Shared Coordinates origin and the Project Coordinates origins are more than 2 miles apart, importing by Shared Coordinates always fails -- it defaults to center-to-center. So if your DWG is a mile wide and 0,0 is in the middle of it, the Shared Coordinates origin must be less than 1.5 miles from the Project Coordinates origin for import by Shared Coordinates to work seamlessly.*

2.4.6 Program Spatial Requirements

a) Spatial data should be generated and associated with bounding elements (walls, doors, windows, floors, ceilings).
b) Space/area schedules and diagrams must be dynamically updated from the model geometry.
c) LACCD Spatial Requirements must be validated using BIM Technology.
d) Each space shall include the following spatial information:

Space type - Omniclass
Space number-Omniclass
Space name
Space description
Department
Program

2.4.7 As Built BIM

BIM must be updated continuously throughout the construction phase and must include all RFI's, as built conditions, etc.
Upon Substantial Completion, the Design-Builder must submit the As Built BIM to the District. The as-built BIM shall include the following:

a. All as-built information.

b. Native file formats and all associated and linked files (if applicable) with full description of how to reassemble the model and how to extract 2D documentation, software and version number.
c. Digital Fabrication Models **(ref. sec 3.2.4.c for additional info)**
d. Any other fabrication models prepared by sub-contractors

2.5 Drawing Requirements

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

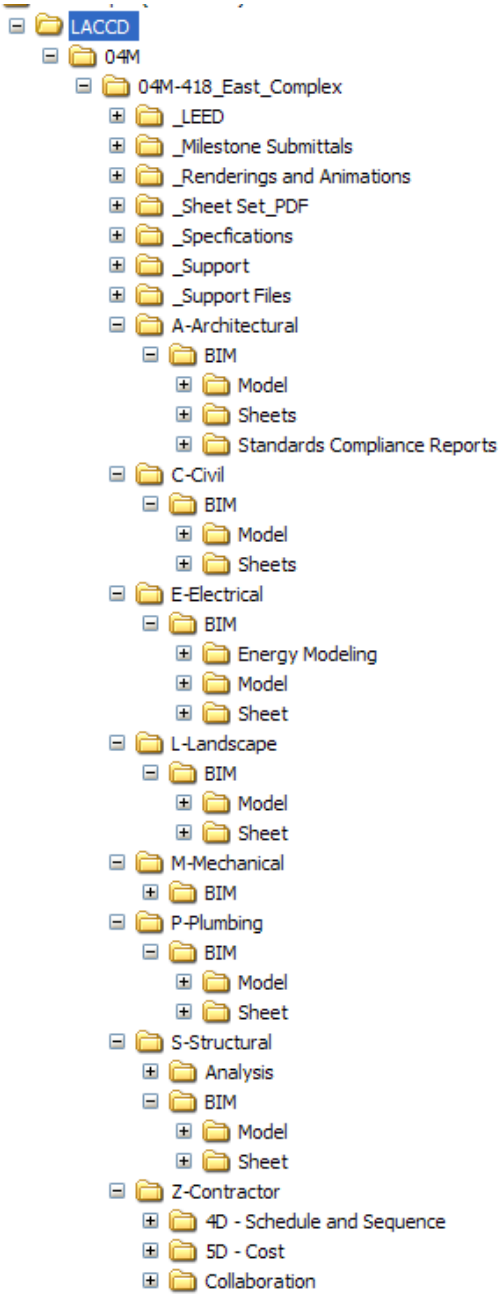
In addition to these BIM Standards, all LACCD Projects, shall refer to* sections 2.0 through 20.0, and the referenced appendices *of LACCD CAD Standards 3.0 for drawing requirements.

2.6 Project Folder Structure

2.6.1 General

Maintaining consistent file naming and structure is critical for referenced (linked) files to function properly across project teams and for end users such as facilities managers, to be able to retrieve files quickly once the project is complete. For this reason, LACCD has developed a filing structure to organize BIM Files and other deliverables for the duration of the project.

