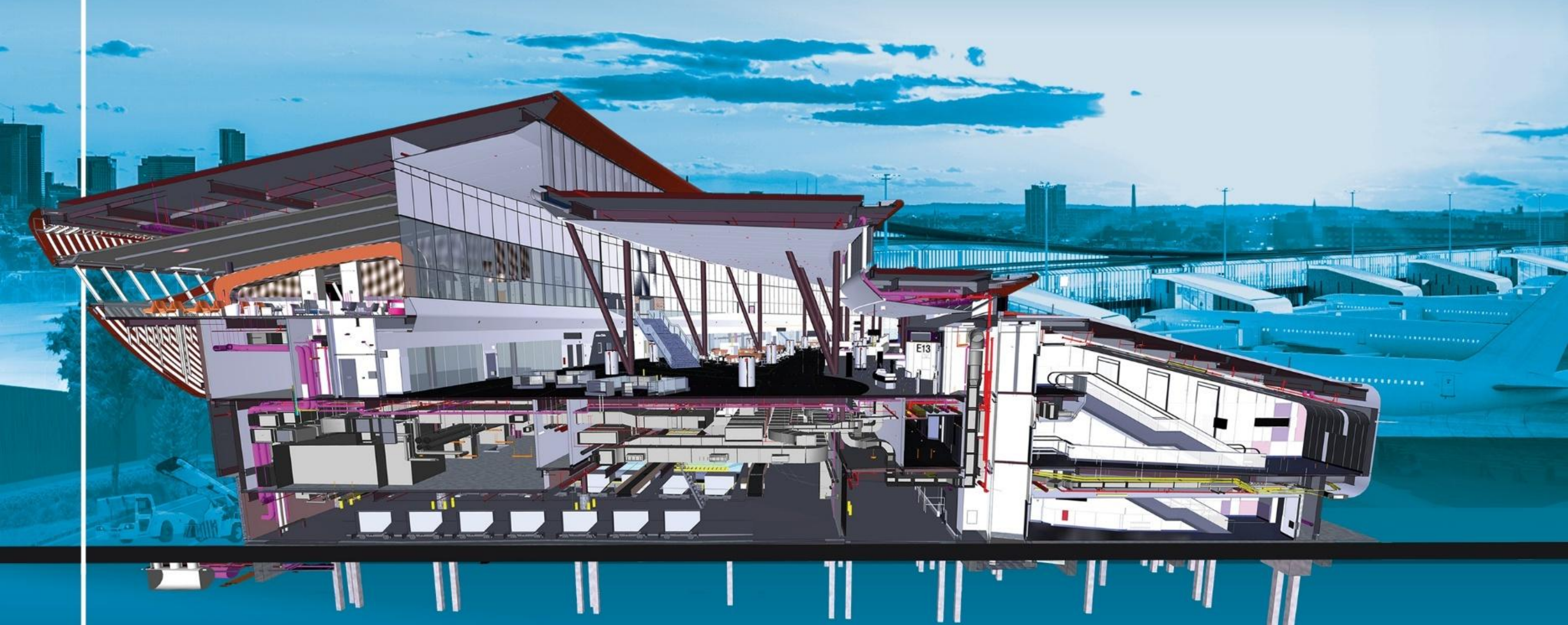
MASSPORT

BUILDING INFORMATION MODELING

BIM STANDARD

massport

Massachusetts Port Authority | Capital Programs

CREDITS AND ACKNOWLEDGEMENTS

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1. INTRODUCTION

BIM STANDARD AUDIENCE

- BIM Coordinators
- Discipline BIM Modelers
- Consultants
- Fabrication, Trade Modelers
- Model Element Authors
- Reality Capture Teams
- Commissioning Agent
- Massport PM

Building Information Modeling (BIM) is essential for implementing Virtual Design and Construction (VDC) in capital projects. Massport adopts a model-first approach to project delivery and embraces a lifecycle perspective in its asset management planning. The Massport BIM standard aligns with the ISO 19650-1 framework, BIM Stage 2 and 3 maturity levels, and the National BIM Standard v4.

This document defines the required model standards, data requirements, processes, and BIM Uses to achieve a data-driven decision process and model-first construction. The design and construction teams' BIM Coordinators collaborate with the VDC Managers and the Massport Digital Technologies Integration Group (DTIG) BIM Manager to develop models that adhere to Massport's standards.

The BIM Use outcomes, construction documentation, asset data, Record, and As-built models are the essential information deliverables ensuring Massport facilities and infrastructure retain value throughout their lifecycles. BIM helps drive Massport's digital twin and virtual campus initiatives.

