LACCD Building Information Modeling Standards

For Design-Bid Build Projects

(LACCD BIMS)

Interim Version 2.0

Prepared by:

BuildLACCD

September 9, 2009

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Overview

In conjunction with its Sustainable Building Program, the Los Angeles Community College District (LACCD) is committed to utilizing the tools of Building Information Modeling (BIM) to execute the design, construction and management of its new High Performance buildings, and the upgrade of its existing facilities and infrastructure to achieve a carbon neutral footprint for its nine campuses. The LACCD BIM Standards have been developed to define a process and establish requirements, procedures and protocol for the utilization of BIM in the various stages of our projects. These Standards are based upon the National Building Information Standards (NBIMS) and reference the current technology Standards developed by the General Services Administration (GSA), the US Army Corps of Engineers (USACE), 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 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.

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 generated from the Project BIM at project milestones designated by the contract. At the completion of Construction Documentation Phase, the Design Team shall provide to potential bidders a copy of the fully assembled and coordinated BIM in a non-editable format. (i.e. Navisworks nwd, dwf, 3d pdf).

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 Project Team for better visualization and coordination of the construction sequence for respective trades.
Prior to the start of construction, Design-Builder (General Contractor in Design-Bid-Build Projects) 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 teams 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. During Construction, visualization models may be developed by the Contractor to help simulate and sequence construction of a room before it is built.

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. For Design-Bid-Build Projects, Design Team shall provide awarded General Contractor a copy of the fully coordinated and assembled BIM (in Navisworks or equal), as well as copies of the Authoring BIMS for each trade (see Sec 3.2.c). These Authoring BIMS shall be used as basis for fabrication models generated by sub-contractors. It is recommended Design Team and Contractor establish a protocol for digital data exchange (i.e. interoperable file formats) prior to providing these models.

g. Design-Builder (or General Contractor in Design Bid Build Projects) shall utilize model geometry and extract graphical information for generating construction administration documents from the Project BIM, i.e. RFI's, Directives, Bulletins, Change Orders. Construction team shall record as-built conditions in BIM as part of final delivery to LACCD.

h. 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"[1]**

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. Contractor shall have modelers on site continuously updating constructed related changes. Design Team shall update design changes coordinated with the contractor via RFI's and change orders.

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.

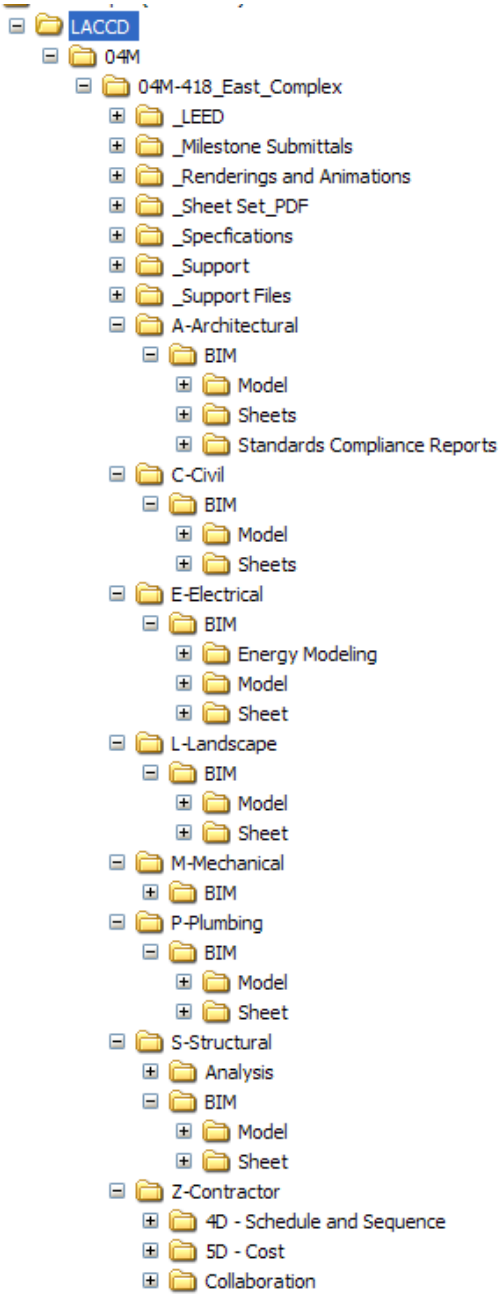
In addition to these BIM Standards, all LACCD Projects, shall refer to* sections 2.0 through 20.0, and the referenced appendices *of LACCD CAD Standards 3.0 for drawing requirements.