Sample Folder Structure



The root location (drive letter) of the Project folders may differ from office to office. However, all LACCD project data should be independent of the root drive letter to allow sharing between differing office server structures. The Root project Directory (LACCD) must reside directly below the Drive letter:

P:/ 🗁LACCD
🗁04M ←Campus Code Folder
🗁04M-418_East Complex ← Project Folder
🗁A-Architectural ← discipline folder
🗁BIM
🗁Model
🗁Sheet

Campus Codes Table 1	
Campus	**CODE**
LA City College	01C
East LA College	02E
LA Harbor College	03H
LA Mission College	04M
Pierce College	05P
LA Southwest College	06S
LA Trade-Technical College	07T
LA Valley College	08V
West LA College	09W
District Wide	10D

a. Campus Codes

Campus Codes (Table 1) shall be used to organize all projects by a consultant at a particular college. Folders consist of the 3 character Campus code, and shall be placed directly below the LACCD Project Directory as shown above. Campus Name can follow campus code if desired.

b. Project Number

Prior to commencing work, project teams shall be assigned an LACCD Project Number by the College Project Manager. This number shall be used for organizing the project files, and should include the common name on the file name project.

- (**Example:** Mission College CPM assigns the **East Complex** project a project number of 04M-418. Therefore project folder shall be named **04M-418 East Complex**)

c. Discipline Folders

Each discipline shall be assigned a folder corresponding to a Discipline Designator as listed in Table 2. All project files received and referenced from each discipline shall be organized in this folder. As a project progresses, the contents within these discipline folders will expand, and each deliverable should be clearly organized in its own folder.

Discipline Designators Table 2	
Discipline (in alphabetical order)	**Designator**
Architectural	**A**
Geotechnical	**B**
Civil	**C**
Process	**D**
Electrical	**E**
Fire Protection	**F**
General	**G**
Hazardous Materials	**H**
Interiors	**I**
Landscape	**L**
Mechanical	**M**
Facilities / Operations	**O**
Plumbing	**P**
Equipment/Specialty Design	**Q**
Structural	**S**
Telecommunication	**T**
Security	**TY**
Survey	**V**
Civil Works	**W**
Other Disciplines	**X**
Contractor/ Shop Drawings	**Z**

d. BIM Folder

BIM Files shall be sorted by model files and sheet files.

Model Files - Original files from other disciplines should be linked from their discipline folder location and relative path to models. Model file names shall follow file naming convention outlined in Section 3.1 Model file Naming of this document

Sheet Files - PDF and dwg (dgn) formats of the most current sheets shall be maintained in this folder and organized with sheet file naming outlined in File Naming Section 3.2 Sheet Naming and Numbering of LACCD CAD Standards.

Revit Users - *Revit does not organize its model with individual sheet files. However, record sheet files shall be exported to the sheet folder at project milestone submittals, as noted in the Document Submission Standards.*

e. **Support Files** - Standard items needed for the project, such as a project specific symbols, applications (lisp, script, etc.), logos and graphics. Project Specific Model Content can also be placed here.

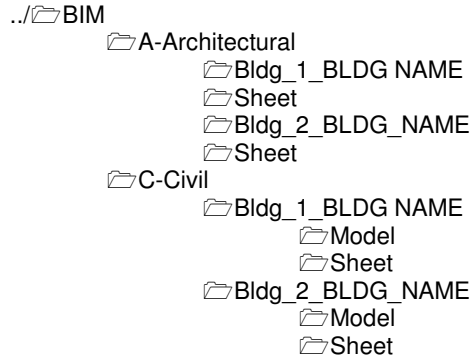
f. **Coordination Files** – Files for Construction coordination (clash detection) shall be managed by the BIM Facilitator or Builder, and organized by date as the project progresses.

g. **Other Folders -** Renderings, analyses, LEED, etc., will have their own folders which will be populated as the project progresses.

2.6.2 Variant Folder Tree

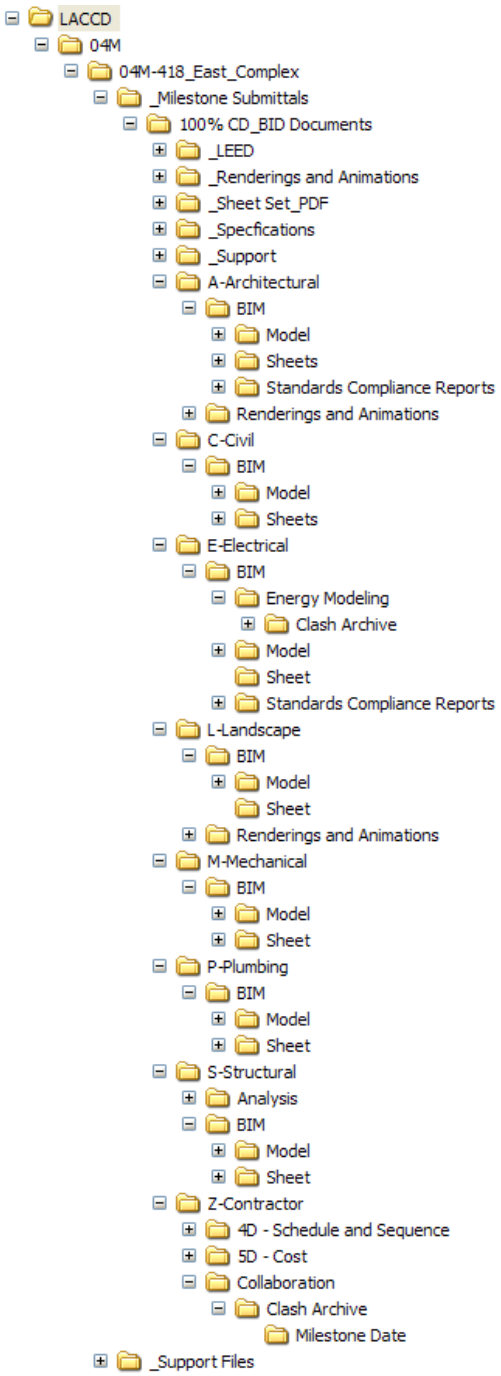
For projects that require multiple buildings:

Create building folders below the discipline directories as required for the project.



2.6.3 Archiving Milestone Submittals

All documentation pertaining to Milestone Submittals shall be archived and stored within the project file structure with a heading corresponding to the submittal type (i.e. 100% Construction Documents). A sample file structure is shown below:



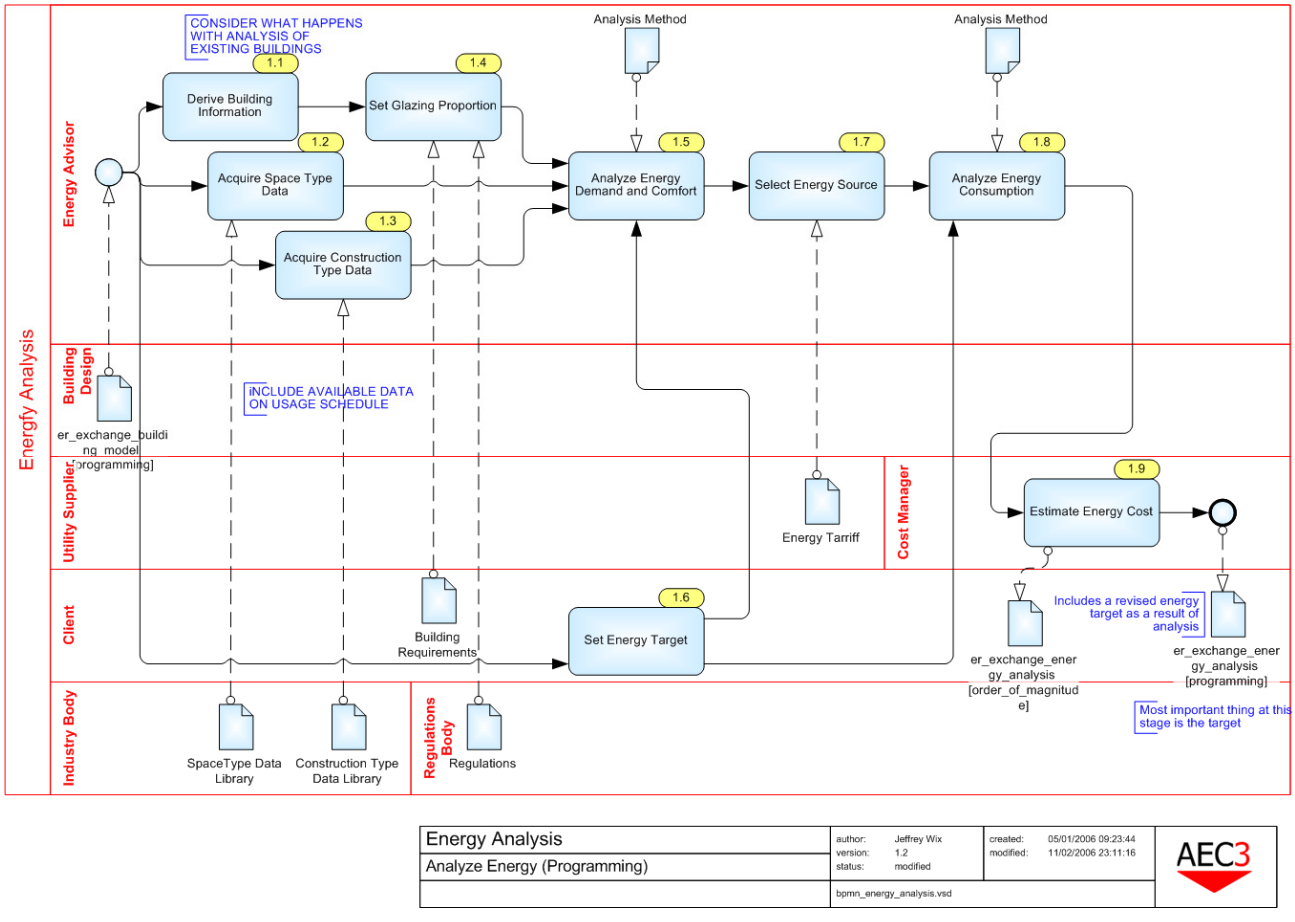
2.7 Information Delivery Manual (IDM)

