

A large, faint, and slightly blurred architectural rendering of an airport terminal building, showing a complex structure with multiple wings and a central hub, serving as a background for the cover page.

# Volume 3: **BIM Project Execution Plan (BPXP)** **Template for** Building Information Modeling

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# 1 INTRODUCTION

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## 1.1 Preface

This template exists to document the decisions made by the project team in working through the BIM Execution Planning Process. Several other files have been provided to help teams work through this process.

## 1.2 Additional Documents

- Worksheets: These are tools designed to help the decision making process and record the result. These become attachments to the final document
- Instructions: Provide guidance for the overall process as well as step by step instructions for the worksheets.

## 1.3 Instructions

Several forms of instruction exist throughout this document to help teams through the Project Execution Planning process. Within this document there are two styles of text:

1. Text in **Green** is of the style Example TEXT. Any text of this style is just sample text and should be replaced by actual text per project.

**If modified, the format of the text should be changed to match the rest of the document.**

This can be completed, in most cases, by selecting the normal style in the template styles.

Alternatively CTRL-Shift-C will copy formatting from selected text and CTRL-Shift-V will paste the formatting onto existing text

2. INSTRUCTIONS: Text in Grey is part of the original template and has been expanded in this document. All text in this format should be deleted as the form is filled out per project. Note that placeholder text and text used to reference other sources, as temporary content will be formatted with this style. As the document develops and a greater level of detail or finalization occurs, this format should be replaced with appropriate body text.

## 2 BIM PROJECT EXECUTION PLAN OVERVIEW

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### 2.1 BIM Execution Plan

The goal of LAWA is to integrate BIM and take advantage of the information model created during design and construction to enhance and feed into existing and future facilities processes. To successfully implement Building Information Modeling (BIM) on a project, LAWA has developed this detailed BIM Project Execution Plan. The BIM Project Execution Plan defines uses for BIM on the project (e.g. design authoring, cost estimating, and design coordination), along with a detailed design of the process for executing BIM throughout the project lifecycle. Additionally, this plan is to provide all stakeholders with a delineation of roles and responsibilities detailing scope of information to be shared, relevant business processes and supporting software.

This template exists to document the decisions made by the project team in working through the BIM

#### **BIM Project Execution Plan Change Management**

*This is designed to be a living document that will change throughout the life of the project. Changes requested to this document must be submitted in writing to the BIM Manager for LAWA. To be accepted into the document, changes must be agreed to by the BIM leads for key project stakeholders, by LAWA or have no impact on scope or schedule. Key Project Stakeholders are identified in bold in table 2.2 Key Project Contacts*

Execution Planning Process on a project by project basis. Several other files have also been provided to help teams work through this process.

### 2.2 What is the BPXP?

The BIM Project Execution Plan (BPXP) is an agreement by all parties of a project to share in the development and use of a common Building Information Model for a specific project. It is a document intended to help plan the ownership and scope of the models involved in preparing a BIM project for LAWA. LAWA requires a BPXP be developed to provide a master information/data management plan including assignment of roles and responsibilities for model creation and data integration which include design professionals of all team members.

#### 2.2.1 Typical Project Information

Typically included in this plan are records of the following items, agreed by consensus of all teams involved in the project:

- 1) General Project Information
  - a) Who is involved in this project?
  - b) Contract type / Delivery method
  - c) Milestones of the project
- 2) General File Issues
  - a) Naming conventions (how are the files to be named?)



- b) How files are transferred between parties

### 2.2.2 Typical BIM Information

These items are typical for most project agreements, however, the PXP adds in several items that help identify qualities of the project unique to BIM:

- 1) **Level Of Detail:** How much and what detail of modeling will be included at each milestone?
- 2) **Level of Development:** Is the degree to which the elements geometry and attached information has been thought through – the degree to which project team members may rely on the information when using the model
- 3) **Authorship:** Who is creating that level of detail at each milestone?
- 4) **BIM Uses:** How does the project team want to use the BIM Model for each milestone?

Each of these last three items is included in a BPXP specifically because they help identify common BIM project collaboration issues before they happen.

### 2.2.3 BPXP Submission Schedule

The Design Build Team shall submit a completed BIM Project Execution Plan (BPXP) to LAWA within thirty (30) days of contract execution. This BIM Project Execution Plan shall identify the entire Project BIM Team including all consulting engineers and any specialty consultants. The BPXP should be considered a living document and shall be continually developed and refined throughout the project development lifecycle.

Upon receipt of the BIM Project Execution Plan, LAWA will have thirty (30) days to review and approve the plan. If the BPXP is rejected by LAWA, the Design Build team has thirty (30) days to resubmit. LAWA has thirty (30) days to review the resubmitted plan. An approved plan must be in place within one hundred twenty (120) days unless otherwise noted in contract.

In those projects where construction information is available during the design phase (using the PROJECT TEAM, IPD or other project execution strategies), the BPXP shall address both design and construction activities.

For project delivery strategies where the contractor is not part of the original Project BIM Team, the BPXP also should include roles and responsibilities of the contractor(s) even if that party has not yet been identified.

### 2.2.4 LAWABPXP Document List

The LAWA BPXP is not a single document, rather a set of documents provided to aid in the creation, organization and delivery of BIM projects. This set of documents serves two main purposes for any LAWA project:

- Provides a group of tools to facilitate a group consensus/decision making process.
- Provides a format to record the process and final decisions made during that process.

While some of the BIM Project Execution Plan is background information such as project name etc, the bulk of the plan is a set of instruments designed to help focus the expectations and responsibilities of all parties involved in the BIM aspects of the work based on goals set by the team.

By working through the BIM Project Execution Plan Process, each team:

- Clarifies the Level of Detail they will be contributing to the model
- Clarifies the Level of Development of the model at specific deliverable milestones.
- Identify their processes (BIM Uses) and any unique needs from the model

Each of these documents is attached to this one for the use of the Design Builder to develop the required deliverables for the Validation period.

## 2.2.5 LAWA: BPXP documents

Here is a list of the BPXP documents:

LAWASM: BIM STANDARDS	TITLE
BPXP Documents	LAWA - BPXP Template.docx
BPXP Worksheets	LAWA – BPXP BIM Matrix.xlsx
	01 - Team Members
	02 - BIM Matrix
	03 - Level Of Development
BPXP Process Maps	LAWA - BPXP Process Map Templates.vsd

### ***BPXP Documents***

This document is the base file to be completed for all LAWA projects by the Project BIM Team and is part of the BIMPXP package submitted to the LAWA.

### ***BPXP Worksheets***

The two worksheets are provided to help clarify the project goals, ownership and deliverables based on the needs of the project and project team makeup. The worksheets, once completed, will become attachments to the submitted Project Execution Plan.

### ***BPXP Process Map Templates.vsd***

a) This Visio file has multiple tabs to identify “process mappings” for all phases of the work. To view a “sample” map, open the example file titled: LAWASM - BPXP Process Map Templates Example.vsd.

b) The Project BIM Team is to create an overall roadmap of the BIM progress from start to end (concept to owner), identifying project milestones (Level 1 map below).

## 2.3 Project Information

This section defines basic project reference information and determined project milestones.

<b>Project Owner:</b>
Los Angeles World Airports
<b>Project Name:</b>
<b>Project Location and Address:</b>
verify address with LAWA staff
<b>Contract Type / Delivery Method:</b>
(Design Build, Design-Bid-Build, PM/CM, etc.)
<b>Brief Project Description:</b>

## 2.4 Key Project Contacts

The following is a list of lead BIM contacts for each organization on the project.

This is a high level list of contacts; additional contacts can be included later in the document.

FIRM	ROLE	CONTACT NAME	E-MAIL	PHONE

### 3 PROJECT BIM GOALS/BIM USES

#### 3.1 Major BIM Goals/Objectives

State Major BIM Goals and Objectives

PRIORITY (HIGH/ MED/ LOW)	GOAL DESCRIPTION	POTENTIAL BIM USES
High	Project Documentation	
High	Clash detection / consultant coordination	
High	Capture pertinent data for facilities management	

#### 3.2 BIM Uses

**Key:** LAWA PT = Project Team **Function:** P = PRIMARY S = SECONDARY R = REVIEW

X = Required		X = Desired, but Not Required		X = Not Required		
EXISTING CONDITIONS MODELING						
Description	Pre-Construction		Design	Construction	Facilities Management	
Laser Scanning (Exterior, Interior, Featured MEP)	X	PT / P, LAWA / R	X	PT / P, LAWA / R	X	LAWA / P
Development of BIM from existing documents	X	PT / P, LAWA / R	X	PT / P, LAWA / R	X	PT / P, LAWA / S, LAWA / P
Field Capture Model	X	PT / P, LAWA / R	X	PT / P, LAWA / R	X	PT / P, LAWA / R
DESIGN MODELING						
	Design		Construction	Facilities Management		
Design Authoring						
Design Visualization-all disciplines	X	PT / P, LAWA / R	X	PT / P, LAWA / R		
Design Alternatives-all disciplines	X	PT / P, LAWA / R	X	PT / P, LAWA / R		
Way finding Analysis	X	PT / P, LAWA / S	X	PT / P, LAWA / S	X	LAWA / P
Spatial Coordination	X	PT / P, LAWA / R	X	PT / P, LAWA / R		
Asset Management						
Operational Planning	X	PT / P, LAWA / R	X	PT / P, LAWA / R	X	LAWA / P
Data Normalization	X	PT / P, LAWA / R	X	PT / P, LAWA / R	X	LAWA / P
Room Management and Tracking	X	PT / P, LAWA / R	X	PT / P, LAWA / R	X	LAWA / P
Area Space Management	X	PT / P, LAWA / S		PT / P		LAWA / P
Design Model Reviews						
Space and Equipment review	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Building code analysis	X	PT / P, LAWA / R	X	PT / P, LAWA / R		
Constructability	X	PT / P, LAWA / S	X	PT / P, LAWA / S		LAWA / P

Analysis						
Sustainability	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Structural	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Lighting	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Mechanical	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Energy	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Other	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Reconciled Record Design Model						
Model management during CA	X	LAWA / P, DB / R	X	LAWA / P, PT / R	X	LAWA / P
Incorporation of Changes	X	PT / P, LAWA / R	X	PT / P, LAWA / S / R	X	LAWA / P
Incorporation of RFI	X	PT / P, LAWA / R	X	PT / P, LAWA / S / R	X	LAWA / P
Incorporation of Submittals			X	PT / P, LAWA / R	X	LAWA / P
CONSTRUCTION MODELING						
	Design		Construction		Facilities Management	
3D Coordination						
Clash Detection / Trade Coordination	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Site Utilization / Logistics / Crane Lifts	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Manufacturing / Digital Fabrication	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Field Data Management	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Interactive Project Site	X	PT / P, LAWA / R	X	PT / P, LAWA / R		LAWA / P
Construction Layout			X	PT / P, LAWA / R		LAWA / P
4D Modelling / Phase Planning						
Full Project Schedule	X	PT / P, LAWA / S	X	PT / P, LAWA / R		
Look Ahead Schedule	X	PT / P, LAWA / S	X	PT / P, LAWA / R		
As scheduled vs. As built	X	PT / P, LAWA / S	X	PT / P, LAWA / R		
Procurement Tracking	X	PT / P, LAWA / S	X	PT / P, LAWA / R		
Safety Management	X	PT / P, LAWA / S	X	PT / P, LAWA / R		LAWA / P
Operational Impact Analysis	X	PT / P, LAWA / S	X	PT / P, LAWA / R		LAWA / P
5D Modelling / Cost Estimation						
Quantity Take Off	X	PT / P, LAWA / S	X	PT / P, LAWA / R	X	LAWA / P
Projected Cash Flow	X	PT / P, LAWA / S	X	PT / P, LAWA / R	X	LAWA / P
COMMISSIONING AND CLOSEOUT						
Description	Design		Construction		Facilities Management	
QA/QC	X	LAWA / P, PT / R	X	LAWA / P, PT / R	X	LAWA / P
Punch List	X	PT / P, LAWA / R	X	PT / P, LAWA / S	X	LAWA / P
Commissioning	X	PT / P, LAWA / R	X	PT / P, LAWA / S		LAWA / P
Ability to link to CMMS			X	PT / P, LAWA / R	X	LAWA / P
Ability to link to BAS			X	PT / P, LAWA / R	X	LAWA / P

FACILITIES MAINTENANCE AND OPERATIONS					
Description	Design		Construction		Facilities Management
Integrate with Space management			X	PT / P, LAWA / R	X LAWA / P
FACILITIES MAINTENANCE AND OPERATIONS					
Description	Design		Construction		Facilities Management
Verified as-built geometry			X	PT / P, LAWA / R	X LAWA / P
Verified as-built Data			X	PT / P, LAWA / R	X LAWA / P
Data integration with CMMS			X	PT / P, LAWA / R	X LAWA / P
Integration with GIS Systems					
Circulation and Security, Emergency Management & Analysis, Traffic Studies, Zone Analysis			X	PT, LAWA / P	X LAWA / P
ALP airport layout plan			X	PT, LAWA / P	X LAWA / P
Exterior Feature definition and Capture			X	PT, LAWA / P	X LAWA / P
Survey Control and Coordinate Systems			X	PT, LAWA / P	X LAWA / P
Interior Schema Feature definition and capture			X	PT, LAWA / P	X LAWA / P

### 3.3 Model Definitions

#### 3.3.1 As-Built Model

The “As-Built Model” is a further development of the “Construction Model” that has been spatially and technically validated in the field. Prior to the start of construction, the contractor shall submit a plan to the Owner for review that outlines the required process for concurrent as-built documentation. This validated Model is generated by the contractor or trade subcontractor incorporating all changes in the project and any deviations between the construction drawings and the work actually built. Validation may occur through physical measurement or electronic measurement techniques.