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.

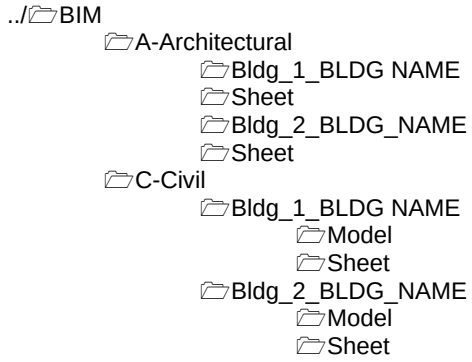
f. **Coordination Files** – Files for Construction coordination (clash detection) shall be managed by the BIM Facilitator or Builder, and organized by date as the project progresses.

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

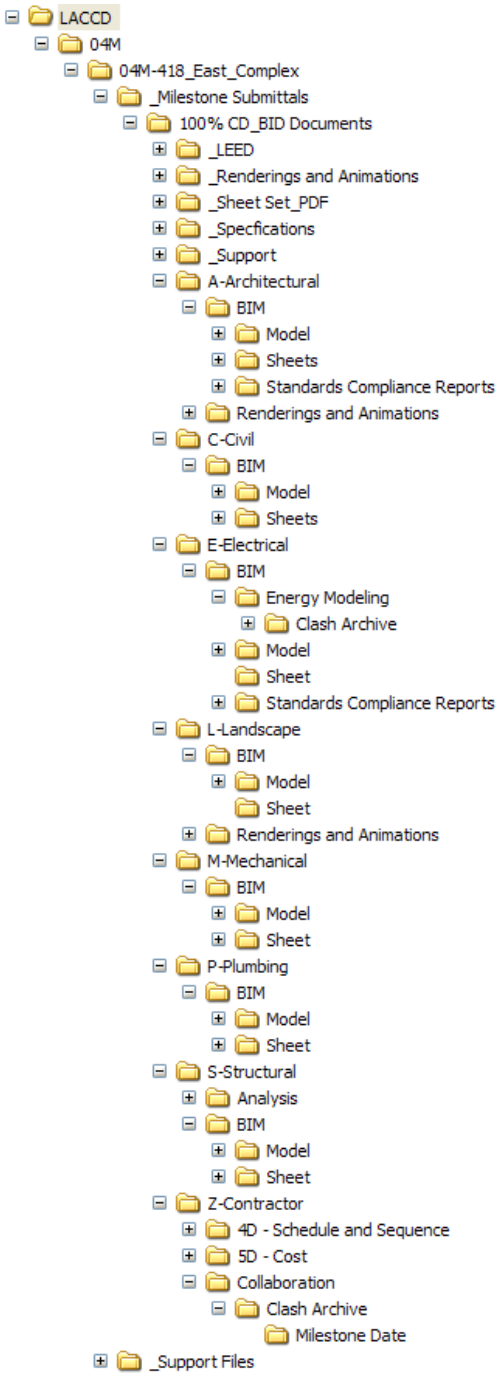
For projects that require multiple buildings:

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:



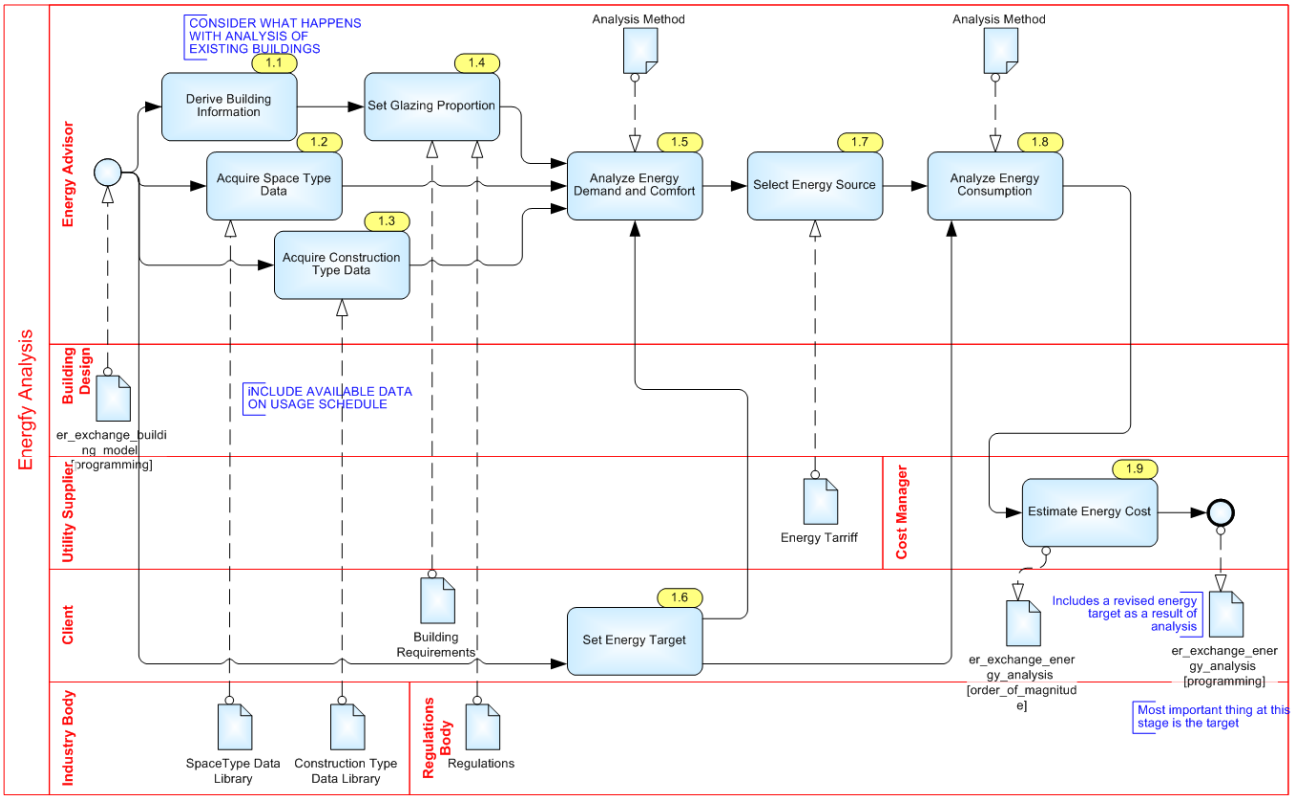
2.7 Information Delivery Manual (IDM)

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.

Design 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

Project Teams shall establish a data security protocol to prevent any possible data corruption, virus “infections” and data misuse or deliberate damage by their own employees or outside sources. Both the Design Team and Construction teams shall establish adequate user access rights to prevent data loss or damage during file exchange, maintenance, and archiving.

At the request of the college, project teams shall provide access rights for LACCD’s users/stakeholders for review and comment only.

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. These guidelines shall be considered Project BIM requirements not District BIM Guidelines. 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

a. Design Phase

1. Architect shall assign a Lead BIM Facilitator to coordinate BIM workflow per section 3.4 of LACCD BIM Standards.
2. Designers shall use trade specific analytic and authoring tools to create 3D models to meet predefined project requirements.
3. For Spatial Coordination, BIM Facilitator will integrate the design discipline and trade specific models into a consolidated 3D-model using coordination software (i.e. Navisworks, Bentley Navigator). The consolidated model will be used for assembling the various design models and providing a report and view list of design coordination issues.
4. Resolution of Spatial Conflicts: During coordination meetings, the Design 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.
5. Prior to each scheduled coordination meeting, an updated clash report will be issued by Project Team BIM Facilitator to track the progress of coordination, analyze conflicts and help facilitate issue resolution prior to construction.
6. Spatial Coordination Sign-off Drawings: Once all spatial conflicts have been resolved by the design team and the structural, architectural, MEP, and Civil systems have been fully coordinated, each consultant shall 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 be used as reference model for the construction team to coordinate compliance of fabrication models with design intent, and shall be updated in a timely manner to reflect design changes in the field.
7. 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.

8. DSA Review and use of digital models for approval will be developed in collaboration with DSA by LACCD.

b. Bidding Phase

1. As part of documents delivered to potential bidders, Design Team shall provide non-editable version of the coordinated BIM for reference and visualization of the building.
2. After Contract is awarded, the coordinated Design BIM and all native BIM files will be provided to the General Contractor.

c. Construction Phase

1. Prior to the start of construction, Contractor shall assign a Team BIM Facilitator to coordinate fabrication models with coordinated design model. If acceptable to the Contractor and Design Team, Contractor may request Team BIM Facilitator be the same individual assigned in the Design Phase.
2. Construction Trades noted in Section 3.2.4.c shall generate fabrication models using Design Team BIMs that have been issued for construction.
3. 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 RFI's and submittals.
4. As part of the requirement for record delieverables Contractor shall continually update the Construction Record BIMs with as-built conditions. Concurrently, Design Team shall update Design Record BIMs with 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.

a. **Shared File Server** - Prior to start of design,it is required that Design 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 same purposes during Construction. 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.