The IDM is a methodology to document the exchange of information using BIM tools to support the sustainable building design solutions with a process map that can be reused to support future project design.

All Project Teams shall provide IDMs for executing energy analyses, verification of geospatial requirements, project water management, and daylight harvesting analysis in compliance with the Information Delivery Model (IDM) published by the Building Smart Alliance.

(IDM link http://idm.buildingsmart.no/confluence/display/IDM/home)

A Sample process map is provided below:



Source – AEC3

2.8 Data Security

The Design-Builder shall establish a data security protocol to prevent any possible data corruption, virus “infections” and data misuse or deliberate damage by his/her own employees. The Design builder shall establish adequate user access rights to prevent data loss or damage.

The Design-Builder shall provide access rights for LACCD’s users/stakeholders as provided in the Reference Section User Access Matrix.

3 BIM PROCESS AND IMPLEMENTATION

3.1 General

The project BIM Implementation Plan is intended to be used as a guideline to incorporate BIM as an integral part of LACCD's design, construction and facilities management processes. This document represents guidelines for implementation of certain BIM processes that may be new to the Project Team. Any deviations to the guidelines outlined herein must be documented by the Project Team, and then reviewed and approved by LACCD prior to commencement. As technology progresses, LACCD will work with project teams to update these requirements accordingly.