#### 3.3.2 Construction Model

The Construction Model is generated by the Contractor or trade subcontractor. The Construction Model is developed to be used for generation of Coordinated Construction and Shop Drawing Level Information. It must be clear that each party be able to rely on the fact that the model furnished by others (designer, contractor, or trade subcontractor) “match” the 2D contract documents or shop drawings, generated by the model, in their equivalent state of development.

#### 3.3.3 Design Model

A Model that has reached the stage of completion in 3D that would customarily be expressed by an architect or engineer in two-dimensional construction documents. A Design Model is generally, an assemblage of several Models produced by various disciplines, each of which is comprised of numerous Objects. It must be clear that each party be able to rely on the fact that the model furnished by others (designer, contractor, or trade subcontractor) “match” the 2D contract documents or shop drawings, generated by the model, in their equivalent state of development.

#### 3.3.4 Facilities Model

The Facilities Model is developed from the Reconciled Record Model. It is extracted at a point in time when the 3D content has been substantially reconciled with the Contractors As-Built Models. The Facilities Model shall be purged of all extraneous views, stories, abandoned Design Options,

miscellaneous in-place object creation and testing places, and any other content not represented in sheet views. The majority of details, sections, elevations, and annotation sheets may be removed from this model. Specified plan sheets, schedules, and legends shall remain in the model.

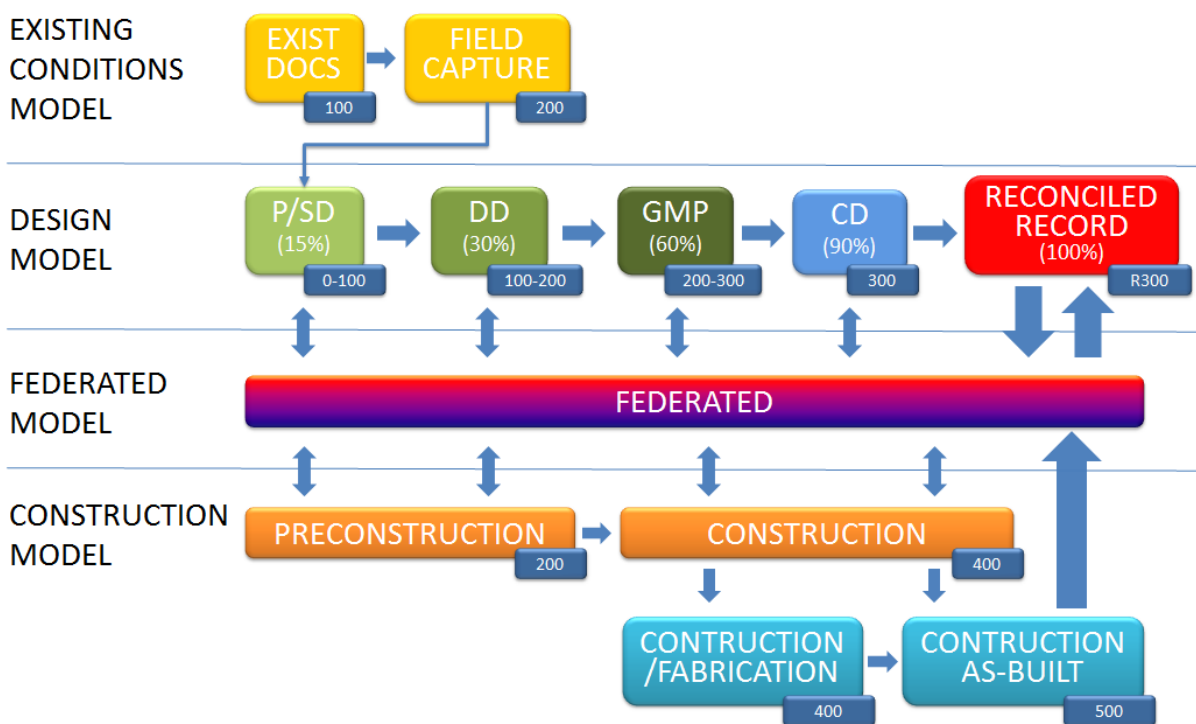
### 3.3.5 Federated Model (FED)

The Fed Model is comprised of all linked, Native Models and is a virtual representation of the entire Project developed to a specified Level of Development. The FED Model shall consist of all discipline Native Models such as Civil, Architectural, Structural, Mechanical, Electrical, Fire Protection, and Special Equipment, depending on the specific scope of the project.

### 3.3.6 Reconciled Record Model (RRM)

The model developed as a result of aligning the Design Model with the Contractor provided As-Built Model(s) for spatial coordination. The RRM is the basis BIM model of the “Record Documents” and is submitted as part of project close-out. Prior to the start of construction, the designer shall submit a plan to the Owner for review that outlines the required process for concurrent reconciled record model documentation.

### 3.3.7 BIM Model Progression Diagram



- Models may be transferred for the purpose of allowing the recipients to develop derivative models to develop the means and methods by which to construct the project.
- It must be clear that each party be able to rely on the fact that the model furnished by others “match the 2D contract documents or shop drawings in their equivalent state of development”

## 3.4 Organizational Roles/Staffing

The project team will provide oversight for BIM during LAWA projects. Each of the prime contacts for the project team and each AoR for BIM are highlighted in table 2.2. Each of these teams is separately in charge of identifying staffing needs and meeting the BIM requirements for their particular scopes of work.

## 3.5 Training

### 3.5.1 LAWA BIM Design Submittal Process Training

LAWA Recognizes that in order to achieve maximum effect of incorporating BIM-based technologies and processes into its overall lifecycle operations, management and development goals, specific training would be required for vendors and agents doing business with LAWA.

This training will be a requirement of all vendors and agents wishing to engage with LAWA concerning any/all existing and future BIM-based project development. The training will focus specifically on how vendors and agents would engage to begin, develop and submit LAWA projects utilizing specific LAWA processes, workflows and software, and is intended to be technical in nature. Training shall be scheduled to be completed within 30 calendar days of initial release of the Project BIM Execution Plan.

### 3.5.2 Training Outline [Design / Project Teams]:

- Review LAWA BIM Goals & Objectives
  - Why BIM at LAWA? Why Data normalization?
  - High Level Workflow Overview
  - Templates, IT/Infrastructure & CMMS Overview
    - BPXP - Project Execution Planning
    - LAWA KoP - (coming Spring 2018)
      - Revit Project & Family Templates
      - Existing Conditions Models / Legacy Data
      - Data normalization Database/Content
      - FM/OM/Specifications Data
    - Project Milestone Submission Requirement Overview
- Starting A Project (Reference LAWA BIM Standards Manual for Additional Information)
  - Locating LAWA Master Content
    - LAWA BPXP
    - LAWA BIM Site, Project & Family Templates
    - LAWA Data normalization Database/Content
    - IT/Infrastructure & CMMS
- Using LAWA Master Content / KoP (Kit of Parts)
  - Creating A Revit Project
  - Locating the Project Design Models
  - Creating A Data normalization Project
  - Creating/Modifying Revit Families
  - Linking Spaces, Doors and FF+ Equipment
- Developing A Project
  - Project Milestone Submission Requirements
    - IT/Infrastructure & CMMS
    - Team Collaboration / Data Federation
    - BIM & Data normalization Spaces, Doors and FF+ Equipment
    - Quality Controls / Standards Review / Model & Database Review
    - Blending and Vetting Data Record Milestone Deliverables
    - Record Milestone Submission
    - Updating Master Content / CMMS
  - Updating: Design to Construction Data for downstream FM/OM use
- Closing A Project/Final Submission As-Built



## 4 PROJECT BIM GOALS/BIM USES

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Process maps for each BIM Use in section D: Project Goals/BIM Objectives are provided as an attachment to this document. These process maps provide a detailed plan for execution of each BIM Use and are designed to be a visual aid in understanding the workflows involved in the project. They also define the specific Information Exchanges for each activity, building the foundation for the entire execution plan. The plan includes the Overview Map (Level 1) of the BIM Uses, a Detailed Map of each BIM Use (Level 2), and a description of elements on each map, as appropriate.

### 4.1 Level One Process Overview Map: Attachment 1

*Attached*

### 4.2 List of Level Two – Detailed BIM Use Process Maps: Attachment 2

The following is a list of the BIM Uses mapped in Attachment 2

1. Existing Conditions Modeling
2. Programming (not used)
3. Site Analysis (not used)
4. Design Authoring
5. Design Coordination (not used)
6. Data normalization Integration
7. Design Review
8. Energy Analysis (if applicable)
9. Lighting Analysis (if applicable)
10. Structural Analysis (if applicable)
11. 3D Spatial Coordination
12. 3D Control and Planning
13. Construction Authoring
14. Site Utilization Planning
15. 4D Modeling (scheduling)
16. Cost Estimation (5D Modeling)
17. Record Modeling
  - Reconciled Record 300 Level Model
  - Coordinated Model Process
  - Data normalization Design Integration Process
18. Maintenance Scheduling
19. Building System Analysis
  - Request for Information (RFI)

### 4.3 BIM Process Design Phase – General Notes

There are several elements that will need to be addressed by the various design and documentation teams as general information that does not appear in other locations in this document or the LAWA BIM Standards Manual. This information will need to be maintained consistently throughout all of the models and is listed below:

## 4.4 Area Calculations

LAWA follows the BOMA / ANSI Z65.3 2009 standards for general square foot calculations for area (gross and net) calculations. For the area plans calculated in Revit, area plans will be created for each floor. Areas will be calculated at finished floor elevation for all levels. LAWA area plans will be labeled LAWA - BOMA-Level XX for gross department calculations. These area plans will be used to compare programmatic areas required by LAWA. Each plan will contain the following departments:

- Building Common Area (restrooms, janitor closets, ticketing, lobby, storage)
- Exterior Area (covered areas, exterior stairs, loading, outdoor baggage)
- Major Vertical Penetrations (stairs, elevators, mechanical shafts)
- Office Area (airport offices, bag claim, concessions, retail)

## 4.5 Sensitive Security Information

The LAWA project will follow the SSI (Sensitive Security Information) guidelines set forth by LAWA in accordance with TSA regulations.

# 5 BIM INFORMATION EXCHANGES

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Model elements by discipline, level of detail, and any specific attributes important to the project are documented using an information exchange worksheet. LAWA has provided two worksheets as attachments 3 and 4 to this document.

## 5.1 BIM Matrix Worksheet: Attachment 3

## 5.2 Level of Detail Worksheet: Attachment 4

Note: The **LAWA – BPXP BIM Matrix.xlsx** combines the “Attachment 1 – BIM Matrix (Model Progression Specification)” and “Attachment 2 – Level of Development Worksheet” into a single spreadsheet:

# 6 BIM AND FACILITY DATA REQUIREMENTS

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LAWA requires all Revit building projects to include a corresponding Data normalized project database. LAWA will provide the AE Consultants and Contractors, at the start of each project, the LAWA Kit of Parts (KoP) which will include pre-built Revit family components as well as templates for creating Revit Projects and Component Families that have LAWA graphic standards built in. The LAWA KoP also includes a list of parameters required as part of the BIM milestone submissions

As per this LAWA BPXP, the AE Consultants and Contractors will organize the structure and linking of all the Revit models that make up each project. Those multiple models are then to be aggregated into single project database. All objects (equipment, fixtures, etc.) that exist within the Revit project models are to be linked to their corresponding room within the project database using the LAWA Data normalization methods specified in the LAWA BIM Standards Manual.