    1. 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.

2. 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)

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

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

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

1. LACCD BIM Standards and Workflow process
2. Statement of Owner's Project Requirements
3. All data developed during the project validation phase
4. Project Model Template (aka dataset)

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.

e. **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 BIM Collaboration Room ("BIM Theater")

During the Design Phases, the Design Team Prime Consultant will provide a room (BIM Theater) for facilitating BIM Collaboration. 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.

During Construction, Contractor will provide and set 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, convert them to RFI's or other relevant reference documents. [2]

3.2.4 Spatial Coordination and Clash Detection

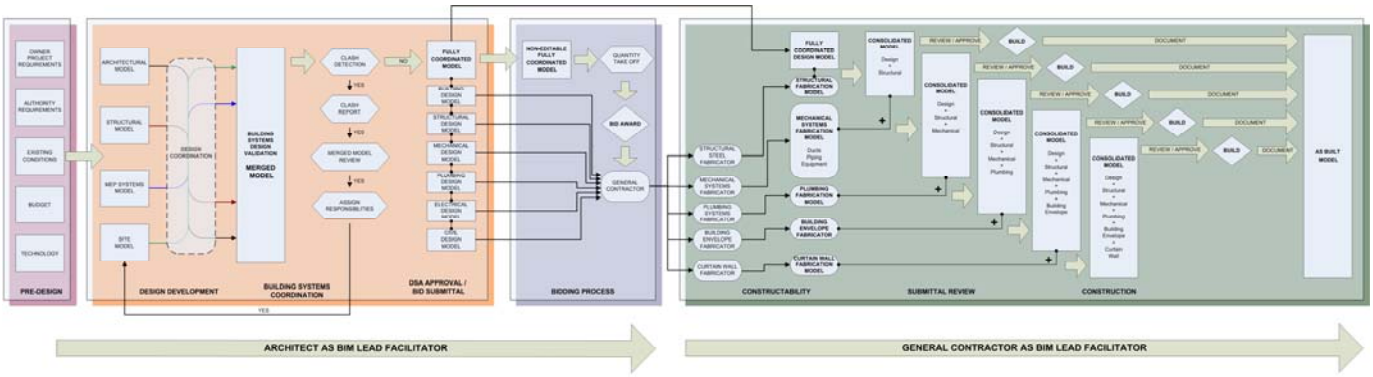


Figure 2 Illustrates the BIM based coordination process during design and construction phases

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.

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. In the Design Model, reasonable abstractions can be made (i.e. pipe fittings do not need to be modeled), and shall be coordinated with the Builder to ensure meaningful coordination and clash detection.
Before modeling begins, BIM Facilitator will work with team to develop a structure and features of the files that are to be submitted (Documents: File Structure, Modeling Scope Matrix). Typcially, BIM Coordination requires the following model structure and features:

1. Project team shall follow LACCD File Naming requirements as documented in LACCD CAD Standards **"Section 3.0 File Naming Guidelines"**
2. One file for each floor (or zone) of one floor and trade (e.g. 4 floors, 2 wings per floor, and 5 trades => 40 files)
3. For 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 BIM facilitator will adjust the elevations of the architectural and structural elements to 0'0".
4. All other trades will be modeled at the correct elevation (not all floors modeled at the same elevation).
5. All elements of the building must be represented in only one file and should be modeled by their specific trade. For example, the architectural model provided for 3D coordination should not include any of the structural elements contained in the structural model. Lights should be modeled by the electrical engineer, not the architect.

6. The architectural ceilings should contain openings for lights, registers, etc. as required.
7. All models should include separate 3D representations of required clearances and/or access requirements for equipment access, light clearances, overhead cable tray access, etc. These clearance/access models should be in a separate layer(s) for each trade clearly labeled as such.
8. The granularity of elements in the model has to correspond with the sequence of the installation at the site (e.g. not one wall element for the entire floor).
9. All 3D model files submitted for clash detection must be "clean" – with any extraneous 2D references and/or 3d elements stripped from the models.
10. 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

Prior to installation, Contractor will hold planning meetings with affected sub-contractors where the coordinated model will be used 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.

c. 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 fabricaton models with parametric model objects:

1. Structural Steel
2. Mechanical System Duct
3. Curtain Wall
4. Building Envelope Systems (i.e. rain screens, pre-cast panels)
5. Casework and furniture systems

6. Any additional fabrication models generated by subcontractor

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

d. Coordination of entire building - BIM Facilitator will assemble a composite model from all of the model parts of each design discipline for the purpose of performing a visual check of the building design for spatial and system coordination. Vertical shafts should also be reviewed to ensure that adequate space has been allocated for all of the vertical mechanical systems and that all of the shafts line up floor to floor.

e. Coordination, floor by floor - On a multistory project, the models may need 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.