BIM/VDC Project Expectation

- Maximize BIM and related technologies to achieve the project Conditions of Satisfaction (CoS).
- Work with DTIG using the BIM Decision Matrix. Determine the right level of BIM use on projects-all delivery types and sizes. (large capital projects, smaller renovation projects, TAA)
- Deliver a model-first process, a constructible model that the constructor shall build in the field.
- Foster VDC collaboration driven by high-performing teams using BIM and Lean management.
- Support and manage a BIM and data-driven decision process.
- Develop project models that meet ISO BIM Stage Two requirements.
- Use Autodesk Cloud Construction (ACC) as the project Common Data Environment (CDE)[1]
- Execute the selected BIM Uses to support project progression and decision support.
- Deliver standardized record, as-built models, and asset data complying with the BIM standard.

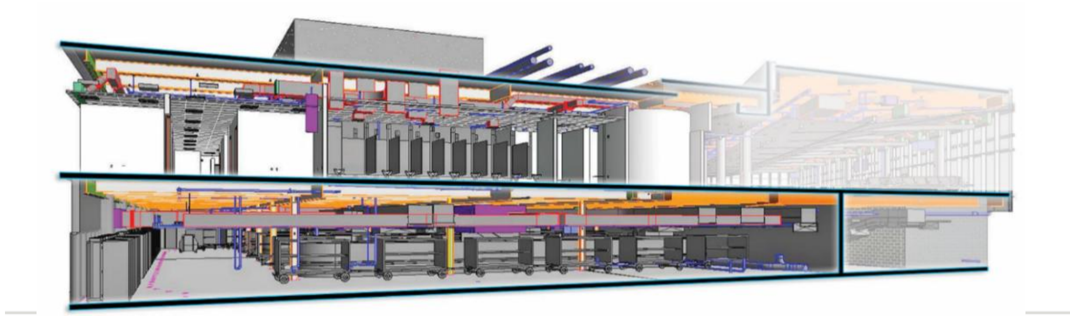

Figure 1-Massport BIM Model Section

1 CDE - Cloud-based Collaboration Site - Massport uses Autodesk Construction Cloud (ACC)

The BIM Standard Sections:

Massport's BIM Stage Two approach, terminology, technical requirements, prescriptive standards, critical asset data, and documentation requirements are divided into six sections.

- Section 1 – Introduction
- Section 2 – BIM Approach
- Section 3 – Technical Solutions
- Section 4 – Mobilization
- Section 5 – Model and Document Standards
- Section 6 – Appendix A - BIM Uses

The BIM Standard is a dynamic document regularly revised and updated to reflect the evolving design and technical standards for BIM in digital project delivery. Any proposed modifications to this document must be submitted in writing to the DTIG BIM Manager for consideration. Additionally, the Massport DTIG periodically publishes updates and revisions on its official webpage to ensure accessibility and transparency regarding the latest standards.

Using the BIM Standard

The BIM Standard is a companion document to the VDC Guide, which explains the processes and technical specifications essential for effectively executing VDC model-first projects. Massport provides additional required guidelines, standard operating procedures (SOPs), and industry-standard resources to augment these documents.

The Massport BIM resources are included in the project's ACC environment and are also available on the DTIG website. The project team should routinely consult the website for updates of these documents.

MASSPORT REFERENCE DOCUMENTS and STANDARDS

Massport developed documents- Massport Digital Technologies Integration Group.

- Massport VDC Guide
- Massport VDC Roadmap
- Massport BIM Standard
- Massport CAD Site/Civil Standard
- Massport BIM QA/QC Document
- Massport GIS Standard
- Massport Room Numbering Standard
- Massport Project Title Block Sheet List
- Massport Laser Scanning Standard Guidelines
- ACC Implementation Guideline

NATIONAL & INTERNATIONAL STANDARDS

These documents are available online through the organizations' websites.

- ISO 19650-1 - ISO UK BIM Framework
- National BIM Standard v.4 - NBIMS-NIBS
- LOD Specification 2024- BIM Forum
- BuildingSMART- www.buildingsmart.org
- Construction Owners Building Information Exchange (COBie) - COBie Standard | NBIMS

1.1. TERMINOLOGY

Many industry terms have multiple definitions. Massport has provided this section to help teams understand the standard's terminology and communicate clearly during project execution.

ISO defines three stages for BIM implementation. Currently, Massport accepts BIM Stage One. VDC requires BIM Stage 2, working toward BIM Stage 3 delivery, supporting Massport Digital Twins.