3.2 BIM WORKFLOW PROCESS

3.2.1 BIM Development Process Summary

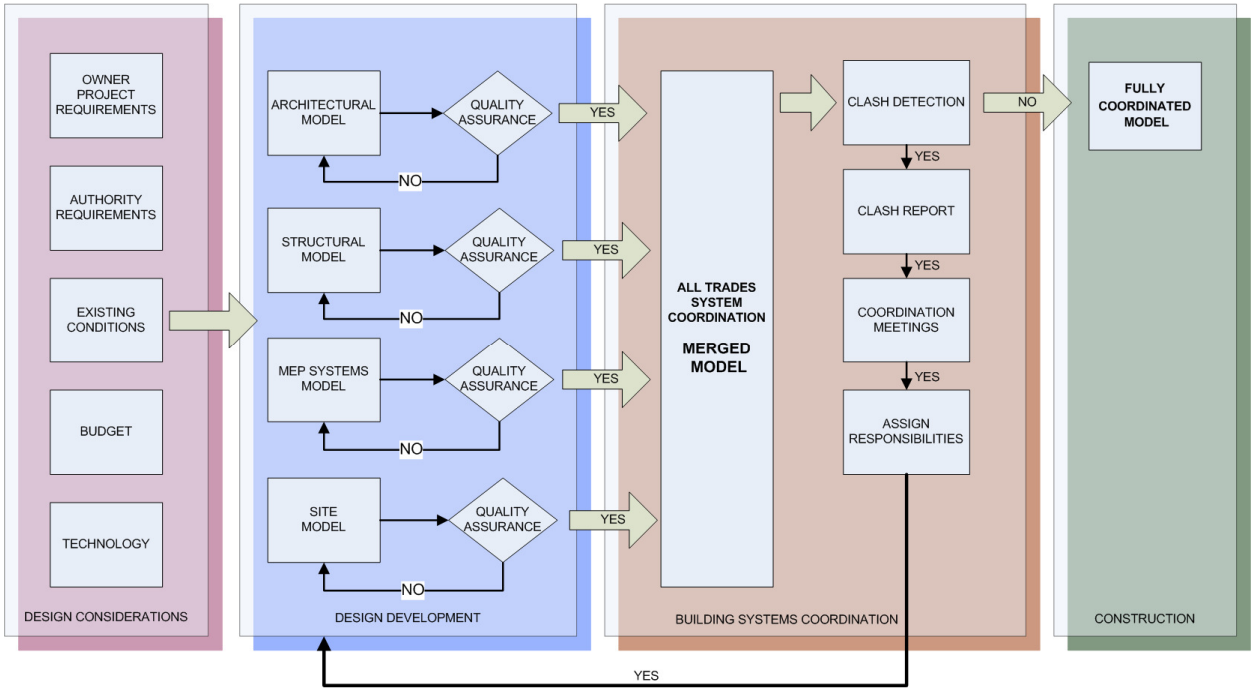


Figure 1 Illustrates the 3D model based Design Coordination process

a. In the early design phases, designers use trade specific analytic and authoring tools to create 3D models collaboratively to meet predefined project requirements.
b. Design-Build subcontractors will create 3D models of their respective scope of work based on their design documents.
c. 3D model files will be stored on shared Project Server for team access.
d. The designated BIM Facilitator will integrate the design discipline and trade specific models into a consolidated 3D-model using coordination software (i.e. Navisworks, Bentley Navigator) which will be used for assembling the various design models and for providing a report and view list of design coordination issues.

e. Resolution of Interferences: During mandatory regular coordination meetings, the Project Team will electronically identify, track and publish for distribution interferences between all affected trades. Project Team shall be required to utilize coordination, spatial review conflict, and clash detection software to provide “real time” solid object views of the structure, architectural and MEP components. Coordination interferences will be resolved interactively during the coordination meetings by the individual MEPF subcontractor detailers facilitated by the BIM coordinator with the use of coordination software.
f. The clash report will be used for measuring the progress, analyzing conflicts and to help facilitate issue resolution.
g. Submittal and Coordination Sign-off Drawings: Once all conflicts have been resolved and the structural, architectural and MEPF systems have been fully coordinated, each consultant and subcontractor is to provide fully annotated drawings of their respective systems in PDF format for submission to the Architect / Engineer of Record for review and approval. The fully coordinated model shall serve as the basis for resolution of any future field installation conflicts.

3.2.2 Building System Coordination and Team Collaboration

The success of a BIM enabled design process is highly dependant upon the level at which the entire project team can work collaboratively and maintain open lines of communication throughout the project . In addition to Authoring and Analysis tools, this process requires specialized coordination software (i.e. Navisworks, Bentley Navigator) that is interoperable across software formats, and facilitates the coordination of spatial review conflict in a 3D Environment. This section documents the recommended BIM oriented collaboration process for effectively managing this process.

a. Design-Builder shall require Trade (MEPF) detailers to submit models that are clash free from any structural and architectural elements that are included in the models provided by designers.
b. Model assembly- entire building
   The BIM Facilitator will assemble all of the model parts from the trades and design disciplines for the purpose of performing a visual check of the composite model for compatibility and design synergy. Vertical shafts can also be viewed 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.
c. Model division and assembly-floor by floor
   On a multistory project, the models will need be split on a level by level basis for MEPF coordination. If a floor is particularly large, it may also need to be split by zones to reduce file size.
   Each floor shall be created as a separate level in the coordination software, and all trades shall reference a shared and documented insertion point and methodology for developing these files.
   Typically, 3D coordination continues single floor until building systems are fully coordinated, and then continues on the next floor up .
d. File formats
   The architectural and structural models must be saved out in one or more of the file formats listed below:

Dwg, IFC, Native, Nwc/nwd

e. Points of reference

The BIM facilitator will provide a 3D grid for incorporation into the coordination file. 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.

f. Shared Project Server

The designers and subcontractors will upload their individual 3D models to the shared Project Server as agreed upon with LACCD. Models on this shared server will be fully accessible on-line to all team members via assigned site user names and passwords. The BIM team leader will be responsible for monitoring usage, storage capacity and maintaining access of this server.