During the scope of work, the first, official submission delivered to LAWA by the A+E consultants will be for the 50% Schematic Design issue. All subsequent project Design submissions to LAWA will include the BIM models and a corresponding Data normalization project database. Between official submission deadlines, the LAWA will review both the BIM model and model database regularly to ensure consistency and alignment with the process.

## 7 COLLABORATION PROCEDURES

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### 7.1 Communication

**Design Phases:** The Design Team will use Electronic file collaboration sites for the exchange of electronic documents between the design consultants. Access to the chosen system is to be provided and managed by the Project Team. Files will be shared via the collaboration site which will allow document sharing via a synchronized file structure.

### 7.2 Document Management

#### 7.2.1 Uploading Files

When team members upload files to the collaboration site, please organize information in either folders with current date and/or an archived zipped file. This will ensure that the data is easily understood by the rest of the team. When uploading files, please send out an email to all affected parties including the following:

- Uploaded files (list of file names)
- Summary and purpose of contents
- Location (if placed in specific folder)

#### 7.2.2 Upload Frequency

Each project team will upload current project data at least once a week in order to maintain the latest working files throughout the design & construction process.

- Uploads will occur throughout the work week, but will occur consistently as follows:
- Mandatory upload date/times: Every Monday no later than 5:00 PM PST

#### 7.2.3 Downloading Files

It is the responsibility of each team member to always download the latest files necessary to complete their task. Please check the folder location, name and dates of the files you download. This will reduce coordination errors throughout the design and construction phases. Teams are encouraged to link directly to the Collaboration folder structure and content so new backgrounds will be automatically linked once the synchronization is completed.

### 7.3 Records Storage

The Project Team shall produce a Model Archive at the end of each Major Design Deliverable and shall preserve the Model Archive as a record that may not be altered for any reason.

Phases in which Model(s) are to be archived shall follow the proposed Design Deliverable schedule of the contract and may be similar to the following:

- Completion of Schematic Design
- Design Development at key project milestone completion
- GMP bid
- Construction Documents at key project milestone completion
- Shop Drawings / Fabrication Models
- As-Builts

The Model Archive shall consist of two sets of files. The first set shall be a collection of individual Models as received from the Model Element Author(s) in the original file format(s). The second set of files shall consist of the aggregate of those individual Models in a format suitable for archiving and viewing. The second set shall be saved in the following file formats (or approved alternative):

- Autodesk NavisWorks .nwd
- Autodesk Revit .rvt
- Data normalization .db
- Synchro .sp
- Primavera .xer
- Autodesk Civil 3D .dwg and .xml
- Portable Document File .pdf

## 7.4 Meeting Procedures

### 7.4.1 Kickoff Meeting

At the beginning of the project, the PROJECT TEAM will hold a BIM introduction or "kickoff" meeting to establish the BIM program(s), procedures, organization and setups for all members of the Design Team. Topics to be covered are:

- Project Information
- BIM Project Execution Plan
- LoD
- Critical Path Deadlines
- Version & Build of Revit to be used
- Data Normalization process/procedures
- How each team will use Revit
- General Requirements / Deliverables
- Spatial Coordination
- Model Divisions and Sharing
- Building Areas of Responsibility (Shared Models)
- Team Responsibility (BIM Point of Contact)
- File Divisions / Organization
- Best Practices / Guidelines
- Anticipated Model Uses
- Procedure for Updates
- Coordination and Communication
- Best Practices

MEETING TYPE	PROJECT STAGE	FREQUENCY	PARTICIPANTS	LOCATION
BIM REQUIREMENTS KICK-OFF	Schematic Design	Once or as needed for new team members	All are required once	LAWA Offices
BIM EXECUTION PLAN DEMONSTRATION	Schematic Design	Once or as needed for new team members	All are required once	LAWA Offices
DESIGN COORDINATION	All Design Stages	Formally at major submission deadlines. Informally weekly.	All	Virtual
CONSTRUCTION OVER-THE-SHOULDER PROGRESS REVIEWS	TDB by CMGCs	Weekly or as needed	All required based on phase	Virtual

#### 7.4.2 Supplemental Instructions for LAWA BIM Project Execution Planning

The LAWA BIM Project Execution Plan is based on a template provided by CIC/Penn State. The template word document and each of the worksheets have been modified for use by LAWA.

#### 7.4.3 Coordination

Models will need to be exchanged with the LAWA and additional Contract teams for coordination. Timing for the exchange of models is based on key project milestones as defined by the LAWA and PROJECT TEAM for individual contracts.

#### 7.4.4 Recurring Regularly Scheduled Activities

- Design and Construction coordination meetings – to be scheduled by the Design Build Team leads at a frequency that is meaningful for the LAWA and other stakeholders.
- Model Coordination meetings – to occur a maximum of once a week on Tuesdays at 10am. The purpose of these meetings is to coordinate non-design information during the design phase such as errors and warnings, modeling best practices, standards coordination, etc.
- Construction coordination meetings – Clash Detection – Weekly. Date, time and location TDB.

#### 7.4.5 Model Archive Schedule

Models will be uploaded to the “Package of the Week” folder on the Collaboration Site. From there, the models will be collected by the Project Team and filed in their appropriate design folders. Archives will be kept weekly for 4 weeks and monthly for 4 months on the Collaboration site. Weekly archives will be kept outside of the Collaboration site for the length of the project.

#### 7.4.6 Project close-out and final BIM deliverables

The collection of individual Models as received from the Model Element Authors(s) shall be delivered as BIM & 3D models in their native file formats.

The aggregate of those individual Models will be in Autodesk NavisWorks .NWD format. Implementation of the Model for facilities management and maintenance is TBD during the validation phase.

INFORMATION EXCHANGE	FILE SENDER	FILE RECEIVER	ONE-TIME FREQ.	MODEL FILE	MODEL SOFTWARE	NATIVE FILE TYPE	FILE EXCHANGE TYPE
Design Authoring Coordination	Any Design Team Member	Collaboration Site	WEEKLY	Arch / MEP/ Struct	Revit	.RVT	.RVT
Construction Coordination	AoR Leads and PT	Collaboration Site	WEEKLY	Arch / MEP/ Struct	Revit	.RVT	.RVT

## 7.5 Interactive Workspace

**Design & Construction Phases.** Each project team member will utilize the designated Collaboration site setup and distributed by the Design Build Team (DB) to transfer project specific information and 2D/3D/BIM/4D/5D data. The Collaboration site will be continually updated with project information by both PROJECT TEAM and project team members. For official submissions to LAWA during scheduled project submissions, LAWA's Sharepoint site will be utilized (or other site as designated).

## 7.6 Electronic Communication Procedures

LAWA Design Submittal Process: LAWA recognizes the need for an expedient design and review process in order to meet the current project schedule and deliverables. In order to incorporate regular project reviews and meet quality control standards, the project review process has been broken down into the following sections.

### 7.6.1 LAWA Design Submittal Process – Model Content Review

LAWA recognizes that in order to achieve maximum effect of incorporating BIM-based technologies and processes into its overall lifecycle operations, management and development goals, regular review of the BIM deliverables will be necessary. In summary, this review is to deal with technical and quality control issues surrounding the model itself and to ensure LAWA parameter/data/standards requirements are being adhered to. Some examples are verifying family naming matches the LAWA standards, review of the errors and warnings, workset integrity, etc. These elements are to be reviewed and reported upon on a weekly basis. This process does not entail any design review.

### 7.6.2 LAWA Design Submittal Process – Design Review

[Provide content to reflect the intended Design review process here.](#)

### 7.6.3 Access: Each project team member (consultant/contractor) will have:

Access to the Collaboration site via a unique username and password (received via email).

- Allocated areas for uploading/downloading data.
- A secure area that will be shared between only Project Team and that team member consultant.
- Access to Project Team aggregate coordination Models.

#### 7.6.4 Collaboration site updates:

**Collaboration site** updates will occur weekly or at key project milestones and teams will be notified with via email. All files uploaded/downloaded by the project team are to be used for this project **ONLY**. Files are not to be shared outside of the project team without written permission from LAWA and the Project Team . This applies to graphical and non-graphical information (e.g. drawings, documents, databases, emails, renderings, or any other visual manifestations of the design). All project team members will **ONLY** upload project data in their respective folders. If you do not have rights to upload or change the data located in your company folder, then contact your project manager. Collaboration user access will range from Authors and Readers. Please give active participants in your team Author usernames.

FILE LOCATION	FILE STRUCTURE/ NAME	FILE TYPE	PASSWORD PROTECT	FILE OWNER	UPDATED
Collaboration SITE: <span style="color: green;">SITE</span>	ROOT PROJECT FOLDER	FOLDER	YES	PT Project Mgr	ONCE
<span style="color: green;">Provide further information on structure of Collaboration site</span>	ROOT PROJECT FOLDER	FOLDER	YES	PMG Project Mgr	ONCE
<span style="color: green;">Provide further information on structure of Collaboration site</span>	<b>TBD</b>	RVT	YES	PMG Project Mgr	WEEKLY

## 8 COLLABORATION PROCEDURES

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### 8.1 Modeling Guidelines – Design

#### 8.1.1 Origin Point

All models must be in the correct location in 3D Space (x, y, and z coordinates). These coordinates will be set by LAWA and distributed to all consultants & trade contractors for their use within the Kit of Parts. This includes correct floor elevation(s) (z coordinates). The correct insertion point is critical and ensures that each model will align properly for the master aggregate Model without modification.

#### 8.1.2 Tolerances

Model(s) and Model Elements must be within 1/8" of theoretical dimensions. Tolerances for specific items and systems will be determined as necessary. Model tolerances are not to be construed as construction tolerances.

#### 8.1.3 Units

- US Feet units: One (1) unit in the model equals 0'-1".
- US Decimal Feet Units in Civil 3D models: One (1) unit in the model equals 1.00 feet.

#### 8.1.4 Scale

BIM/3D Models need to be in the correct scale and units relative to the physical world. One unit (in the model) equals one inch, or 1 foot in the C3D model.

#### 8.1.5 Best Practices

Contributors to the model(s) shall follow to the best of their ability the best practices listed in the "Autodesk Revit Platform 2009 Technical Note Model Performance". (Update with current content if available).

Geometry from CAD applications such as AutoCAD, IFC or MicroStation shall not be imported or linked into the model. Image files shall not be imported or linked into the model to represent geometry. Revit Warnings should be kept to a minimum and model geometry called out in the Model Requirements section of this document shall not be associated with any Warnings.



## 9 MODELING REQUIREMENTS – DESIGN PHASE

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### 9.1 Scope

In general, the scope of work is to create a technically accurate and highly detailed BIM/3D computer model of the architectural, structural, building systems, lighting, signage, mechanical, electrical, plumbing, fire protection, fire alarm, passenger loading bridges (PLBs), and baggage handling system (BHS).

### 9.2 Extent of Model

The building computer model (in plan view) shall typically extend to five feet beyond the exterior walls of the building(s) being modeled. Vertically, the model shall extend from the lowest extent of the foundations or lowest underground utility up through (and including) the roof of the top most floor, or highest overhead utility or adjacent structure. To the extent that the scope includes building systems, those systems will be included to the full horizontal and vertical extents of the model including underground utilities and roof-top mounted items.

## 10 EXISTING CONDITIONS

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### 10.1 Laser Scanning

High definition laser scanning and existing conditions surveying will be conducted for the buildings and rooms adjacent to the project boundary. It will be the responsibility of the Design team to physically survey the existing rooms adjacent to the project boundary to confirm occupancy, use, FFE, and internal service utilities. Areas of the existing building and surveyed are to be translated to a Revit model for coordination and made available to Design Team and Construction Team. Laser scans are to be registered and tied back to LAWA Survey Control Network.

## 11 SYSTEMS MODELED AND LEVEL OF DETAIL – DESIGN MODEL

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The level of detail defined in each section below is the minimum level of detail required in the model. Greater detail than the minimum should be incorporated in the model whenever possible. Refer also to the Model Progression Specification (Attachment 1) for the modeling requirements in relationship to each phase of the project. Any further Model development or scope deemed necessary and not previously defined will be addressed as they are identified. The Designer and Contractor will determine the effect on the Model(s) and scope, and propose the appropriate response to accommodate the noted Model development and/or coordination issue.

