# LACCD Building Information Modeling Standards

## (LACCD BIMS)

**Version 3.0**

**Prepared by:**

BuildLACCD

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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:

1. LACCD CADD Standards 3.1
2. Sustainable Design Standards
3. Owner Project Requirements

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**DISCLAIMER**

THE INSTRUCTIONS, STANDARDS AND GUIDELINES CONTAINED IN THIS 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.

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## 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.

LACCD will be using the OmniClass table structure to classify attributes of the model (i.e. Labeling / Identifying Spaces, Work Results and Products, Phases and Disciplines). These categories are identified through out this standard. See OmniClass link www.**omniclass**.org

### 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:
1. Most current version of Industry Foundation Classes (IFC) file format
2. 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 (Timeliner), , 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 above may be used subject to the above compliance requirements and approval by LACCD Staff.
**some software may link a Primavera or MS Project schedule to model

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. The Design Build Teams shall incorporate OmniClass tables 13 (Spaces by Function) and 14 (Spaces by Form) into the As-Built Models.

### 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 Charrette 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 deliverables may include massing studies, design visualization renderings, 3D models, and preliminary building performance and cost estimating analysis.

1. Programming shall become the basis of massing diagrams in BIM, and shall be validated by an approved format pre-determined by the District.
2. 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 District 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. The Design Build Teams shall incorporate OmniClass tables 13 (Spaces by Function) and 14 (Spaces by Form) into the As-Built Models at the Model Element Level.

### 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

Cost estimation shall be prepared from the Project Team's BIM Process. Reference 2.3.8

### 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 |
| Plumbing | Main Connection lines from site, main plumbing lines |
| Site work and ground plane | Excavation work, footings, foundations, on-grade Slab |
| Site Logistics Planning (optional) | Site layout, safety access, and coordination |

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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 at 100% Design Development and 100% Construction Documents submittals. 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.

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Models and their Elements must be in concert with the Project Schedule to the Milestone Level.

Design Build Teams are encouraged to incorporate OmniClass tables 31 (Phases) and 33 (Disciplines) into the As-Built Models at the Model Element Level.

#### 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

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, etc.

2. 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.

3. 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)

4. 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

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

6. Design-Builder shall utilize model geometry and extract graphical information for generating construction administration documents from the Project BIM, i.e. RFIs, Directives, Bulletins, Change Orders.

7. 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:

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.

**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-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 CADD Standard 3.1, Section 8.0. "Setting the Origin"[1].**

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### 2.4.6 Program Spatial Requirements

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

***Space type – Omniclass (Table 13)***
***Space number-Omniclass (Table 14)***
***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 RFIs, as-built conditions, etc.
Per Contract Requirements, the Design-Builder must submit the As Built BIM to LACCD. The as-built BIM shall include the following:

1. All as-built information
2. 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.
3. Digital Fabrication Models **(ref. sec 3.2.4.c for additional info)**
4. Any other fabrication models prepared by sub-contractors
5. The Design Build Teams are encouraged to incorporate OmniClass tables 22 (Work Results) and 23 (Products) into the As-Built Models at the Model Element Level.

### 2.4.8 Model File Conversion

Upon receipt of DSA Approval and at Final Completion of Construction, DB Team shall submit as part of the deliverables, and in addition to the native model files, all models converted to .dgn or i-model format. Conversion shall utilize built-in software conversion

tools and compatible plug-in tools from the software vendors, based upon current technology, and shall support IFC compliant attributes.