1. 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.

f. Clash detection and reporting

1. Coordination software will be used for assembling the various design models and for providing a report and view list of design coordination issues. The Design Team, including Team BIM Facilitator and Discipline BIM Lead Modelers, will review the model and the Clash Reports in coordination meetings on a regular (weekly) basis.
2. The report will be reviewed by the team members and agreed upon solutions will be implemented per an agreed upon schedule. This process will be repeated throughout the design phases until all spatial and system coordination issues have been resolved.
3. During the construction phase, the Contractor shall utilize the fully coordinated and consolidated design model to verify the accuracy of certain fabrication models (ref. Sec 3.2.4.c). Prior to each fabrication submittal for approval, fabrication contractors shall submit their models to the Contractor's BIM Facilitator for integration with the Design Model.
4. 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 BIM Facilitator for spatial and system coordination.

3.3 Project BIM Work Plan

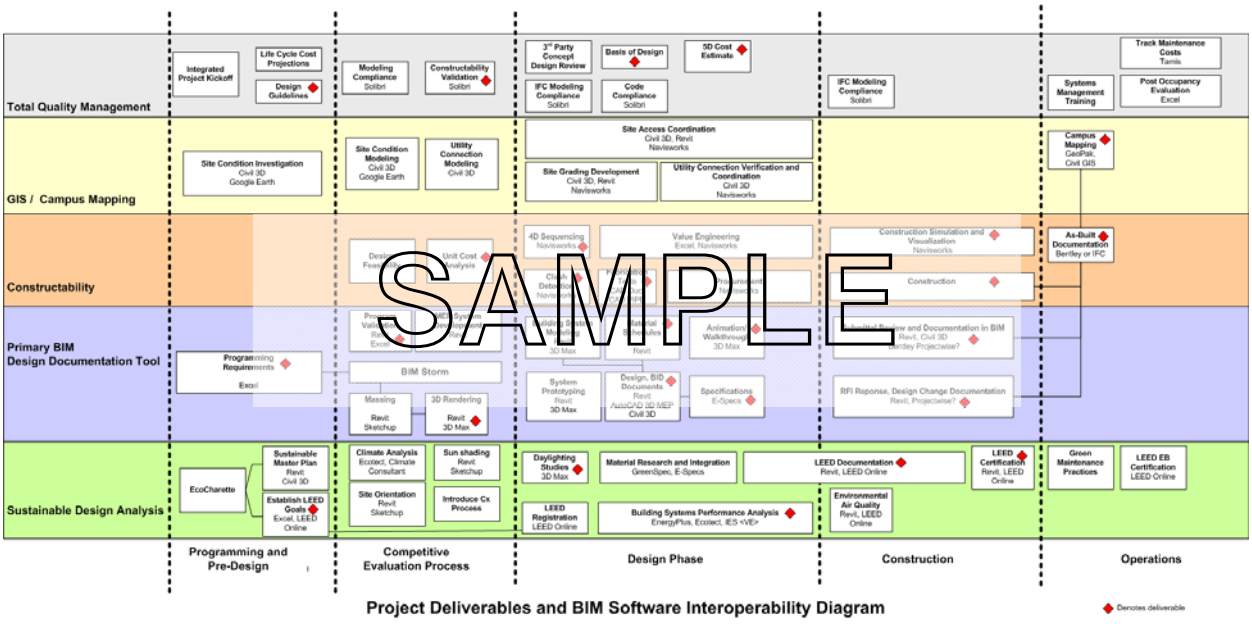
Design and Construction teams shall be required to submit to LACCD for approval, Project BIM Work Plans demonstrating their strategy for using Building Information Modeling to executing project deliverables.