### 11.1 Architectural

The following stipulations will be used for architectural model elements.

- All exterior walls, doors, windows, steps, railings and roofs will be modeled utilizing modeling best practices for room/space/volume calculations.
- All interior walls, including non-rated walls separating rooms, will be modeled. Studs and individual layers of drywall will not be modeled.
- Risers and sloped floors will be modeled.

- Interior doors and windows will be modeled to the extent that the walls that they are associated with are included in the model. King studs and headers shall be modeled as part wall adjacent to the window or door family.
- All interior ceilings, soffits, stairs, and railings will be modeled.
- Walls, ceilings, and soffits will be modeled as the overall thickness including elevation changes and termination points. Overall thickness to be determined by their actual total composite assemblies.
- Doors, window leaves, and frames will be modeled. Door and window hardware will not be modeled.
- The overall extent of stairs and loading docks will be modeled including railings; intermediate railing members do not have to be modeled.
- If light fixtures will be modeled for coordination in the Architectural model, they must: be placed on a separate workset that can be turned off for export, they will be modeled to the overall height, width, depth and access through the interstitial space.
- Elevator shaft clear space will be modeled to the worst case clear width, depth and height only from preferred possible vendors; elevator cabs, equipment, etc. will not be modeled. Nominal elevator cab size and overrun shall be modeled, including hoist beam.
- Escalators and moving sidewalks shall be modeled to the worst case clear width, depth and height only from preferred possible vendors
- Signage shall be limited to Way Finding and Room Identification required by Code.
- Passenger Boarding Bridges (PBBs) will be modeled at a Level 250 (Section G), and will be representative of either an Apron or Radial bridge type. The PBB length shall be modeled within the design limit for the bridge type (Apron or Radial).
- Fixed furnishings including systems furniture will be modeled. Equipment will be modeled. Casework, including upper and lower cabinets will be modeled. Carpet, paint, wall coverings, tile, wall base and trim carpentry will not be modeled.

## 11.2 Structural

The following stipulations will be used for structural model elements.

- All cast-in-place concrete, including all penetrations and openings identified in the construction documents, will be modeled. Slab camber will not be modeled. Chamfers at corners will not be modeled (but will be detailed).
- Edges of all slabs and penetrations of structural systems will be accurately located in the model.
- All primary and secondary structural steel members will be modeled, including standard steel member sizes, gusset plates, braces, kickers and equipment supports. Reinforcing steel and imbeds will not be modeled.
- Metal, wood and concrete decks will be modeled as the overall thickness of the slab; ribs in metal decks will not be modeled.
- Bolts, clip angles, etc. will not be modeled.
- Miscellaneous metals such as elevator hoist beams, rails and intermediate rail support steel for the elevator will be modeled.
- Identify reinforcing or penetration “no-fly” zones as applicable.

## 11.3 HVAC

The following stipulations will be used for HVAC model elements.

- All ducts and air handling equipment will be modeled. Ducts will be modeled to the outside face dimension of the flanges/insulation. Duct joints do not have to be modeled, but all hangers will be modeled to ensure conflicts are reduced.
- Equipment will be modeled to its overall height, width and depth. Equipment access zones will be modeled as solids.
- Any piping associated with the mechanical equipment will be modeled. Pipes will be modeled to the outside diameter of the pipe or pipe insulation (whichever is greater). Fittings and
- Connections will not be modeled.
- Any electrical associated with HVAC will be modeled per the electrical modeling requirements as outlined in Section 11.4.
- The intent of this model is to show the ductwork and piping, etc. in as true representation of the actual condition at construction completion. Specific dimensional location of ductwork and piping may not be included in the construction documents. To the extent that location can be determined from the construction documents, the model will reflect that location.
- Identify “no-fly zones” with solid transparent (50%) placeholder clearance object for: access issues, code issues, and/or constructability.
- MEP Spaces will be modeled corresponding/coordinated with Architectural Rooms.
- Additional MEP Areas such as above ceiling Plenums will have MEP Spaces created accordingly to provide a full volume within the building/model envelope.

## 11.4 Electrical

The following stipulations will be used for electrical model elements.

- Conduits 2” or greater or, smaller conduits if in ganged runs will be modeled.
- Ganged runs shall be modeled as a mass.
- Cable tray, access zones, and equipment to be included in the model.
- Light fixture locations and space requirements to be included in the model.
- All electrical equipment and fixtures shall be properly circuited and scheduled within the model itself.
- All equipment shall utilize dynamic tags (no “dumb” text tags allowed)
- All power feeds to equipment and all switch gear will be modeled.
- Consider modeling switches and outlets where coordination with architectural FFE or interior elevations is a concern.
- Any access zones requirements will be modeled as solids.
- “No-fly zones” above electrical panels shall be modeled as solids
- MEP Spaces will be modeled corresponding/coordinated with Architectural Rooms.

## 11.5 Plumbing

The following stipulations will be used for plumbing model elements.

- Piping 1” or greater or smaller piping if in ganged runs will be modeled.
- Plumbing piping and gas piping, including specialty gas, and equipment will be modeled. Pipes will be modeled to the outside diameter of the pipe or the pipe insulation, whichever is greater.
- Pipe slope will be incorporated in the model. Fittings and connections will not be modeled.
- All plumbing equipment will be modeled to its overall height, width and depth.
- All valves and clean outs will be modeled along with all access to valves/cleanouts.
- Any access zone requirements will be modeled as solids.
- All equipment and fixtures shall be properly circuited and scheduled within the model itself.

- All equipment shall utilize dynamic tags (no “dumb” text tags allowed)
- MEP Spaces will be modeled corresponding/coordinated with Architectural Rooms.

## 11.6 Fire Protection (Sprinkler & Alarm)

The following stipulations will be used for fire protection model components.

- All components 2” or greater of the fire protection system will be modeled. This includes all piping, valves, fire pump, and sprinkler heads.
- Any access zone requirements will be modeled as solids.
- “No-fly zones” above control panels shall be modeled as solids.
- All equipment and fixtures shall be properly circuited and scheduled within the model itself.
- All equipment shall utilize dynamic tags (no “dumb” text tags allowed)
- Fire alarm modeling requirements shall follow the requirements of the section 4.4 Electrical.
- MEP Spaces will be modeled corresponding/coordinated with Architectural Rooms.

## 11.7 Vertical Transportation

Elevator clear shaft space requirements are included in the architectural scope.

- All equipment and fixtures shall be properly circuited and scheduled within the model itself.
- All equipment shall utilize dynamic tags (no “dumb” text tags allowed)

## 11.8 Civil/Site

- Utilities within the project boundary of the project footprint are to be modeled in three dimensions and accurately represented with AEC Object elements. The Civil / Site model will be delivered in Civil3D including the following:
  - Utility trench excavation surfaces
  - Excavation lift models of proposed daily progress of mass excavation & utility trenches
  - Shored walls/surfaces
  - MSE walls
  - Bridge soffit surfaces – Pre-camber & post-camber
  - Bridge bents
  - Bridge top deck surfaces – Pre-camber & post-camber
  - Bridge hinge keys
  - Electroliner bases on bridges
  - Bridge barriers
- Piping / Conduit / Duct banks: Model all proposed installations including but not limited too; piping, joints, sump basins, storage tanks, and free draining material wraps or bedding around piping. Pipe networks “part properties” shall be populated with relevant geometric and analytic data pertaining to; “Geometry, Resize Behavior, Hydraulic Properties, and Part Data”.
- Excavation and vertical underground elements: Model all temporary and permanent shoring, and areas of excavation including affected lay back areas, with appropriate sloped surfaces.
- Horizontal site development: Model all temporary roadways required for potential phasing including but not limited to: perimeter barriers (jersey barriers, k-rails), paving surface relocations, storm drainage requirements, snow storage areas, and first responders site and perimeter access roadways.
- Site areas of impact: Provide model elements to indicate areas of influence. Sterile area boundaries, AOA boundaries, or stakeholder access zones.

Civil 3D deliverable files should be accompanied by a LandXML 1.2 file of alignments /profiles / surfaces & points, and an IFC if possible.

## 11.9 Baggage Handling System (BHS)

- Baggage Handling System shall be modeled in 3D and provide the clear area and dimensions of equipment. Model equipment to suitable level of detail to ensure the required clear space for the baggage envelope, egress and other right-of-ways are maintained throughout the system.
- Equipment will be modeled to its overall height, width and depth, including motors.
- Model the required clear space for the baggage envelope as solid above the bag line surface.
- Any access zone (work areas for pulling motors) requirements will be modeled as solids. i.e. clearances in front of motor control centers.
- Model the preliminary support structure for the BHS; Floor, wall or ceiling mounted supports.
- Model any catwalks necessary for the BHS.
- Coordinate clear width and height egress paths.
- All equipment and fixtures shall be properly circuited and scheduled within the model itself.
- All equipment shall utilize dynamic tags (no “dumb” text tags allowed)
- Coordinate all floor and wall openings, concrete curbs, and security/fire doors required for the BHS.
- “No-fly zones” above control panels shall be modeled as solids.

## 11.10 Security and IT Systems

- Electrical/wiring associated with Security and IT Systems are to be modeled per the electrical modeling requirements as outlined in Section 11.4.
- At a minimum, device locations are to be designated by installation points in 3D space.
- All equipment and fixtures shall be properly circuited and scheduled within the model itself.
- All equipment shall utilize dynamic tags (no “dumb” text tags allowed)
- Equipment and server racks are to be modeled as solid objects to their overall height, width, and depth.
- “No-fly zones” above control panels shall be modeled as solids.

## **12 BIM COORDINATION PROCEDURE OUTLINE – DESIGN MODEL**

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### **12.1 Architectural Design Team**

Will create a BIM model and produce 2D Construction Documents using Autodesk Revit (Current approved version). The Revit Architecture, Structural, and MEP files shall be 100% Revit. The Revit file shall NOT contain any imported or linked AutoCAD, Bentley or other CAD or graphic files (unless approved by LAWA). This file shall include the model, families and 2D documentation. Civil design and BHS may be designed and executed in an approved alternate software platform.

Architectural Design team will provide a Revit Architecture model as a 3D background model to be used by Contractor, structural, MEP+FP, FA, and special consultants.

### **12.2 Structural Consultant(s)**

Will provide a BIM model and produce 2D Construction Documents using Revit Structure (Current Approved Version). The Revit Structure file shall be 100% Revit. The Revit file shall NOT contain any imported or linked AutoCAD, Bentley or other CAD or graphic files. This shall include the model, families and 2D documentation.

The Structural Design Team will provide a Revit Structural model as a 3D background model to be used by Contractor, structural, MEP+FP, FA, and special consultants.

### **12.3 MEP Consultant(s)**

Will provide a BIM model and produce 2D Construction Documents using Revit MEP. The Revit MEP file shall be 100% Revit. The Revit file shall NOT contain any imported or linked AutoCAD, Bentley or other drawing files. This shall include the model, families and 2D documentation.

The MEP Design Team will provide a RevitMEP model as a 3D background model to be used by Contractor, structural, MEP+FP, FA, and special consultants.

### **12.4 Fire Protection (Sprinkler & Alarm) Consultant(s)**

The Consultant will provide a BIM model and produce 2D Construction Documents using Revit MEP. The Revit MEP file shall be 100% Revit. The Revit file shall NOT contain any imported or linked AutoCAD, Bentley or other drawing files. This shall include the model, families and 2D documentation.

### **12.5 Baggage Handling System Consultant(s)**

The Consultant will provide a BIM or 3D Solid model and produce 2D Construction Documents using Revit MEP or AutoCAD MEP. Revit MEP is the preferred application to be used. The design consultant shall consult Designer prior to performing any work with AutoCAD MEP. The Revit MEP file shall be 100% Revit. The Revit file shall NOT contain any imported or linked AutoCAD, Bentley or other drawing files. This shall include the model, families and 2D documentation.