### 2.4.9 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 CADD Standards 3.1 for drawing requirements.***

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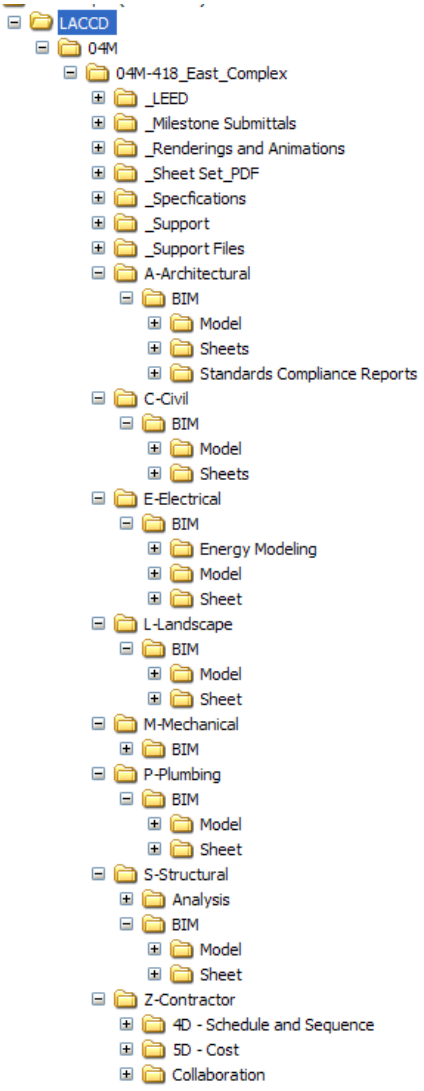
## 2.5 Project Folder Structure

### 2.5.1 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**<br>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 |

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.

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**)

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**<br>Table 2 | |
|---|---|
| **Discipline**<br>(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** |

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 CADD Standards 3.1.[2]

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.

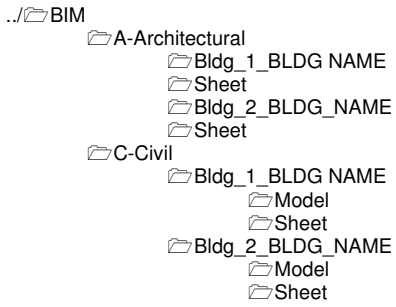
Coordination Files – Files for Construction coordination (clash detection) shall be managed by the Virtual Design and Construction Manager or Builder, and organized by date as the project progresses.

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

### 2.5.1 Variant Folder Tree

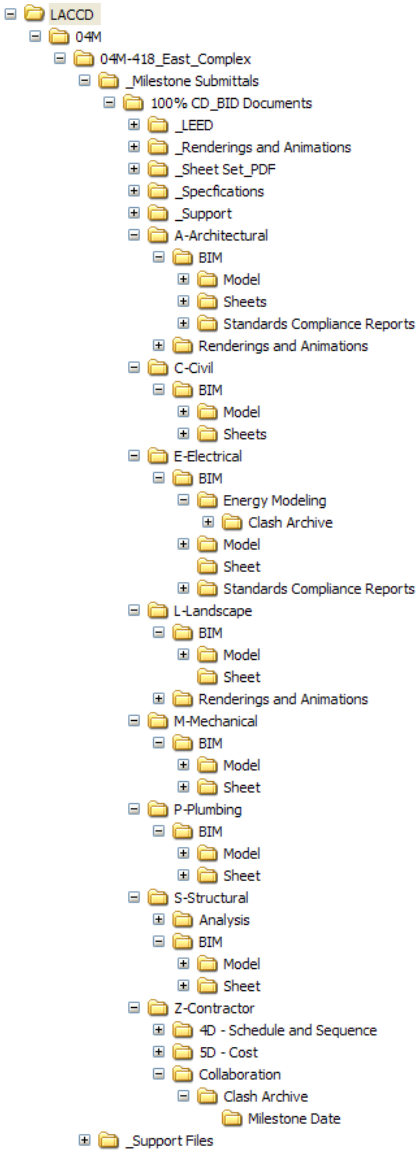
For projects that require multiple buildings:

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



### 2.5.2 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:



## 2.6 Information Delivery Manual (IDM)

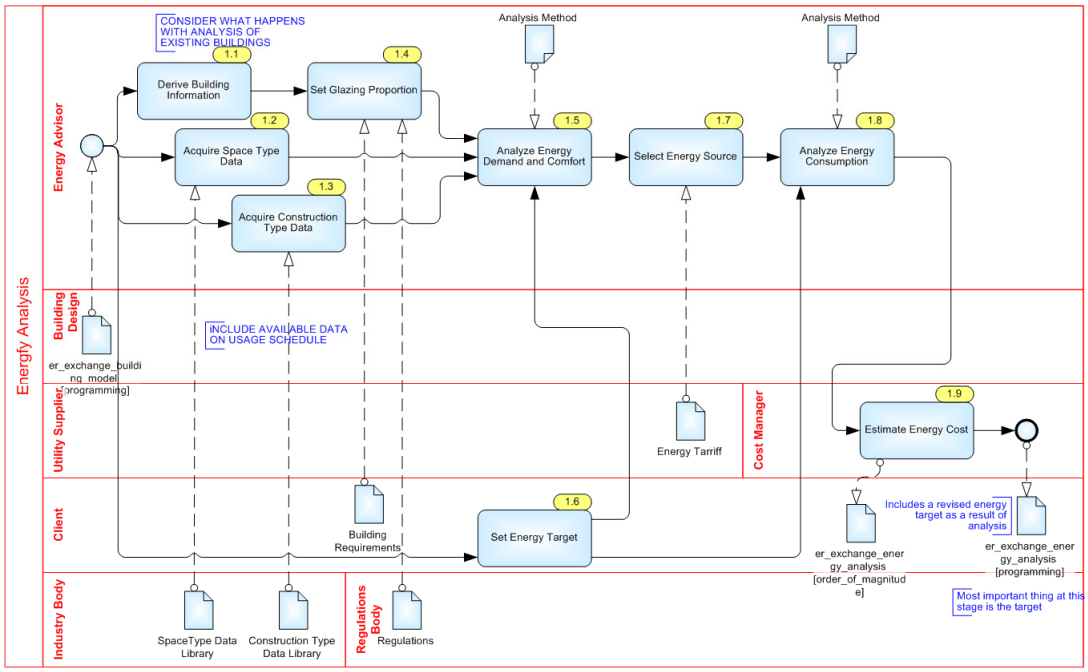
The Information Delivery Manual is a methodology to document a team's intended process of exchanging information using BIM tools to support sustainable design solutions, the process maps shall be used to validate the design intent, and document the process for future projects.

As part of the BIM Execution Plan, Design Build Teams shall provide, IDM Process Maps documenting the teams strategy for executing energy analyses, verification of geospatial requirements, project water management, and daylight harvesting analysis. These process maps shall be tied to specific requirements and performance goals and of the project.

It is the intent that these process maps be 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**

### 2.7 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 Workflow Summary

During Design Process, sub-contractors active involvement including design and constructability input, are required as a part of the design-build team collaboration

1. Design Phases

   a. During the RFP, DB Team shall assign a Virtual Design and Construction Manager to coordinate BIM workflow per section 3.4 of LACCD BIM Standards.
   b. Designers shall use trade specific analytic and authoring tools to create 3D models to meet predefined project requirements.
   c. Virtual Design and Construction Manager will integrate the design disciplines and trade (sub-contractor) specific models into a consolidated 3D-model using coordination software (i.e. Navisworks, Bentley Navigator). The consolidated model will be used for coordinating systems and spatial requirements, providing clash reports, and view list of design coordination issues.
   d. Resolution of Spatial Conflicts: During coordination meetings, the DB Team 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.
   e. Prior to each scheduled coordination meeting, an updated clash report will be issued by VDC Manager to track the progress of coordination, analyze conflicts and help facilitate issue resolution prior to construction.
   f. Spatial Coordination Sign-off Drawings: Once all spatial conflicts have been resolved by the Design-Build team and the structural, architectural, MEP, and Civil systems have been fully coordinated, each trade shall provide fully annotated

drawings of their respective systems in PDF format for submission to the Architect / Engineer of Record for review and approval.
g. Building Performance and Energy Modeling – Design Team 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.
h. DSA Review and use of digital models for approval will be developed in collaboration with DSA by LACCD.