a. **Design BIM Work Plan** - As part of their design proposal, The Design Team shall submit "BIM Work Plan" which shall contain the following:
    1. Proposed BIM Software to be used
    2. Proposed BIM Workshops and Training integrated in to project schedule
    3. Strategy for compliance with LACCD BIM Project Requirements **(ref. Sec 2 - BIM PROJECT REQUIREMENTS)**
    4. Schedule integrating progress BIMs per Design Document Submission Standards
    5. File formats used for project submittal and file exchange
    6. File exchange protocol
    7. Strategy for establishing and managing shared file server (ref. 3.2.2.a)
    8. Strategy for updating and coordinating design changes during construction using BIM
    9. Documentation of any proposed deviation from BIM Standards for LACCD consideration
    10. Project team qualifications and experience in BIM, and a list of individuals with relevant experience assigned to the following roles:
        - Design BIM Facilitator (ref. Section 3.4.1)
        - Mechanical System BIM Coordinator (ref. Section 3.4.2)
        - Lead BIM Technicians for all major trades (i.e. Architect, Civil, MEP, Structural)
        - Senior Project Designers and Engineers
        - BIM and IT Managers for all applicable trades

b. **Construction BIM Work Plan -** In the Bid, Contractor shall submit a Construction BIM Work Plan, outlining their strategy for utilizing BIM Technology to execute construction related activities and coordination
    1. List of Sub-contractors using digital fabrication per Section 3.2.4.c
    2. Proposed BIM Software to be used by the GC and fabrication modelers for approval by LACCD
    3. Proposed BIM Workshops and Training integrated in to project schedule
    4. Strategy for file exchange and integrating Construction Management Activities in to Shared File Server
    5. Documentation of any deviation from LACCD BIM Standards for LACCD consideration
    6. Proposed strategy for utilizing BIM during construction phase including:
        - Proposed use of digital fabrication to validate constructability of design
        - Updating as built conditions in Construction Record BIM
        - Integration of Record information in to Construction Record BIM
        - Proposed utilization of 4D Scheduling and Sequencing technology
    7. Project team qualifications and experience in BIM, and a list of individuals with relevant experience assigned to the following roles:

- Construction BIM Facilitator (ref. Section 3.4.1)
- Lead Fabrication Modelers for all trades in section 3.2.4.c

Figure 2 – Sample of Project BIM Work Flow



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 responsiblities outlined below.

3.4.1 Design Team BIM Facilitator

As part of the execution of the Design BIM Work Plan, Project Team shall assign an individual to the role of Design Team BIM Facilitator. The indivudal shall have at least 3 years of BIM experience and shall have relevant proficiency in proposed BIM Authoring and Coordination Software. This individual and their qulaifications 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:

a. Ensure compliance with Design BIM Work Plan
b. Coordinate Project-wide training sessions with LACCD BIM Coordinator
c. Coordinates software training and establishes protocol for efficient use of software

d. 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
e. Assembles composite design model for coordination meetings
f. Provide Modeling Quality Control / Quality Assurance Check of Design BIMs.
g. Facilitates use of composite design model in design coordination meetings
h. Ensures that BIMs are used appropriately to test design requirements / criteria
i. Interfaces with Project team BIM and IT Managers to ensure software is installed and operating properly
j. Interfaces with software developers to provide feedback and bug reports
k. Provides specifications for "BIM Coordination Room" to LACCD for approval
l. Facilitates BIM Technical meetings with Lead BIM Technicians
m. Ensure Design Team understands, supports, and meets LACCD Vision and Main Objectives for BIM **(ref. Section 1.2)**
n. Ensure the shared geo-reference points noted in Section 2.4.5 are distributed and used by ALL team members.
o. Interfaces with LACCD's e7 studio for data and file exchange as needed
p. Coordinate BIM File Exchange and archiving of Milestone Submittals

3.4.2 Lead BIM Technicians

a. All major design trades 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:
    1. lead the internal project team BIM in its documentation and analysis efforts
    2. Interface with Design BIM Facilitator for BIM related meetings and issues
    3. Coordinate internal project team training as required