### **12.6 3RD PARTY SOFTWARE COORDINATION**

MEP Consultants and Trade Contractors are to inform LAWA and PROJECT TEAM of any libraries, object enablers, software plug-ins, 3D viewers, etc. required for LAWA to view their 3D content. The required plug-ins will be downloaded, and posted to Collaboration site for use of entire project team. Below is a few of the common software plug-ins LAWA uses to view MEP 3D models

- NavisWorks Freedom Viewer

- Autodesk Design Review
- Quickpen 3D PipeDesigner viewer v. 3.6/3.9
- CAD DUCT plug-in
- ADT object Enabler 2006/2007
- ABS object Enabler 2006/2007
- IFC to DWG converter

## 13 SPATIAL COORDINATION PROCEDURE – DESIGN PHASE

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3D Computer coordination as it relates to Architecture, Structure, Mechanical, Electrical, Plumbing, Fire Protection, Fire Alarm, Baggage Handling System and Special Systems during design model phase:

### 13.1 Spatial Coordination Procedure

Design Consultants shall be prepared to accommodate weekly or every 2 week spatial coordination meetings. Spatial coordination meetings will begin, one quarter of the way into the Schematic Design phase to resolve model conflicts.

- Design Consultants are required to run model spatial coordination analysis for their respective trade system(s). The models submitted by the design consultants for overall coordination are required to be checked and coordinated with the architecture, structure and the Design Consultant's own Work prior to submittal. At a minimum, the model shall be pre-coordinated by the Design Consultant to avoid: conflicts with architecture, structure, other MEP systems, walls, ceiling systems, and enclosure.
- Conflicts should be kept to a minimum and will be evaluated for acceptable tolerance.
- Design Consultants required to post to the Collaboration site, updated drawings/models at least once per week, prior to the spatial coordination analysis run by the PROJECT TEAM BIM Coordinator. Day and time of the posting is listed in each model content section above. This will continue until the area is completely coordinated.
- Design Consultants are required to collaborate with each other trade through electronic means, email, telephone, and in person to resolve basic clashes outside of the weekly Spatial Coordination meetings. It is expected that the weekly meetings are held to address difficult areas that are not able to be coordinated between the multiple disciplines themselves. At these meetings, the resolution will be collectively agreed upon, and a discipline will be identified as having to "move". This discipline will adjust the respective model and repost it for the following weeks meeting. All disciplines are responsible to update and post the changes agreed upon at the meeting within 1 week after the coordination meeting.

### 13.2 Documentation of Coordination

The following will be included as a zipped file and posted by Designer for Design Consultants.

- A Solibri or NavisWorks (NWD) Published file that includes the final conflict reports and Comments.
- PDF file(s) of above reports.

### 13.3 Model Management

Design Consultants shall provide updates/maintenance of Electronic Data/3D Model throughout construction that modify the design intent and/or special coordination to the design model to include but not limited to:

- Incorporation of RFIs
- Incorporation of ASIs, CDs, CCDs, MODs
- Submittal comments and revisions on approved shop drawings.
- Implementation of modifications to the project Building Information Model(s) due to RFI responses will be the responsibility of the Model Element Author in primary control of the effected Model Element at the RFIs initiation. (refer to the attached Model Progression Specification)



## 14 MODELING GUIDELINES – CONSTRUCTION

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### 14.1 Model Ownership

As the model transitions from design to construction there will be some variation on model ownership / authoring. Some disciplines will maintain the model throughout construction (e.g. architecture) while other disciplines will begin creating new models during the shop drawing process (e.g. HVAC). In the case of model authorship by members of the design team, requirements in Section 6 will supersede this section. In the case of models created by the contractor or their subs, requirements in this section will be followed.

### 14.2 Origin Point

The Origin is to be the same as that established during the design phase of the project. All models must be in the correct location in 3D Space (x, y, and z coordinates). These coordinates will be set by LAWA and distributed to all consultants & trade contractors for their use. This includes correct floor elevation(s) (z coordinates). The correct insertion point is critical and ensures that each model will align properly for the master aggregate Model without modification. General Guidelines for Construction Model authoring process shall follow Attachment 2, m. Construction Modeling.

### 14.3 Tolerances

Model(s) and Model Elements must be within 1/8" of theoretical dimensions. Tolerances for specific items and systems will be determined as necessary. Model tolerances are not to be construed as construction tolerances.

### 14.4 Units

Imperial units: One (1) unit in the model equals 0'-1"

### 14.5 Scale

BIM/3D Models need to be in the correct scale and units. One unit (in the model) equals one inch. Model must be 100% complete for the current building, level, and phase. A good rule of thumb is that if you don't want to move it, it needs to be in the model. This includes, but is not limited to:

- Piping that is larger than 1" diameter.
- Model all equipment and panels to scale with required clearance zones included.
- Identify all service and access areas.
- Show size and thickness of housekeeping pads.
- Show all sleeved or cored hole penetrations.
- Model all "no-fly zones" for: access, maintenance clearance, elevator shaft, code issues, constructability with solid objects.
- Any item which may impact coordination with other disciplines
- Penetration thru building systems such as cast-in-place concrete and CMU walls shall be identified in the Trade Contractor's model by means of a modeled sleeve (w/ defined tolerance).
- All model elements (families) are to have identity codes or CSI codes attached as defined in the data normalization requirements.
- All model elements are to have LAWA required parameters and their values included for As-Built submission.
- Individual Trade Contractors' 3D model content requirements will be detailed and finalized in conjunction with the final contract agreement.

- Project Team will ensure collection and data population of LAWA required parameters from all subcontractors and vendors.

## 15 MODELING REQUIREMENTS – CONSTRUCTION PHASE

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### 15.1 Systems Modeled and Level of Detail

The level of detail defined in each section below is the minimum level of detail required in the model. Greater detail than the minimum should be incorporated in the model whenever possible. **Refer also to the Model Progression Specification (Attachment 1) for the modeling requirements in relationship to each phase of the project.** Any further Model development or scope deemed necessary and not previously defined will be addressed as they are identified. The Contractor will determine the effect on the Model(s) and scope, and propose the appropriate response to accommodate the noted Model development and/or coordination issue.

## 16 SYSTEMS MODELED AND LOD – CONSTRUCTION MODEL

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The Contractor shall provide modeling to accurately represent the scope of the work contracted for and shall provide separate model iterations to reflect the proposed stages of work for periods no less than one month duration or “snapshots in time”, at significant milestones within the schedule. Project model elements shall, at a minimum, conform to the requirements established in LAWA BIM Standards Manual.

### 16.1 Civil/Site (Horizontal BIM)

Proposed Civil / Site elements below are the minimum required and shall be modeled to the “Level of Development” as represented by the “Attachment 1 – BIM Matrix”.

Piping / Conduit / Duct banks: Model all proposed installations including but not limited too; piping, joints, valves, catch basins, valve boxes, pull boxes, sump basins, tanks, trench bedding, encasements, and free draining material wraps or bedding around installations.

Excavation and vertical underground elements: Model all temporary and permanent shoring, and areas of excavation including affected lay back areas, with appropriate sloped surfaces.

Horizontal BIM site development: Model all temporary roadways required for potential phasing including but not limited to: perimeter barriers (jersey barriers, k-rails), paving surface relocations, storm drainage requirements, snow storage areas, and first responders site and perimeter access roadways.

Site areas of impact: Provide model elements to indicate areas of influence. Model all phase revisions for required GSE routes, critical delivery points, Sterile area boundaries, AOA boundaries, or stakeholder access zones.

### 16.2 Steel

The fabrication level detailed model shall include, but is not limited to, major structural members, secondary structural members, and miscellaneous steel connections including:

- Trusses
- Beams
- Columns

- Gusset plates
- Bracing
- Angles
- Knife plates
- Edges of all slabs and penetrations of structural systems will be accurately located in the model.
- Other elements necessary for the successful coordination of other building trades
- Kickers and equipment supports
- Miscellaneous metals such as elevator hoist beams, rails and intermediate rail support steel for the elevator will be modeled.
- All model elements are to have LAWA required parameters and their values included for As-Built submission. See “Attachment 2 – Level of Development Worksheet” for a complete list and instructions

### 16.3 HVAC

- Model All ductwork to be shown as actual duct size, in the correct location in 3D space
- External insulation on piping and ductwork must be modeled to scale, Internal insulated duct is to be noted.
- Model all grilles, registers, louvers and diffusers.
- Model all fire and smoke dampers and indicate service access requirement (i.e. access panel) if not readily accessible.
- Identify duct balance dampers and model service access requirements as solid objects.
- Model coil pull areas.
- Model duct hangers, supports and seismic bracing carrying 2 or more ducts.
- Model all Mechanical Equipment: Fans, AHUs, Built-Up AHUs, pumps, tanks, valves, controls, heat exchangers, All Valves (including valve stems and handles), gauges & control valves, High & low point drains, and Starters, etc.
- The HVAC Contractor shall also include in the 3D model Concrete Equipment pads, inertia pads and Access Doors.
- The HVAC Contractor shall identify under separate drawing layer Access doors and Accessibility requirements for above listed items for code and maintenance purposes.
- All model elements are to have LAWA required parameters and their values included for As-Built submission. See “Attachment 2 – Level of Development Worksheet” for a complete list and instructions

### 16.4 Plumbing

- Model all piping 1” and larger including insulated piping with insulation O.D. at 1” and greater.
- Model all valves, gauges, and control valves and service access.
- Model pipe hangers, supports and seismic bracing carrying 2 or more pipes.
- External insulation on piping must be modeled to scale.
- Model all drip legs, drain pipes, blow down valves, and cleanouts
- Model all underground piping.
- Model all Plumbing Equipment: Domestic Water, Chilled Water, Steam, Storm/Roof Leaders, pumps, tanks, water heaters, in wall carriers, In wall plumbing equipment, etc.
- The Plumbing Contractor shall also include in the 3D model Concrete Equipment pads, inertia pads and Access Doors.

- The Plumbing Contractor shall identify under separate drawing layer Access doors and Accessibility requirements for above listed items for code and maintenance purposes.
- All model elements are to have LAWA required parameters and their values included for As-Built submission. See “Attachment 2 – Level of Development Worksheet” for a complete list and instructions

## 16.5 Fire Protection

- Model all Fire Protection Equipment: Pre-action System, Dry System, and Main Fire Protection Systems, Hangers & Seismic Bracing, Valve Assemblies, Drain valves, Fire Department Valves, Fire Pump etc.
- Model all sprinkler head locations and sprinkler head types.
- Model any tanks not included in the architectural or structural Models.
- Model all fittings, drains and test connections.
- Model “No-fly zones” above control panels shall be modeled as solids.
- The Fire Protection Contractor shall also include in the 3D model Concrete Equipment pads, inertia pads and Access Doors.
- The Fire Protection Contractor shall identify under separate drawing layer Access doors and Accessibility requirements for above listed items for code and maintenance purposes.
- All model elements are to have LAWA required parameters and their values included for As-Built submission. See “Attachment 2 – Level of Development Worksheet” for a complete list and instructions

## 16.6 High & Low Voltage Electrical

- Model all conduit raceways 1” and larger.
- Model all grouped conduit raceways with 2 or more conduits.
- Model all junction boxes 6”x6” and larger.
- Model all cable trays and/or hook locations.
- Model hangers, supports and seismic bracing.
- Model all light fixtures (including neon) and switching devices.
- Model door security J.B.s.
- Model all Fire Alarm devices
- Model phone/data ports
- Model all security devices (cameras, card readers, motion sensors, auto door locks, etc.)
- Model all audio speakers and equipment.
- Model all Electrical Equipment: panels, transformers, switch/paralleling gear, ATs, generators, data racks, starters, VFDs, Exit Signs, AV Equipment, Recessed Electrical devices and Access Doors, etc.
- The Electrical Contractor shall also include in the 3D model Equipment pads, inertia pads, and Access Doors
- The Electrical Contractor shall identify under separate drawing layer Access doors and Accessibility requirements for above listed items for code and maintenance purposes.
- All model elements are to have LAWA required parameters and their values included for As-Built submission. See “Attachment 2 – Level of Development Worksheet” for a complete list and instructions

## 16.7 Controls

- Model all panels

- Model Individual Conduits 1" and larger, racks carrying more than 2 conduits 1" and smaller.
- Model hangers, supports and seismic bracing.
- Model all Controls Equipment: panels, transformers, controls, cable tray, data racks, starters, VFDs, etc.
- The Facilities Management System Contractor shall also include in the 3D model Concrete Equipment pads, inertia pads and Access Doors.
- The Controls Contractor shall identify under separate drawing layer Access doors and Accessibility requirements for above listed items for maintenance purposes.
- All model elements are to have LAWA required parameters and their values included for As-Built submission. See "Attachment 2 – Level of Development Worksheet" for a complete list and instructions

## 16.8 General Requirements

Proposed elements below are the minimum required and the content may be revised as required by the project.