2. Construction Phase

a. Construction Trades noted in Section 3.2.4.c shall generate fabrication models for spatial coordination and shop drawing development.
b. Contractor's Fabrication models shall be coordinated with the design model. Any conflicts to the design model that need to be made prior fabrication and construction shall be reported to Design Team in the form of an RFI. Clash reports may also be issued by General Contractor as background information for RFIs and submittals.
c. As part of the requirement for record deliverables DB Team shall continually update the Record BIM with as-built conditions, and shall incorporate documented design changes in the field.

### 3.2.2 Project Team 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.

**1. Shared File Server** – As part of the BIM Work Plan, it is required that the DB Team establish a single shared project server for the upload and exchange of digital models, and the collection of project deliverables at pre-determined milestones. The same shared server shall continue to be used for the duration of the project. Models on this shared server will be fully accessible web based to all team members via assigned site user names and passwords. If a LACCD provided shared file server is available, Project Team shall coordinate with the District to establish access.

a. Upload Models to Shared Project Server - During the Design Phases, design engineers and architects will upload their trade specific authoring and analysis models to the shared Project Server for scheduled coordination meetings and milestone submittals.
b. Design Models uploaded for clash detection and systems coordination should be saved in an optimal interoperable format agreed upon by project team. (i.e. Navisworks accepts several file types but .dwg, .nwd/.nwc, and .ifc are file formats that are operable across multiple software platforms)

**2. Coordinated Insertion Point** – Prior to the start of modeling in BIM, Team Virtual Design and Construction Manager shall work with project team 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 CADD Standards 3.1 for additional information on how to establish insertion points.***

**3. Points of Reference**– The Virtual Design and Construction Manager 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.

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

**5. BIM Standards and Workflow process**

a. Project Team BIM Execution Plan to meet Owner Project Requirements and compliance with BIM Standards
b. All data developed during the project validation phase
c. Project Model Template (a.k.a. dataset)
d. Identify Team's IDM Strategies

During Bidding, use of BIM Standards will also be announced to potential bidders, and then reviewed with selected General Contractor prior to the start of construction.

**6. 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")

The DB Team shall provide a room for facilitating BIM Collaboration (BIM Theater). The BIM Theater shall serve as a collaborative work environment for design review and coordination. Alternately, collaboration using web conference (i.e. WebEx, GoToMeeting) is acceptable for facilitating these meetings.

DB Team shall be responsible for providing and setting up a BIM Collaboration room located at or near the construction site to coordinate fabrication models with respective trades.

For each BIM Theater, Smart boards may be used to view documentation (2D and 3D), create mark ups interactively, archive the latter, and convert them to RFIs or other relevant reference documents.[3]