g. Clash detection and reporting

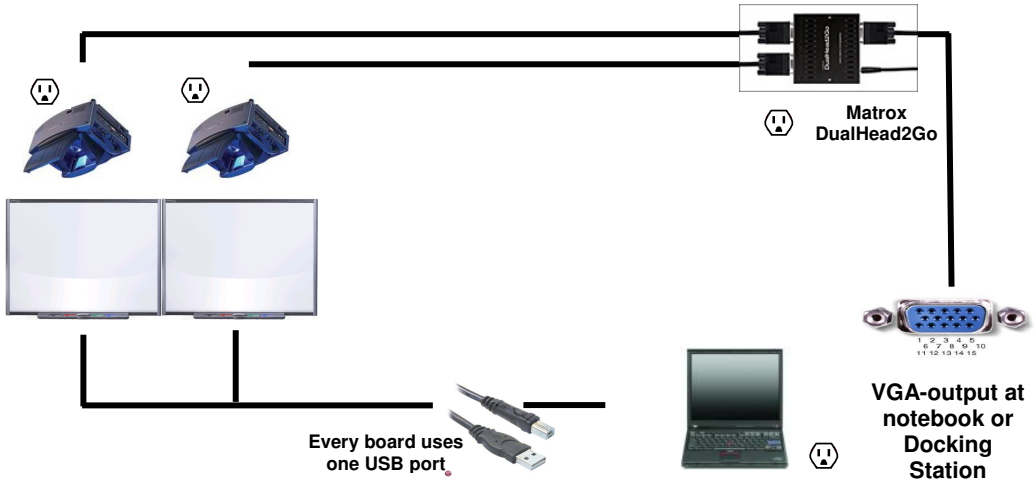
1. Coordination software will be used for assembling the various design and trade models and for providing a report and view list of design coordination issues. The Project MEPF coordinator(s) and the BIM facilitator will review the model and the Clash Reports in coordination meetings with the designers and subcontractors on a regular (weekly) basis.
2. The report will be reviewed by the team members and agreed upon solutions will be implemented per the agreed upon schedule. This process will be repeated throughout the design phases until all design and coordination issues have been resolved.
3. Coordination of each floor or level should be complete in advance of construction of that floor with enough time allocated for proper layout documentation to be generated, approved and passed on to the field crew.
4. Internal Clash Resolution - Subcontractors who are responsible for multiple scopes of work are expected to coordinate the clashes between those scopes ***prior*** to the project coordination meetings. For any disputes, DB will make the final determination.
5. Third party involvement - The Project Team is encouraged to seek involvement of selected third parties, such as building officials, local utility companies and other stakeholders that may benefit from a visual review of the coordination model.

3.2.3 Team Collaboration Room (BIM Theater)

DB team will provide a room (BIM Theater) for facilitating BIM Collaboration during the design-build process. The BIM Theater shall serve as a collaborative work environment for design review and coordination. Smart boards can be used to view documentation (2D and 3D), create mark ups interactively, archive the latter, convert them to RFI's or other relevant reference documents.

<u>BIM Theater installation and setup</u>
Connect a notebook or desktop to the Smartboard(s) and projectors.

BIM Coordination Room – 1 or 2 boards to notebook



3.2.4 Coordination and clash Detection

Use a geospatially located established reference point for collaboration of all models. ***See CADD Standards section 8.0 "Setting the Origin" for additional information.***

a. 3D-Models, Formats and Model Structures

The 3D models shall consist of 3D-Solids (not lines or wire frames) that represent the actual dimensions of the building elements and the equipment that will be installed on the project. Reasonable abstractions can be made, (i.e. pipe fittings do not need to be modeled) shall be coordinated with the Builder to ensure meaningful coordination and clash detection.
Before modeling begins, Design Builder will specify a structure and features of the files that are to be submitted (Documents: File Structure, Modeling Scope Matrix). In general, DB requires the following model structure and features:

1. 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)
2. For MEPF trades, the 3D representations of each floor may be relative to a 0'-0" FFL as long as all MEPF trades agree on the same protocol. The BIM facilitator will adjust the elevations of the architectural and structural elements to 0'0".
3. All other trades will be modeled at the correct elevation (not all floors modeled at the same elevation).
4. Elements of the building must be represented in only one file - there must be no overlap of elements of different files. 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 subcontractor, not the architect.
5. The architectural ceilings should contain openings for lights, registers, etc. as required.
6. 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.

7. 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).
8. Project team shall follow LACCD File Naming requirements as documented in LACCD CAD Standards **"Section 3.0 File Naming Guidelines"**
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. E-mail notifications will be generated automatically by the Server system every time a new file is uploaded.
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
    - Plumbing: magenta
    - HVAC Duct: blue
    - HVAC Pipe: lime green
    - Electrical: cyan
    - Pneumatic Tube: dark green
    - Concrete: Grey
    - Structural Steel: maroon
    - Architectural: white

b. Collaboration in the Installation Planning Process

DB team will hold installation planning meetings where the coordinated model will be used to review and optimize field installation. Subcontractors will be expected to have field representatives attend who can actively engage in the planning process and make schedule commitments.

c. Digital Fabrication

The collaborative process will ensure that the deep knowledge and associated efficiencies of the fabricator is embedded into the design. 3D parametric modeling and collaborative processes will allows this project to accurately produce key components off site such as:

1. Structural Steel
2. Mechanical System Duct
3. Mechanical System Hydronic Piping
4. Plumbing
5. Curtain Wall
6. Building Envelope
7. FF&E
8. Equipment (e.g., chillers, boilers, pumps, etc)

Procedures

1. Designers specify only vendors who can provide “design” level models of their products for FF&E.
2. MEP subcontractors should incorporate vendor models for equipment if available

d. RFP Kickoff BIM Standards Orientation

1. Review LACCD BIM Standards and Workflow process with design team.
2. Review Statement of Owner’s Project Requirements
3. Review all data developed during the project validation phase
4. Review & Issue Project Model Template (aka dataset)

e. DSA Review and Approval (To be developed in collaboration with DSA.)

3.3 DB Team BIM Work Plan

As part of their Request for Proposal, The Design-Builder shall submit “BIM Work Plan” for LACCD review and approval.

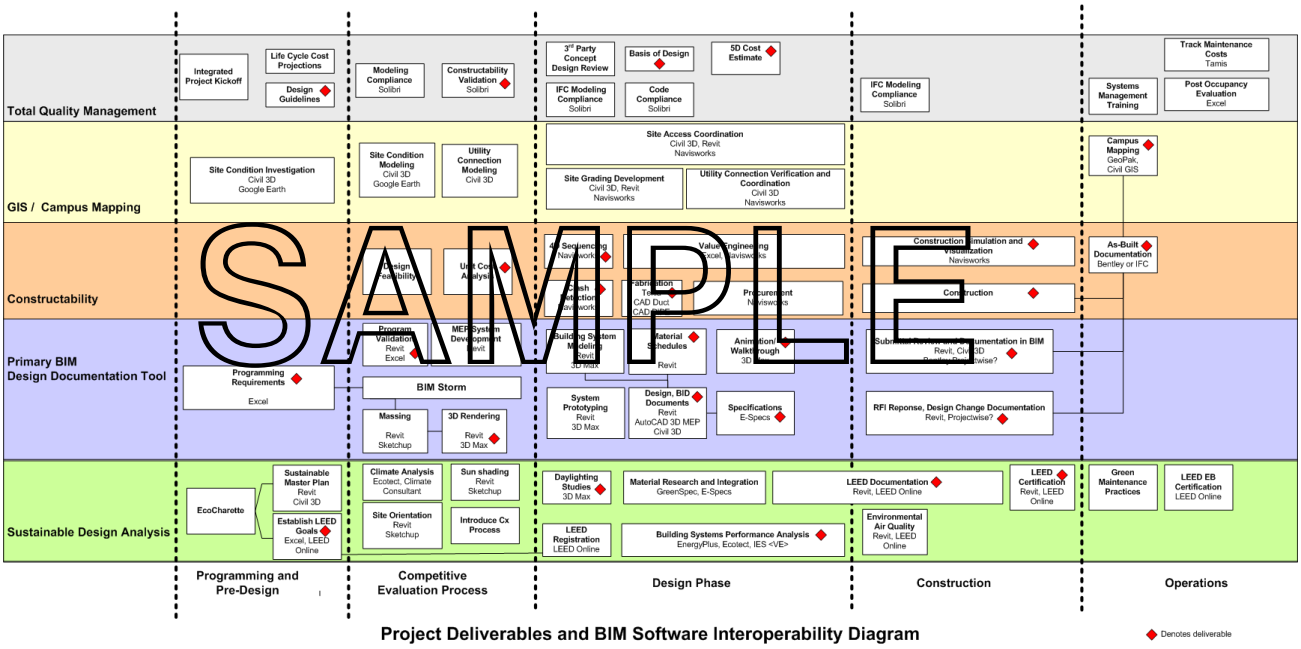


Figure 2 – Sample of DB Project BIM Work Flow

The plan shall include:

a. Software used
b. Types of models to be created at each phase and the purpose of each model (see Figure 2)
c. Schedule for initial delivery of each model
d. Schedule for updating of each model and preservation of versions of each model
e. Model(s) as part of the As-Built/Record Drawings documents
f. File formats used for project submittal and file exchange
g. Compliance with Folder Structure, File Naming, Object naming conventions per LACCD Standards
h. Utilization of Web Site and FTP Sites
i. Utilization of BIM for RFI's and Change Orders
j. Documentation of any proposed deviation from BIM Standards for LACCD consideration
k. DB BIM Team Personnel and Qualifications, such as: BIM manager, BIM Team Facilitator, Lead BIM Technicians by Discipline, Designers and 3D Detailers, as noted below:
    1. It is the responsibility of all Consultants and Contractors to have or obtain, at their cost, the trained personnel, hardware, and software needed to successfully complete the BIM 3D coordination phase of the project. Personnel participating in the design/coordination efforts of the project must be proficient in the use of all hardware and software required. 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.
    2. DB team must submit for acceptance by the LACCD, the individual proposed for the position of **Team BIM facilitator (ref. Sec 3.4)** . The submittal shall include four (4) copies of a resume documenting their relevant experience and providing at least three current references. Experience shall be as follows:

        A minimum of 4 years experience as a mechanical coordinator on similar size and type of construction projects that included the major trades involved with this Project and the creation of a BIM for the mechanical, plumbing, electrical and fire protection systems.
    3. Provide qualifications and expertise of each firm, and key individuals committed to the BIM Team with specific emphasis on:
        - Experience in Integrated Project Delivery
        - Commitment to collaborative process
        - Balance and breadth of team experience/expertise
        - Ability and willingness to be "team players"

3.4 Role and Responsibilities of DB Team BIM Facilitator

At inception of project, Design Build Team shall assign a single BIM Facilitator as main point of contact for BIM related issues.

a. Coordinates Project-wide training sessions with LACCD BIM Coordinator, and BIM Resources
b. Coordinates shared portal set up with DB Team IT and LACCD
c. Creates composite/Structure Master and Project Master model
d. Model Quality control checks
e. Provides design coordination & constructability feedback
f. Facilitates design coordination meetings
g. Ensures that BIM's are used appropriately to test design requirements / criteria
h. Interfaces with LACCD's e7 studio for data and file exchange as needed
i. Interfaces with DB team-IT to ensure software is operating properly
j. Interfaces with DB team-IT to set up portal, permissions, etc.
k. Interfaces with software developers – provides feedback and bug reports – additional requirements
l. Navisworks training – ensures efficient use of Navisworks
m. Provides specifications for "BIM Coordination Room" to LACCD for approval
n. Facilitates BIM Coordination meetings with project designers
o. Communicates LACCD BIM Vision to entire team
p. Serves as POC for all internal and external BIM-related issues
q. Liaison between DB team & LACCD for Geospatial data
r. Ensure the reference point is distributed and used by ALL team members.
s. Coordinates & schedules BIM Workshops for Project Team
t. Ensures that all BIM users are taken into account at each design phase.
u. Communicates the data extraction sets required by the construction team and ensures that these requests are met

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- BuildingSMART is an international membership organization with representation in North America, Europe, Asia and Australasia. It brings together architects, engineers, constructors, product manufacturers and facilities managers, along with software vendors.

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. Component data can be used for quantity take-offs, specification sections based on CSI format and even cost data.

CPM- College Project Manager

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.

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 .

IDM- Information Delivery Manual- provides an approach to providing an integrated reference for process and data required by BIM. It describes how to identify and describe the processes undertaken within construction, the information required for their execution and the results. It also describes how the information can be further detailed to support solutions provided by building information system providers in a form that enables its reuse and how it can be configured to meet national, local and project needs.

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

Model File In the BIM process, the Model File contains a referenced Extraction and model file-specific information. It is recommended that Extractions not serve directly as Model Files, since if Extractions have to be regenerated, all model file-specific information added to the Extractions will be lost. See the A/E/C CADD Standard for more information.

NBIMS- National Building Information Model Standard
OmniClass Classification System- otherwise known as OmniClass or OCCS, is a 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 Data Standards for Facilities, Infrastructure, and Environment- The SDSFIE Steering Group, made up of members from the Armed Forces and the U.S. Army Corps of Engineers, has set an ambitious goal of creating the DoD standard for facilities, infrastructure, environment, and civil works.

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. See the A/E/C CADD Standard for more information.

References

1. **GSA BIM Guide For Spatial Program Validation, Volume 2 ,** U.S. General Services Administration, May 2007

2. **U.S. National CAD Standards 4.0,** National Institute of Building Sciences, January 2008

3. **National BIM Standards 1.0, Version 1.0—Part 1 Overview, Principles, and Methodologies;** National Institute of Building Sciences, 2007

4. **AIA E202-2008 BIM Protocol Exhibit,** American Institute of Architects

5. **AIA E201 - 2007 Digital Data Protocol Exhibit,** American Institute of Architects

6. **AIA A295-2008 General Conditions of the Contract for IPD,** American Institute of Architects

7. **Information Delivery Manual**, Georgia Tech University, 2007