- Model all perimeter site fencing with required security access points and delivery entrances.
- Model all major SWPPP elements including silt fencing, wash racks, and BMP locations.
- Model all major material and man lifting equipment (Cranes, Man Lifts, fixed Concrete Pump stations, etc.) and proposed envelope of influence (radius of swing, total height, major picking stations, etc.).
- Model all temporary and permanent shoring, and areas of excavation including affected lay back areas, with appropriate sloped surfaces.
- Model all proposed material lay down areas
- Model all temporary office and trailer locations
- Model all temporary roadways required for potential phasing including but not limited to: perimeter barriers (jersey barriers, k-rails), paving surface relocations, storm drainage requirements, snow storage areas, and first responders site and perimeter access roadways.
- Model "no-fly zones surrounding temporary and / or permanent fire hydrant locations.
- Model proposed "evacuation areas".
- Model onsite temporary parking locations.
- Model all phase revisions to temporary pedestrian covered walkways and / or clearance zones.
- Model all phase revisions for required GSE routes, critical delivery points, Sterile area boundaries, AOA boundaries, or stakeholder access zones.
- All model elements are to have LAWA required parameters and their values included for As-Built submission. See "Attachment 2 – Level of Development Worksheet" for a complete list and instructions

## 16.9 Special Construction

To Be Determined after selection of a design option and advancement of that design through Schematic Design Phase.

Baggage Handling system requirements per section 11.9 Baggage Handling Systems (BHS).

## 17 SPATIAL COORDINATION PROCEDURE – CONSTRUCTION PHASE

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3D Computer coordination as it relates to Mechanical, Electrical, Plumbing, Fire Protection, Fire Alarm, Baggage Handling System and Special Systems during the construction modeling phase:

### 17.1 The Trade Contractor

Will deliver a 3D computer model that is complete based upon LAWA standards in their native file format and in NavisWorks Document Format (.NWD) and Revit .rvt.. Any elements not included will become the Trade Contractor's responsibility to coordinate in the field and at no additional cost. All 3D model elements shall include LAWA required parameters and their associated values included for deliverable submission. Trade Contractor shall provide a list of minimum typical clearances for all model components (Clash rule criteria).

### 17.2 The Model

Shall be developed in a software package compatible with Revit and readily translated to Revit for Design and NavisWorks Manage for coordination purposes.

### 17.3 Exchange of 2D CAD Files

Shall be in the AutoCAD file format as defined in the LAWA BIM Requirements, current edition.

### 17.4 Represented in these assigned colors as a guideline

#### 17.5 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

### 17.6 Coordination Procedure

- Trade Contractors shall deliver their scope of Work through the Construction process in general conformance with Attachment 2, k. 3D Coordination. Trade Contractors will take ownership for the construction of the Trade fabrication MEP+FP, BHS and other systems models as defined by the Contractor at Construction Documentation (100%). Design team BIM/3D models: Architectural, Structural, MEP, BHS and Security and IT models shall be posted on the Designer BIM Server, each trade is required to download and use these files to create their system models by sequence or geographic area (Schedule WBS, Work area, etc.). The process is to create and upload system models to the BIM Server as frequently as required by Contractor for other trades to use while modeling their systems. Contractor's BIM coordination process in many respects follows a traditional sequence of drawing / modeling those systems with the most constraints on their routing and then following with those trades that have more flexibility in their placement. Coordination will be expected to start as soon as contracts are awarded and follow the typical sequence:

- Duct will be laid out in conformance with design documents. If floor size permits, duct layout to flow systematically across a floor allowing other trades to follow behind drafted areas.
- Thereafter all pitched plumbing systems are to be drawn and coordinated with the ductwork. Once duct/pitched pipe are coordinated, other major constrained trade systems' components including all HVAC, Fire Protection, electrical cable tray, conduit racks, plumbing racks, are to be drawn/modeled and coordinated.
- Upon completion of drawing/modeling and coordination of major system components of the constrained trades, "minor" components are to follow including branch piping & smaller conduit runs.
- Trade Contractor shall be prepared to accommodate bi-weekly meetings to resolve model conflicts within the Project Schedule and sign off on a 'Master Model' to be considered the basis for construction on an area and floor by floor basis consistent with the Project Schedule.
- Contractor will provide clash detection reports to accommodate the above.
- The clash reports will be run for MEP systems in conflict with other trades and systems. A clash analysis report will be generated by the Contractor's BIM Coordinator which involves looking at each individual clash, and documenting it, by saving the appropriate viewpoints. The Contractor's BIM Coordinator will create a NavisWorks .NWD file showing the clash viewpoints and corresponding Word Document showing clashes. This Clash report & NavisWorks .NWD file will be posted to the BIM Server by the Contractor's BIM Coordinator and a corresponding notice sent by the Coordinator to all parties involved that the report is ready.
- Each Trade is required to review the clash detection report generated by the Contractor BIM Coordinator before the weekly meeting, and arrive at the meeting prepared to address the unresolved clashes in a constructive manner. Subcontractors are responsible for coordinating and resolving the majority of the clashes prior to a meeting so that the meeting time can be used efficiently to focus on the issues that require all participants to resolve.
- Coordinated submittal data is to be distributed on a weekly basis, and 2-3 days prior to coordination meetings. Models will be posted a day in advance of coordination meetings so that the contractor has time to review the models.
- Coordination model shall include, at a minimum: The modeling elements and associated parameters and their data per modeling requirements specified by this document and the LoD and MPS.
- Models to be purged of all non-essential information. All 2D reference information should be deleted (unless such 2D information is required for model orientation or navigation), only 3D information should remain in the file. This includes, but is not limited to the following: Text, Leaders, Symbols, Architectural References, Construction Geometry, etc.
- Each Trade is required to run the clash detection analysis for their respective trade system(s) against the Architectural/Structural design models to ensure that there are no conflicts between the architectural/structural elements and their system(s) prior to submittal.
- Each Trade is required to post to the BIM Server, updated drawings/models at least once per week, prior to the clash detection analysis run by the BIM Coordinator. Day and time of the posting is per Section 1.3 File Management. This will continue until the area is completely coordinated.
- Each Trade is required to collaborate with each other trade through email, telephone, and in person to resolve basic clashes outside of the weekly Coordination meetings. It is expected that the weekly coordination meetings are held to address difficult areas that are not able to be coordinated between the multiple trades themselves. At these meetings, the resolution will be collectively agreed upon, and a trade will be identified as having to "move". This trade will adjust the respective model and repost it for the following weeks meeting. All trades are responsible to



update and post the changes agreed upon at the meeting within 1 week after the coordination meeting.

## 17.7 Trade Contractor

Following 100% coordination and agreement on a 'Master Model', the Trade Contractor agrees and will sign off to be responsible for locating their respective components within an agreed tolerance based on the 'Master Model'.

- Any variation beyond the agreed tolerance must be coordinated with Contractor first and approved by Designer and Owner.
- Items not included in the coordination model will be installed, in the field, after all coordinated elements are in place.
- Components that are installed in conflict with model layout and create obstacles or additional work for other disciplines shall require one of the following: a) removal and reinstallation per model at no cost to other parties, or b) monetary compensation to the affected party and owner.

## 17.8 Documentation of Coordination

The following will be included as a zipped file and posted by Contractor for all subs and design team.

- A record of the Original CAD data used for 'Sign-off' Documentation.
- A NavisWorks (NWD) Published file that includes the final Clash reports and Comments.
- PDF file(s) of above reports.
- 2D print out that includes - Composite floor plan, Text clash report, and clash bubbles in the plan signed by all involved subs.
- Each Trade is required to submit the number of copies of their respective, coordinated systems in a 2-Dimensional format as required by their contract, for approval through the regular submittal process. This is required for each floor as well as each riser. In addition to the development of 3-Dimensional coordination models, all Trade Contractors are responsible for producing a traditional 2-Dimensional coordination drawing after cleaning up resolved all clashes and collisions. In the preparation of the final composite 2-Dimensional coordination drawings, large scale details as well as cross and longitudinal sections developed at coordination Meetings shall be made by the Trade Contractor as required to fully delineate all conditions. The final Coordination BIM drawing file will be re-circulated through all trades after a BIM sign-off meeting. This electronic coordination drawing files shall include all coordinated drawing information, fully dimensions (especially elevation dimensions), texts, and tags, etc. Field installation drawings should be submitted in PDF format and corresponding models should be delivered for incorporation in to the final As-Built model.
- The Contractor is required to compile and plot the number of color copies of the 2-Dimensional, multi- trade, coordinated drawings required by the contract documents for approval through the regular submittal process, for each defined Work area. This is required for each floor as well as each riser.
- Each Effected Trade is required to maintain and provide the 3-Dimensional Model with respect to generating As-Built Drawings/Models. It is the responsibility of each trade to update their respective 3-Dimensional Model throughout construction to reflect field conditions to accurately document As-Built conditions.
- Each Effected Trade is required to submit the number of color copies of their respective scope, As-Built 2-Dimensional drawings as required by the contract documents, for approval through the regular close- out process. This is required for each Work area, floor, as well as each riser. Submit field installation drawings as PDF file.



- Each Effected Trade is required to submit an electronic copy containing the 3-Dimensional As-Built models, once all issues are addressed from above. This deliverable shall contain As-Built models in Revit .rvt, Data normalization .dbm, Postscript Digital File .pdf, NavisWorks .NWD format and the other original authoring files in the native format of the program that created the models. Owner reserves the right to request additional file formats as the needs of the client or project require.

## 17.9 Model Management

- Trade Contractors shall provide updates/maintenance of Electronic Data/3D Model throughout construction to include but not limited to:
- Incorporation of RFIs, Bulletins and Change Orders, etc.
- Submittal comments and revisions on approved shop drawings.
- As-Built field modifications.
- Trade Contractor to provide Contractor with an updated model on a bi-monthly (2x per month) basis throughout the installation of the Work.

### 17.10 Utilization of BIM for the RFI Process

Response protocol and timing, incorporation of responses into any Model.

- Each Trade is required to update and post any changes originating from RFIs, Submittals and Bulletins that have changed their perspective work. Each Trade making changes shall post onto the BIM Server site and send out a corresponding notice indicating the changes and reasoning behind the change within no later than 10 business days from receipt of changes.
- The RFI template is to provide an input box to confirm whether the response to the RFI has the potential to require modification to the project Building Information Model(s). Modification could require geometric model revision or information input.
- This BIM issues item shall be a searchable item of the projects RFI log system.
- Implementation of modifications to the project Building Information Model(s) due to RFI responses will be the responsibility of the Model Element Author in primary control of the effected Model Element at the RFIs initiation. (refer to the attached Model Progression Specification)
- The Contractor will Provide an update of the RFI Log to LAWA on a bi-monthly (2x per month) basis.

### 17.11 Utilization of BIM for the Change Order/Bulletin Process

The process for quantifying and correcting clashes caused by a design change to a signed off and in-progress area is as follows:

- Trade(s) that have work directly affected by the bulletin documents will take the lead in drafting the revised 3-Dimensional layout, minimizing the clashes with other trades as much as possible. Revised layouts are to be drawn in an identifiable layer, labeled to match the respective bulletin.
- Once the work is drafted by the affected trade(s), a clash report is to be prepared by the Contractor BIM Coordinator with all latest posts.
- While running the clash detection feature in NavisWorks, the BIM Coordinator will turn on the 'links view' option and all clashes are labeled while navigating through the model.
- Contractor BIM Coordinator will audit and report the clashes that are local to the area affected by the change documents, similar to the analysis of detected vs. reported clashes in preparation for weekly clash reports.
- The Change Order Request template is to provide an input box to confirm whether the Change Order has potential to require modification to the project Building Information Model(s). Modification could require geometric model revision or information input.
- This BIM issues item shall be a searchable item of the projects Change Order Request log system.

- Incorporating approved Change Orders into the BIM Model (when applicable) shall be completed in no later than 10 business days after execution of the Change Order.
- Implementation of modifications to the project Building Information Model(s) due to Change Orders will be the responsibility of the Model Element Author in primary control of the effected Model Element at the Change Order's initiation. (refer to the attached Model Progression Specification)

## 18 SPATIAL COORDINATION PROCEDURE: DESIGN & CONSTRUCTION PHASE CLASH DETECTION PRIORITIES

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### 18.1 Architecture and Structural

Will be coordinated first and take precedence over other disciplines, this includes ceiling, walls, soffit framing, and king studs at doors etc. with the following exceptions:

- Ceilings should only be lowered (RFI) if all other design alternatives have been exhausted and fully and timely articulated to the MEP Team .
- Architecture should be less significant in mechanical areas (i.e. Special/Main Mech rooms, primary/Main Electrical rooms, etc) look for clear path requirements first!