### 3.2.4 Spatial Coordination and Clash Detection

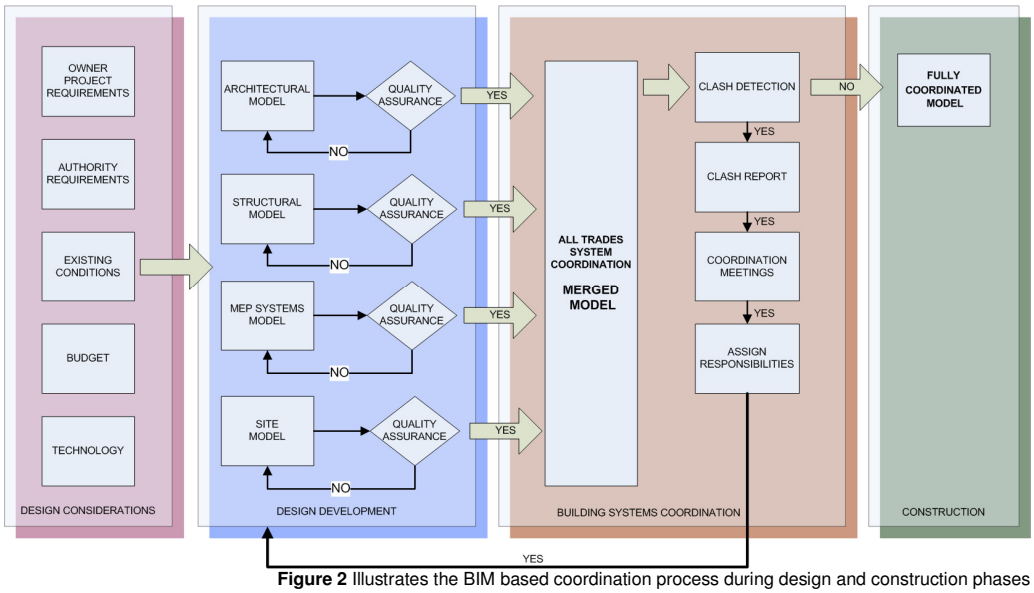



**Figure 2** Illustrates the BIM based coordination process during design and construction phases

In addition to Authoring and Analysis tools, specialized coordination software (i.e. Navisworks, Bentley Navigator) will be needed to facilitate spatial coordination and clash detection in a 3D Environment.

### 1. 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. For system components smaller than 2", 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 modeling begins, Virtual Design and Construction Manager will work with their team to develop procedures and file exchange protocol the files that are to be submitted (Documents: File Structure, Modeling Scope Matrix). Typically, BIM Coordination requires the following model structure and features:

a. Project team shall follow LACCD File Naming requirements as documented in LACCD CADD Standards 3.1 **"Section 3.0 File Naming Guidelines"**
b. 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)
c. For MEP trades, the 3D representations of each floor may be relative to a 0'-0" FFL as long as all MEP trades agree on the same protocol. The Virtual Design and Construction Manager will adjust the elevations of the architectural and structural elements to 0'0".

d. All other trades will be modeled at the correct elevation (not all floors modeled at the same elevation).
e. 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.
f. The architectural ceilings should contain openings for lights, registers, etc. as required.
g. 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.
h. 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).
i. All 3D model files submitted for clash detection must be "clean" – with any extraneous 2D references and/or 3d elements stripped from the models.
j. E-mail notifications will be generated automatically by the Server system every time a new file is uploaded.
k. 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.
l. 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

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

**2. Collaboration in the Installation Planning Process**

Prior to installation, the DB Team Virtual Design and Construction Manager will conduct planning meetings with affected trade sub-contractors using the coordinated spatial model to review and optimize field installation. Subcontractors will be expected to have individuals attend who can actively engage in the planning process and make schedule commitments.

**3. Digital Fabrication**

The collaborative process will ensure that the deep knowledge and associated efficiencies of the fabricator are embedded into the construction model. As part of the contractor's submittal, the following construction trades shall provide 3D fabrication models with parametric model objects:

a. Structural Steel
b. Mechanical System Duct
c. Curtain Wall
d. Building Envelope Systems (i.e. rain screens, pre-cast panels)
e. Casework and furniture systems
f. Any additional fabrication models generated by subcontractor

Note: MEP subcontractors should incorporate vendor models for equipment if available.

4. **Coordination of entire building** - Virtual Design and Construction Manager 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.

5. **Coordination, floor by floor** - On a multistory project, the models may need to be split on a level by level basis for MEP coordination. If a floor is particularly large, it may also need to be split by zones to reduce file size. In such instances, 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 to the next floor up.

**6. Clash detection and reporting**

a. Coordination software will be used for assembling the various design models and for providing a report and view list of design coordination issues. The DB Team, including Team Virtual Design and Construction Manager and Discipline BIM Lead Modelers, will review the model and the Clash Reports in coordination meetings on a regular (weekly) basis.
b. 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.
c. Internal Clash Resolution – Design Consultants and Subcontractors who are responsible for multiple scopes of work are expected to coordinate the clashes between those scopes ***prior*** to providing those model to the Virtual Design and Construction Manager for spatial and system coordination.