3.4.3 Construction BIM Facilitator

As part of the execution of the Construction BIM Work Plan, General Contractor shall assign an individual to the role of Construction BIM Facilitator. This individual shall have at least 2 years of relevant BIM experience and shall have the ability to utilize the BIM software to help identify constructability issues. Assigned responsibilties shall be as follows:

a. Main point of contact between LACCD BIM Coordinator and Construction Team for BIM related issues.
b. Prior to and during Construction, interface with Campus IT to establish and maintain shared portal access and permissions
c. Prior to commencing construction, coordinates Sequencing and Scheduling is integrated with Construction Record BIM
d. Communicates to design team, the data extraction sets required by the construction team and ensures that these requests are met
e. Coordinate with design team to ensure design changes in the field have been documented and are updated in the Design Record BIM in a timely manner
f. Prior to approval and installation, work with Lead Fabrication Modelers to integrate 3D fabrication models with updated design composite model to ensure compliance with design intent
g. Coordinates update of as-built conditions in the Construction Record BIM
h. Ensures record documentation noted in Document Submission Standards are properly linked to Construction Record BIM for final submittal to LACCD

i. Coordinates software training and establishes protocol for efficient use of software for Construction Team
j. Provides specifications for General Contractor's "BIM Coordination Room" to LACCD for approval
k. Ensures Construction Team has necessary hardware and BIM Software properly installed and accessible for project use.

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 Department of Defense 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

APPENDIX

Diagrams and Technical Footnotes

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**.

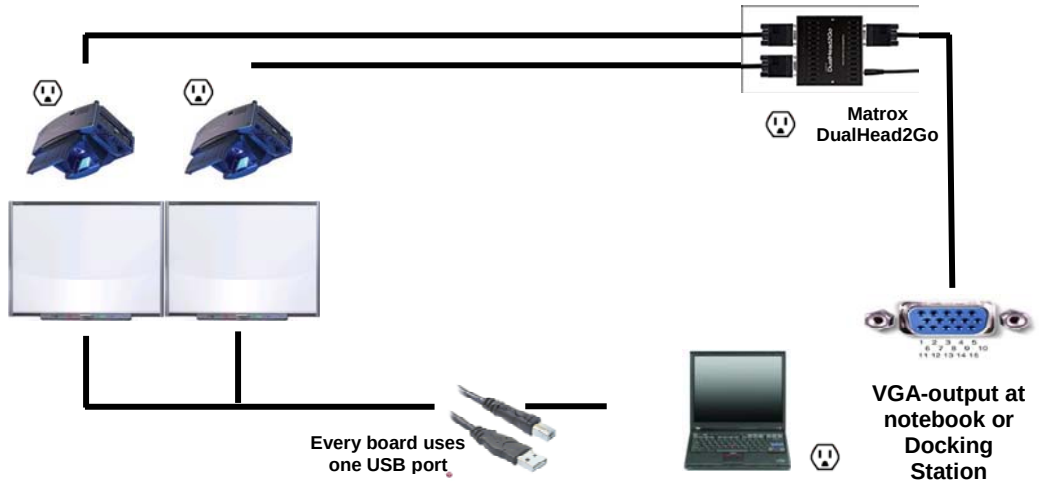
Project Coordinates origin can't be moved. This is not a problem unless you have more than one coordinate system that you need to work with on your project. When the project only needs one 0,0 point, you can locate Shared Coordinates to align with the coordinates in question

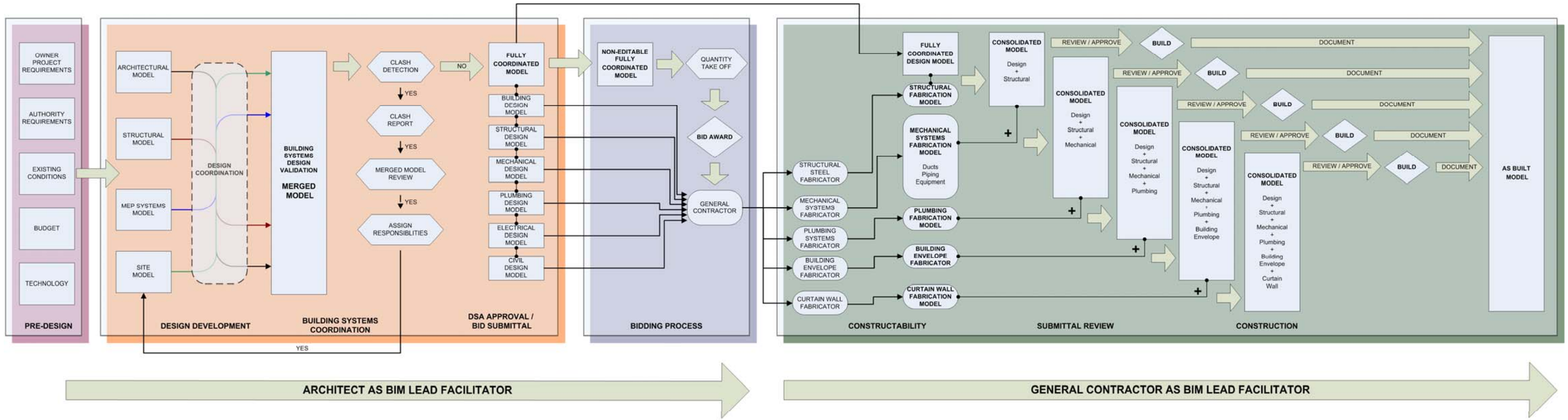
NOTE: if the Shared Coordinates origin and the Project Coordinates origins are more than 2 miles apart, importing by Shared Coordinates will likely fail -- it defaults to center-to-center. So if your DWG is a mile wide and 0,0 is in the middle of it, the Shared Coordinates origin must be less than 1.5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