### 18.2 Structure

Takes precedence over MEP in most cases with exception to the following:

- Fire Protection sleeves are missing.
- Plumbing Sleeves are in conflict per Design (RFI).
- All other design alternatives have been exhausted.

### 18.3 Baggage Handling System (BHS)

Should have some priority as they are not as flexible (large min. turning radius), with the following notes:

- The BHS Equipment must be per the design (this is on the ground) all other alternatives should be exhausted before following up with an RFI
- The BHS Bag Line is slightly more flexible so you can find open areas in the ceiling cavity to elevate any conflicts (they need access panel in hard ceiling, and access to this in general).

### 18.4 Plumbing

- Vent Stack, Storm Drains, Waste and others (large pipes 6" and up) that depend on location of fixture or Minimum slopes typically take precedence over Mech., Elect, and P. Tube
- Small Water supply lines 1" (cold, hot) and Medical Gas lines routing can be flexible (consider moving if they conflict with Elect. Trays, Large conduit banks).

### 18.5 Mechanical

- Large Ducts (size is relative to the job) should have priority over others and run high in the ceiling cavity if possible (below steel and BHS).
- Small Ducts (feeders to vents, returns) have priority only as far as the path is not difficult to reach from main duct to return vents per design.
- If there is conflict with elect. Trays or Conduit Banks you need to make a judgment call.

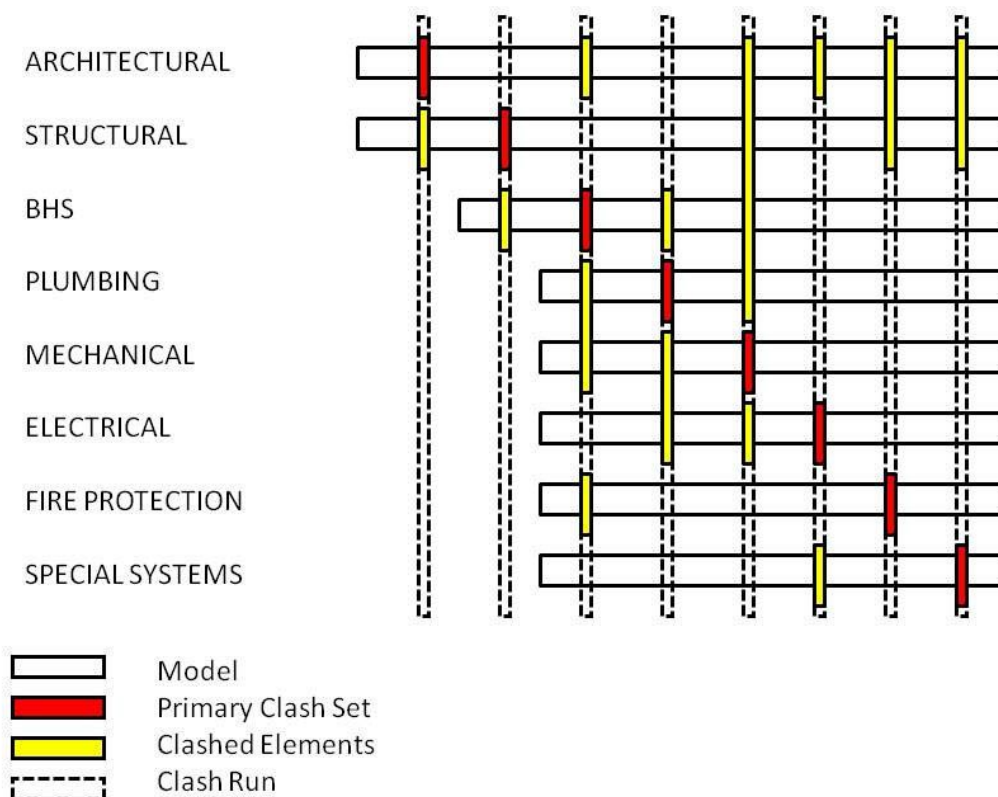
- Do not allow Ducts to run parallel to walls (on top of) or crossing Perpendicular to walls at door frame edge.

## 18.6 Electrical:

- Light fixture location/size is not flexible, only changes after all other options are exhausted per RFI.
- Electrical Trays and Conduit banks should be modified if conflicting with major ducts (or relocated) but take priority over small ducts and other disciplines.
- Give priority to Electrical at routing from Electrical rooms typically.

## 18.7 Fire Protection:

- Sprinkler head is usually required to be centered on ceiling tile and must be spaced to allow sufficient coverage per design.
- Mains (2" to 6") that are running thru beam sleeves should not be interrupted by any other disciplines if possible (in general run them high).
- Control Valve locations might be flexible but you or sub need to block out access to this area



## 18.8 Model Clash Prioritization Graphic

## 19 QUALITY CONTROL CHECKS – DESIGN & CONSTRUCTION PROCESS

The following checks should be performed to assure quality.

CHECKS	DEFINITION	RESPONSIBLE PARTY	SOFTWARE PROGRAM(S)	FREQUENCY
VISUAL CHECK	Ensure there are no unintended model components and the design intent has been followed	AoRs / PMG	REVIT / NAVIS	Ongoing
INTERFERENCE CHECK	Detect problems in the model where two building components are clashing including soft and hard	GC	NAVIS	Bi-weekly
STANDARDS CHECK	Ensure that the BIM and LAWA Standards have been followed (fonts, dimensions, line styles, family naming, shared coordinates, etc)	AoRs / PMG	REVIT / DATA NORMALIZATION	Weekly
BIM CONTENT PLAN	Create a content list / family list of elements in the respective BIM models.	PMG	REVIT / EXCEL	Weekly
MODEL INTEGRITY CHECKS	Describe the QC validation process used to ensure that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements and the reporting process on non-compliant elements and corrective action plans	AoRs / PMG	REVIT	Ongoing
DATA CONTENT CHECK	Conform to LAWA BIM Requirements	AoRs / PMG / LAWA	DATA NORMALIZATION / MAXIMO	Weekly then monthly
ERROR / WARNING CHECK	Conform to LAWA BIM Requirements	AoRs / PMG	REVIT	Weekly

See LAWA BIM Requirements for standard QA/QC on the Revit files including:

Project Maintenance, Review Warnings, Remove Unused Families and Types, Remove Unused Links, Audit, Compact Central File

## 20 MODEL ACCURACY AND TOLERANCES

Models should include all appropriate dimensioning as needed for design intent, analysis, and construction. Level of detail and included model elements are provided in the Information Exchange Worksheet.

PHASE	DISCIPLINE	TOLERANCE
DESIGN DOCUMENTS	ARCH	ACCURATE TO +/- [ 1/16" ] OF ACTUAL SIZE AND LOCATION*
SHOP DRAWINGS	MECH CONTRACTOR	ACCURATE TO +/- [ 1/16" ] OF ACTUAL SIZE AND LOCATION* * Unless otherwise dictated by the element in question needing a higher level of accuracy for design or placement

## 21 4D MODELING – CONSTRUCTION PHASE

### 21.1 Model Guidelines

- Based upon the project challenges, technology and available information, project teams must ensure that the timing of the 4D model creation is correct. 4D models created too early or too late yield less benefits than those created during the ideal time. Although BIM based projects encourage developing a 3D model early on the project, 4D models created too early are generally too superficial and cannot provide insight into the project challenges. During programming and schematic design phases, when objectives and elements will constantly change, a 4D model can convey little useful information. 4D models created too late usually do not allow for changes to be made on the project from new insights or cost more to do so.
- Project teams also need to understand what the scope and LOD should be. Typically, the LOD increases as more design and construction information becomes available throughout the project lifecycle. The following table can be used as a guideline to manage the level of detail but it may vary from project to project.

PHASE	3D MODEL LEVEL OF DETAIL	CONSTRUCTION SCHEDULE LEVEL OF DETAIL
Feasibility Study	Project	Construction project
Concept Design	Buildings / Major Project Elements	Construction areas
Design Development	Systems / Components	Sub areas / Building Units / Disciplines
Construction Documents	Parts	Activities

### 21.2 Project Kickoff Meeting:

A project kickoff meeting should be set up in order to coordinate information exchange and to develop a common understanding of the use of the 4D model. The agenda for the project kickoff meeting should include:

- Introduction of Stakeholders
- Status of Project
- Intended use of 4D model.
- Schedule of integration between 4D model and Project
- Follow-up Responsibilities and Next Steps

## 21.3 Information Checklist

The 4D modeler should ensure the following information is available:

- 2D drawings (if 3D models are not available)
- 3D models (if available)
- 3D renderings
- Construction schedule
- Other project metrics and schedule for analysis (e.g., tenant information, traffic lane schedule, etc.)
- Critical operations and major concerns during the construction process
- The 4D modeler should also understand the LOD of each piece of information. In some cases, the LOD of each piece of information differs from the rest. The 4D model will only be as detailed as the minimum level of detail represented by the 3D model or schedule.

## 21.4 Guidelines of Updating the Model

The 4D modeler should also incorporate any insights or changes to the 3D model or schedule into the next revision of the model. The 4D modeler should also be responsible for managing and coordinating the 3D modeler and scheduler for updates to the 4D model. The 4D model should be updated as often as necessary. The schedule for updating depends upon the model usage and phase. For example, during feasibility, the model may be used for visualization and marketing purposes only, which requires little updating. However, during design development, the 4D model may be used to determine constructability and influence design changes. In this case, the 4D model, 3D model, and schedule may be updated frequently. During construction, the design is finished and managing the construction schedule becomes the main use for the 4D model. Therefore updates to the 4D model and schedule are frequent, while changes to the 3D model are limited.

## 21.5 4D Model Use

### 21.5.1 Schedule Communication

#### ***Full Project Schedule:***

The level of detail (or level of granularity) of the full schedule presentation will need to be reviewed by all parties. The level of development of the 3D model will have to correlate with the relative level of detail for the full schedule presentation. The full schedule shall represent at least: all activities, critical path, relationships, float, durations, and work breakdown structure. The schedule format shall be consistent with the required performance specifications for scheduling required by LAWA.

#### ***Look Ahead Schedule:***

This Schedule shall be used regularly to present an executive level representation of the Past month's work, current work, and future month's planned work. Essentially this schedule shall be a 90 day look ahead from a point in time 30 days prior to the current data date. The schedule shall be used to create a short animation focusing on the time frame. The Look ahead schedule can also be used to focus on specific activities, critical path analysis and specific scopes of work.

#### ***As-planned vs As-built Schedule:***

This scheduling approach is a variation of the look ahead schedule described in 2.1.2. The use of the As-planned vs As-built schedules are particularly useful in projects that have a sequence of repetitive

activities occurring in adjacent locations. Analysis of previously planned work in comparison with completed work may result in improved performance of the next planned sequence of activities.

**Procurement Tracking:**

By linking the schedule to the BIM models, it is possible to view potential sequencing and procurement delays and impacts to construction. For example, if the procurement activities are properly incorporated as schedule activities and a long lead item is scheduled to be installed, and the procurement activities have not yet been completed, the team can address the issue quickly and prevent any further downstream schedule delays. Creating a visual link between procedural items and 3D building model elements helps to better predict the impact that procurement delays will have on construction.

## 21.5.2 Construction Sequence Analysis

**Safety Management:**

Safety is a critical issue for all construction organizations and especially for a public 24/7 operating facility. The 4D model will be used as a visual tool that allows the team and stakeholders to assess conditions and identify unsafe areas that might otherwise go unrealized prior to encountering them in the field. For example, creating envelopes surrounding areas of required public access or first responder corridors can be modeled and used to analyze whether planned construction activities will encroach or require physical relocation of the envelope.

**Operational Impact:**

Operational continuity is also a critical issue for a functioning Airport facility. The 4D model will be used to reflect impact on daily required operation access and facility use. For example, creating envelopes and/or clear access paths for required GSE traffic or Sterile access corridors can be used to analyze potential impacts on stakeholders as well as Construction personnel. Minimizing access to sterile and secured areas by construction personnel will result in saved time and money during construction production.