## 3.3 Project BIM Execution Plan

**3.3.1** As part of their proposal, The DB Team shall submit "BIM Execution Plan" which shall contain the following:

Preliminary Execution Plan including:

1. BIM personnel and qualifications
2. Proposed BIM Software to be used
3. Strategy for compliance with LACCD BIM Project Requirements **(ref. Sec 2 - BIM PROJECT REQUIREMENTS)**

**3.3.2** Upon contract award, and before issuance of Notice to Proceed, DB Team shall provide a detailed BIM Execution Plan including the following:

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
    c. Proposed utilization of 4D Scheduling and Sequencing technology
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. Project team 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)
    c. Senior Project Designers and Engineers
    d. BIM and IT Managers for all applicable trades
    e. Lead Fabrication Modelers for all 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 general contractor, design disciplines, and major sub-contractors

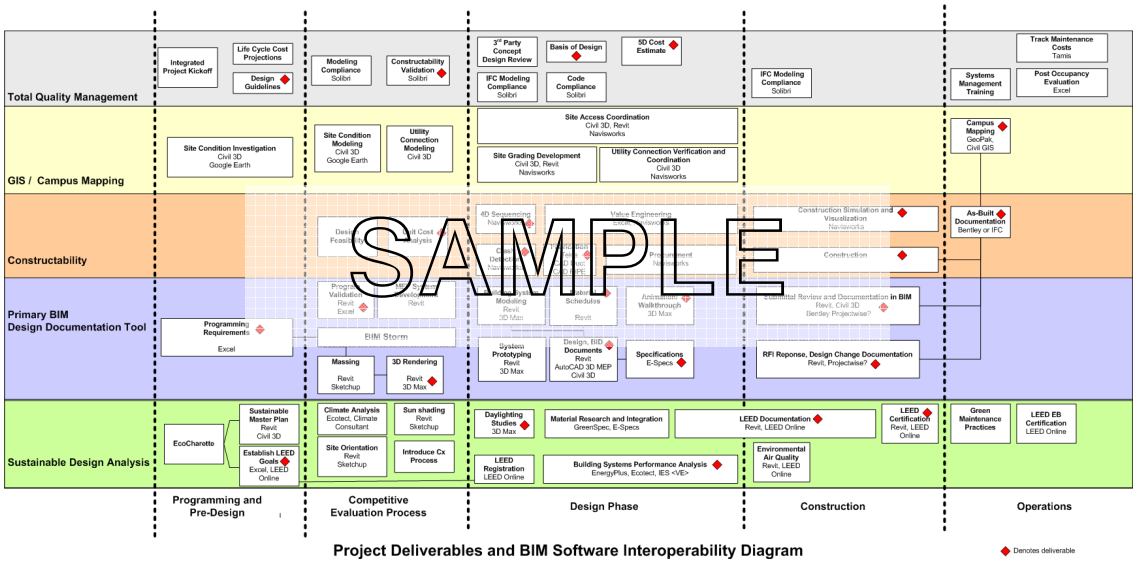



Figure 2 – Sample of Project BIM Work Flow Diagram

## 3.4 BIM Roles and Responsibilities

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 coordination phase of 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 Virtual Design and Construction Manager

As part of the requirements during the RFP Phase, DB Team shall assign an individual to the role of DB Team Virtual Design and Construction Manager. It is strongly recommended that this individual have previous onsite construction experience as Virtual Design and Construction Manager (VDC Manager), Assistant Project Manager (APM), Assistant Superintendent, or Project Engineer. Additionally, the individual shall have at least 3 years of BIM experience and shall have relevant proficiency in proposed BIM Authoring and Coordination Software. Official Certification for proficiency in the above software is also recommended. 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 DB BIM Work Plan
2. Coordinate Project-wide training sessions with LACCD BIM Coordinator
3. Coordinate set up of shared file server with LACCD and Project Team IT staff. This shall include interfacing with Project team IT staff to set up web portal, permissions, etc. If there is a District wide portal, individual shall coordinate with District wide IT Administrator for permissions and set up
4. Assembles composite design model for coordination meetings
5. Provide Modeling Quality Control / Quality Assurance Check of Design BIMs.
6. Facilitates use of composite models in coordination meetings
7. Ensures that BIMs are used appropriately to test design requirements / criteria
8. Interfaces with Project team BIM and IT Managers to ensure software is installed and operating properly
9. Interfaces with software developers to provide feedback and bug reports
10. Provides specifications for "BIM Coordination Room" to LACCD for approval
11. Facilitates BIM Technical meetings with Lead BIM Technicians
12. Ensure Design Team understands, supports, and meets LACCD Vision and Main Objectives for BIM **(ref. Section 1.2)**
13. Ensure the shared geo-reference points noted in Section 2.4.5 are distributed and used by ALL team members.
14. Interfaces with LACCD's e7 studio for data and file exchange as needed
15. Coordinate BIM File Exchange and archiving of Milestone Submittals
16. Prior to commencing construction, integrates Sequencing and Scheduling with Fully Coordinated BIMs.
17. Communicates the data to be provided by the DB team at each phase, and ensures that data is incorporated in to BIMs prior to each milestone
18. Coordinate with DB team to ensure changes in the field have been documented and are updated in the Record BIM in a timely manner
19. Ensures record documentation noted in Document Submission Standards are properly linked to Construction Record BIM for final submittal to LACCD
20. Coordinates software training and establishes protocol for efficient use of software for Construction Team
21. Ensures entire DB Team has necessary hardware and BIM Software properly installed and accessible for project use.