[2] **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





BuildLACCD

BIM COLLABORATION WORKFLOW DIAGRAM FOR DESIGN-BID BUILD PROJECTS

9/9/09

BuildLACCD

Project Name and Number:

College: College Project Manager:

BIM Roles and Responsibilties Matrix

Firm/Company	Discipline(s)	Project BIM Facilitator Contact Info (one per team)	LEAD BIM Modeler Contact Info (one per firm/company)	Software and version to be used (list all)	file formats to be used (native and exchange formats)
Cervantes Arquitectos	Architecture		Howard Roark, AIA 1 Division St. #344 New York, NY	1.Revit Architecture 2010 2. Autodesk Navisworks 2010 3. Autodesk Ecotect 2010 4. Autodesk 3dMax 2010 5. Interspec E-Specs	1. .rvt, .dwg for CAD exchange 2. nwd, dwg 3. gbXML for analysis 4. 3ds, dwg 5. .xml
Millenium Builders	General Contractor	Harrison Smith 1124 Granite Road Irwindale, CA	Carla Baca	1.Revit Architecture 2010 2. Autodesk Navisworks 2010 3. AutoCAD Architecture 2010	1. .rvt, .dwg for CAD exchange 2. nwd, dwg 3. dwg for CAD Exchange
Falcon Engineers	Structural Engineer		James Falcon, P.E. 2687 Golden Ave. Rancho Cucamonga, CA	1.Revit Structural 2010 2. RAM Structural Analysis	1. .rvt, .ifc for BIM exchange 2. .rvt, ifc for BIM Exchange, .dwg for CAD exchange
Flowmax Mechanical	Mechanical Engineer/Contractor		Marvin Ventana, PE 1253 Buenos Aires Blvd Santa Clarita, CA	1.Revit MEP 2010 2. CAD Duct 2010 3. IES <VE>	1. .rvt 2. .dwg 3. .gbXML
Hydra Plumbing	Plumbing Engineer/Contractor		Roger Waters 356 Murky Meadow Dr Los Banos, CA	1. AutoCAD MEP 2. CAD Pipe 2010	1. dwg 2. .dwg
Mano Steel	Steel Fabricator		Clark Kent 431 Lois Lane Gotham, NY	1.Tekla Structures 2010 2. Revit Structural 2010	1. .rvt, .dwg for CAD exchange 2. nwd, dwg
Fiat Lux Electrical	Electrical Engineers		Jane Sparks, P.E. 677 Electric Avenue Downey, CA	1.AutoCAD MEP 2010	1. .rvt, .dwg for CAD exchange 2. nwd, dwg 3. gbXML 4. 3ds, dwg
Tierra Group	Civil Engineer		Joe Dirt, P.E. 222 Clay St. Sand Canyon, CA	1 AutoCAD Civil3D 2010	1. .dwg
Pflanze Landscape Architects	Landscape Architecture		Robert Pflanze 777 Oak Street Redwood City, CA	1.AutoCAD Architecture 2010	1. .dwg
Redline Fire Protection	Fire Protection/Sprinklers		Larry Spritz 1250 Pyro Lane Anaheim, CA	1.Sprink CAD 17.4 2. AutoCAD MEP 2010	1. .dwg 2. .dwg
FiberCom	Telecom/Low Voltage		Patrick Bell 132 Orange St Singal Hill, CA	1.AutoCAD MEP 2010	1. .dwg

BuildLACCD

Project Name and Number:

College: College Project Manager:

BIM Roles and Responsibilties Matrix

Firm/Company	Discipline(s)	Project BIM Facilitator Contact Info (one per team)	LEAD BIM Modeler Contact Info (one per firm/company)	Software and version to be used (list all)	file formats to be used (native and exchange formats)