BIM USE	DISCIPLINE (IF APPLICABLE)	SOFTWARE
Schedule Communication		
Full Project Schedule	Pre-Const / Const	SYNCHRO / NAVISWorks / Primavera P6 / Video output
Look Ahead Schedule	Pre-Const / Const	SYNCHRO / NAVISWorks / Primavera P6 / Video output
As Planned vs As Built Schedule	Pre-Const / Const	SYNCHRO / NAVISWorks / Primavera P6 / Video output
Procurement Tracking	Pre-Const / Const	SYNCHRO / NAVISWorks / Primavera P6 / Video output
Construction Sequence Analysis		
Safety Management	Pre-Const / Const	SYNCHRO / NAVISWorks / Primavera P6 / Video output
Operational Impact	Pre-Const / Const	SYNCHRO / NAVISWorks / Primavera P6 / Video output



## 21.6 4D Model Content:

### 21.6.1 3D content:

The set-up of the 3D model, schedule, and 4D model is critical in effectively using a 4D model. Often times, if these three core components to the model are not set up correctly, it is very difficult to manage and update the model, reducing its effectiveness. The following sections give best practice guidance on creating and managing these core components effectively. At a minimum, 4D models require 3D isometric object data and a schedule with a start date and finish date. While a BIM is not required for a 4D model, project teams should consider creating a BIM to enable the project team to have more opportunities to use 3D, 4D, BIM technologies later.

### 21.6.2 3D modeling for 4D Phasing:

3D models have a specific layering scheme within the 3D modeling application. Objects are typically layered based on building elements. However, in the actual construction of the project (and the 4D model representation), building elements are never constructed all at once. Therefore, it is essential for model management to have a 3D model layering scheme which supports the 4D modeling activities. There are methods to make the 3D model and schedule correspond to each other. These methods use a unique identifier of elements and tasks such as their Work Breakdown Structure (WBS), and using a consistent naming convention recognized by the modeling and scheduling software.

It is important to establish a layering scheme to support the 4D model. Otherwise, it is very difficult to manage and update the 4D model. In addition some elements in the 3D model might have to be divided into segments to correspond to the schedule, for example a large slab might have to be in 2 or more pieces to correspond to different pour schedules.

The 4D modeler must also understand how the model will be used and how often it will be updated. If the model will be updated frequently, an information exchange process must be set up. If the 4D modeler is also the designer (i.e., A/E) the process will be in-house. However, if the 4D modeler is different than the 3D modeler, an information exchange process must be established where one party must update the 3D model per the construction schedule layers. This updated model can then be incorporated into the 4D model. If the model is not updated frequently (e.g., it is used for marketing purposes or pre-bid meeting only), then the information exchange process is not as critical.

### 21.6.3 Additional Building Elements and Activities which Support Visualization:

When building elements in the 3D model are not sufficient to describe the construction or phasing process, supporting building elements and activities need to be created.

For example, a project team may want to examine the use of traffic lanes during construction. If the traffic lanes are not present in the 3D model, additional building elements representing traffic lanes need to be created. Additional activities need to be created that represent traffic movements. Often times, these activities are correlated with existing construction activities.

### 21.6.4 Orienting the Model:

Model orientation is important for stakeholders to understand the 4D model. Without orienting the model, project stakeholders may be confused at what they are seeing. Model orientation can include adding 3D text to locate street names or building levels or adding a high level site model. In addition when the model is used



as a coordination tool for different trades, micro details (e.g. grid lines, room names) can be used to orient the model as well.

#### **21.6.5 Required Building Elements:**

While building elements should be customized for each 4D modeling project, the following building elements should be required in the model:

#### **21.6.6 Required for Phasing Schedules:**

- Site Model
- Foundations
- Structure
- Walls (Exterior and Interior)
- Slabs
- Mechanical System

#### **21.6.7 Required for Construction Schedules:**

Building elements broken down to the same LOD as schedule (e.g., individual AHU units, columns, beams)

#### **21.6.8 Optional (depending on project objectives)**

- Traffic flows
- Temporary structures
- Workspace requirements
- Equipment

## 21.7 4D Model Deliverables:

DESCRIPTION	FORMAT	FREQUENCY
Schedule Communication		
Full Project Schedule		With Baseline schedule and any approved revision Monthly
Look Ahead Schedule		Monthly with Application for Payment
As Planned vs As Built Schedule		As needed and / or after completion of each sequence of work that is recognized as repetitive
Procurement Tracking		Monthly with Application for Payment
Construction Sequence Analysis	Active Synchro Model/ Sequencing Animation	
Safety Management		As needed and / or before commencement of each sequence of work that is recognized as a change in site condition
Operational Impact		As needed and / or before commencement of each sequence of work that is recognized as a change in site condition

## 22 5D MODELING – CONSTRUCTION PHASE

For each LAWA project, cost verification will be handled by a mutually agreed upon software and workflow between LAWA and the Project Team. The following section has been left intact as the standard LAWA template and will be modified once that workflow is established.

### 22.1 5D Model Guidelines:

- Based upon the project challenges, technology and available information, project teams must ensure that the timing of the 5D model creation is correct. 5D models created too early or too late yield less benefits than those created during the ideal time. Although BIM based projects encourage developing a 3D model early on the project, 5D models created too early are generally broad reaching and cannot provide insight into the project challenges. During programming and schematic design phases, when objectives and elements will constantly change, a 5D model can represent low level of detail analysis. 5D models created too late do not allow for analysis of changes made on the project from new insights or cost more to do so.
- Project teams also need to understand what the scope and LOD should be. Typically, the LOD increases as more design and construction information becomes available throughout the project

lifecycle. The following table can be used as a guideline to manage the level of detail but it may vary from project to project.

PHASE	3D MODEL LEVEL OF DETAIL	CONSTRUCTION SCHEDULE LEVEL OF DETAIL
Feasibility Study	Project	Construction project
Concept Design	Buildings / Major Project Elements	Construction areas
Design Development	Systems / Components	Sub areas / Building Units / Disciplines
Construction Documents	Parts	Activities

### 22.1.1 Project Kickoff Meeting:

A project kickoff meeting should be set up in order to coordinate information exchange and to develop a common understanding of the use of the 5D model. The agenda for the project kickoff meeting should include:

- Introduction of Stakeholders
- Status of Project
- Intended use of 5D model.
- Schedule of integration between 3D model and Cost
- Follow-up Responsibilities and Next Steps

### 22.1.2 Information Checklist:

The 5D modeler should ensure the following information is available:

- 2D drawings (if 3D models are not available)
- 3D models (if available)
- 3D renderings
- Construction schedule
- Cost analysis and/or Schedule of Values
- Other project metrics and schedule for analysis (e.g., tenant information, traffic lane schedule, etc.)
- Critical operations and major concerns during the construction process

The 5D modeler should also understand the LOD of each piece of information. In some cases, the LOD of each piece of information differs from the rest. The 5D model will only be as detailed as the minimum level of detail represented by the 3D model or schedule.

### 22.1.3 Guidelines on Updating the Model:

The 5D modeler should also incorporate any insights or changes to the 3D model, schedule, or cost information into the next revision of the model. The 5D modeler should also be responsible for managing and coordinating the 3D modeler and scheduler for updates to the 5D model. The 5D model should be updated as often as necessary. The schedule for updating depends upon the model usage and phase. For example, during feasibility, the model may be used for visualization and marketing purposes only, which requires little updating. However, during design development, the 5D model may be used to determine Estimating and Cost Analysis, and influence design changes. In this case, the 5D model, 3D model, and schedule may be updated frequently. During construction, the design is finished and managing the Cash Flow and Schedule of Values projections becomes the main use for the 5D model.

Therefore updates to the 5D model and schedule are frequent, while changes to the 3D model are limited.

## 22.2 5D Model Use:

BIM USE	DISCIPLINE (IF APPLICABLE)	SOFTWARE	VERSION
Quantity Take Off	CONT	QTO, Revit, Innovaya, Solibri	
Cost Estimating	CONT	Timberline, Excel,	
Cost Analysis	CONT	Timberline, Excel	
Projected Cash Flow Analysis	CONT	Synchro	
Earned Value Analysis	CONT	Synchro	

## 22.3 Model Content:

### 22.3.1 Quantity Take Off:

After you create takeoff data using automatic or manual takeoff tools, it is important to review and validate the data to ensure the quality of the information. When you create takeoff data in an automated program each object and quantity is aggregated in to a table or spreadsheet format. All of this data is linked in a 3-way cross-reference. Therefore, when you select takeoff geometry, the corresponding object should be selected both on the model and in the table. Similarly, when you select an object on the model or in the table, the takeoff geometry is selected as well. This 3-way visual cross-referencing of objects, at the project level (model), and at the sheet (table)—is designed to help you validate takeoff data. Only items that have a measurable value display in the table. Items are measurable when they have both a defined Type value (either Linear, Area, Volume, or Count) and a defined property for at least one dimension. Cross-referencing items on the model with those in the table can help you validate your data.

### 22.3.2 Cost Estimating:

Exported model and table information can be incorporated into existing databases of material, equipment, and labor costs per unit of measure. Appropriate calculations can be applied to generate automated Cost estimates and budgeting projections. Cost data shall conform to the requirements of the current approved LAWA and City of Los Angeles as required by current public policy,

### 22.3.3 Cost Analysis:

Is not specifically a content of 5D modeling rather the result of being able to manipulate information and systems of the 3D model to gather variances in costs. Once the QTO and Estimate are gathered and calculated, efforts to gather the variances in model content between different deliverables can become automated to an extent.

### 22.3.4 Projected Cash Flow:

Budgeted Cost of Work Scheduled (BCWS) shall be incorporated into a comprehensive model view. As example of the difference assume that a schedule contains:

- a task "Test hardware" that is budgeted to cost \$1000 to perform, and
- is expected to begin at the start of January 1 and
- complete at the end of January 10.

- At the end of January 5, the work is scheduled to be 50% complete (5 days of the scheduled 10 days). So, at the end of January 5,
- the BCWS is \$1000 (the budgeted cost) times 50% (the scheduled completion percentage), or \$500.
- Suppose that by the end of January 5, the work is actually only 30% complete. In this case,
- the BCWP would be \$1000 (budgeted cost) times 30% (the actual completion percentage), or \$300.
- Also, suppose that to reach the 30% complete level at the end of January 5, \$250 was actually spent.
- Then, the ACWP would be \$250.

### 22.3.5 Earned Value Analysis

Earned Value Analysis brings cost performance and schedule performance into a single unified view, providing a true picture of a projects value at any point in time, an ideal method of monitoring project status and the likelihood of success. Earned Value Analysis keeps spend levels in-sync with work accomplished while providing accurate forecasts. Budgeted Cost of Work Performed (BCWP) is the budgeted cost of work that has actually been performed in carrying out a scheduled task during a specific time period Eliminate inaccurate assumptions of work completion, and an out-of-sync budget against actual completion.

### 22.3.6 Key points to effective Earned Value Analysis are:

- Plan all work scope for the program from inception to completion.
- Break down scope into finite pieces (WBS) that can be assigned to people and organizations.
- Integrate program work scope, schedule and cost objectives into a performance measurement baseline plan against which accomplishments may be measured. Controlling changes to the baseline.
- Use actual costs incurred and recorded in accomplishing the work performed.
- Objectively assess accomplishments at the work performance level.
- Analyze significant variances from the plan, forecast impacts, and prepare an estimate at completion based on performance to date and work to be performed.
- Utilize Earned Value information in the management processes

## 22.4 5D Deliverables:

DESCRIPTION	FORMAT	FREQUENCY
Quantity Take Off	.xml, .pdf, .txt, .csv	With Baseline schedule and any approved revision
Cost Estimating	.xls, .pdf, .txt, .csv	With Baseline schedule and any approved revision
Cost Analysis	.xls, .pdf, .sp	Monthly with Application for Payment
Projected Cash Flow Analysis	.xls, .pdf, .sp	Monthly with schedule updates
Earned Value Analysis	.xls, .pdf, .sp	Monthly with schedule updates

## 23 CREDITS

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This template is a tool that is provided to assist in the development of a BIM project execution plan as required per contract. The template plan was created from the buildingSMART alliance™ (bSa) Project “BIM Project Execution Planning” as developed by The Computer Integrated Construction (CIC) Research Group of The Pennsylvania State University. The bSa project is sponsored by The Charles Pankow Foundation (<http://www.pankowfoundation.org>), Construction Industry Institute (CII) (<http://www.construction-institute.org>), Penn State Office of Physical Plant (OPP) (<http://www.opp.psu.edu>), and The Partnership for Achieving Construction Excellence (PACE) (<http://www.engr.psu.edu/pace>). The BIM Project Execution Planning Guide can be downloaded at <http://www.engr.psu.edu/BIM/PxP>.

Please direct any questions about this template to the cBIM Program Group.

**END OF BIM PROJECT EXECUTION PLAN**