### 3.4.2 Lead BIM Technicians

1. Each major design discipline and subcontractor shall assign an individual to the role of lead BIM Technician for the duration of the project. These individuals shall have at least 2 years of relevant BIM experience and shall have the following responsibilities:
2. Maintain and manage integrity of discipline model including:
    a. modeling requirements per BIM Standards
    b. file exchange between other disciplines
    c. upload of models to file exchange server
    d. preparation of model for coordination review
3. Ensure development and documentation of clash resolution
    a. Continuous interface with Virtual Design and Construction Manager
    b. Participation in coordination and BIM technology meetings
    c. Coordinate internal project team training as required

# 4. QUALITY ASSURANCE AND VALIDATION

## 4.1. INTRODUCTION

The purpose of the Quality Assurance and Validation process is to ensure project teams are using Best Practices in the development and file exchange of building information models. Quality Assurance is an ongoing process to be conducted by the Project Team 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. It shall be the Design-Build Team's responsibility to submit completed copies of these checklists at each project milestone in conjunction with project deliverables. It shall be the responsibility of the College Project Manager 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 checklists.

1. Develop and maintain a detailed BIM Work Plan for LACCD approval prior to Notice to Proceed
2. Develop and Maintain Information Delivery Manual during design and construction phase with final IDM submitted per Document Submission Standards
3. Verification of assigned roles and responsibilities as documented in RFP and maintained throughout Design and Construction Process

4. 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 submitted by DB Team with each project milestone. These checklists and building information models may be audited by LACCD for BIM QA Reviews as part of the technical review at project milestones.

For each trade, the Lead BIM Technician shall coordinate with the Virtual Design and Construction Manager to complete their respective section of the checklist at each project milestone. Any major discrepancies or conflicts should be resolved prior to submission to LACCD.

## 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.

**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 -** Developed by Georgia Tech University, IDM (Information Delivery Manual is a means for documenting an integrated process data and analysis 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 -** 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 a 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 - S**patial **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. See the LACCD CADD Standards 3.1 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
8. **BIM Wiki Penn State University - http://bim.wikispaces.com/Work+Flows**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## Technical Footnotes

[1] **Finding the Revit Origin and Guidelines for Sharing Coordinates of an existing site file in Autodesk Revit** (source AUGI and Autodesk Revit Factory)

**a. Finding the Revit Origin**

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

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.

**b. Guidelines for Sharing Coordinates of an existing site file in Revit**

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) Here are a few guidelines recommended by Autodesk Revit Factory

- **Always** begin your building model 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 (world coordinate system). True North will be the .dwg's Y axis. Now your building knows where the .dwg 0,0,0 is, but it can still record its own information in smaller numbers 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 will likely fail -- 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]**Sheet Files for 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.

## [3] BIM Coordination Room installation and setup of Smartboards

Connect a notebook or desktop computer to the Smartboard(s) and projectors.

**BIM Coordination Room – 1 or 2 boards to notebook**