- Stage 1 (Partial Collaboration)- In BIM Stage 1, basic 3D modeling capabilities and information are managed in a structured format, often using 2D and 3D CAD drawings. Collaboration is minimal, with data exchanged through traditional methods, and models are not fully integrated or shared in a centralized system.
- Stage 2 (Full Collaboration)-BIM Stage 2 involves multiple disciplines working collaboratively using a shared BIM model within a Common Data Environment (CDE). Information is exchanged in standardized formats, improving coordination, reducing conflicts, and facilitating better project outcomes.
- Stage 3 (Enterprise Integration)-BIM Stage 3 represents full integration where all stakeholders contribute to a single, shared model that allows real-time collaboration and data sharing. This stage focuses on creating a Digital Twin, optimizing asset management, and utilizing advanced technologies such as IoT and AI to enhance operational efficiency and informed decision-making.

TERMS and DEFINITIONS

Abbreviation	Description	Source
A		
Autodesk Construction Cloud	ACC - The cloud-based work space. ACC is the Massport Common Data Environment (CDE)	Autodesk
Asset Information Model	AIM- is the operational model for managing assets in an employer's portfolio.	ISO 19650-1
As-Built Deliverable	A BIM Deliverable developed by the Constructor and captures the final condition of a project after construction. An As-Built Deliverable includes As-Built Drawings, Models, and other relevant information determined by the BIMxP.	Massport
Asset Information Requirements	AIR- The specified data/ information necessary to manage an organization's physical and digital assets effectively and efficiently.	ISO 19650-1
B		
BIM Deliverable	Building information model and/or non-model data to be provided to the Owner in connection with the intended BIM uses in a project.	Massport NBIMS
BIM Dimensions	BIM dimensions refer to 3D, 4D (Time), and 5D (Cost) designations as BIM Uses on projects. It is carried into 7D for asset management to cover the lifecycle of BIM use.	NBIMS
BIM Use	Specification of how a Building Information Model is developed and used to progress a project and achieve the identified project Condition of Satisfaction.	Massport
BIM Execution Plan	BIMxP - A plan that explains BIM information created, managed, and delivered	NBIMS
C		
Condition of Satisfaction (CoS)	An explicit description by a Customer of all the actual requirements that must be satisfied by the Performer for the Customer to feel they received exactly what was wanted.	LCI
Construction Operations Building Information Exchange	COBie - is a data schema delivered in a spreadsheet data format and contains a 'subset' of the information in the building model (all except graphical data, and hence a subset of IFC; see below) for FM handover.	NBIMS
Constructor	General term for team responsible for the construction process. CM, DBB, DB	Massport
Common Data Environment	Agreed source of information for any given project or asset for collecting, managing, and disseminating each BIM Deliverable through a managed process	ISO 19650-1 Massport

Contract Document	A set of legally binding documents that outline the roles, responsibilities, and detailed descriptions of the work to be performed on a project.	AIA
D Digital Twin	Agreed source of information for any given project or asset for collecting, managing, and disseminating each BIM Deliverable through a managed process	Digital Twin Consortium
Discipline Model	A shared digital representation of physical and functional characteristics of a building and/or infrastructure discipline (architectural, structural, etc.).	Massport NBIMS
E, F, G Exchange Information Requirements	EIR - defines each appointment's asset and project information requirements and the information produced within the project during the appointment. These define what information must be delivered as part of the appointment.	ISO 19650-1
H, I, J, K Industry Foundation Class (IFC)	IFC is a format that enables the exchange of information between different software. Developed by 'BuildingSMART,' a global alliance specializing in open standards for BIM, IFC is an official standard and contains geometric and other data.	BuildingSmart International BSI
Information Exchange	Structured sharing of data between Project Team members throughout the project lifecycle.	Massport AIA
Information Model	Structured sharing of data between Project Teams throughout the project lifecycle.	AIA
L Level of Development (LOD)	A specification defining the reliable geometric information used to represent model elements.	NBIMS
M Model-first	Model-first design and construction means making a digital model the primary source of information for a building project. Model-first focus is to develop a constructible model used as a "blueprint" in the field for construction.	LCI
Model Federation	The act of creating a virtual representation of several linked but distinct Discipline Models to accomplish an intended BIM Use.	Massport Autodesk
Meta Data	A set of data that describes and gives information about other data	ISO 19650-1
O Organization Information Requirements	OIR - High-level information on the asset lifecycle - information related to asset management. Objectives, outcomes, and organization policies	ISO 19650-1
Owner	The entity that holds the contract and receives information concerning works, goods, or services. In the context of this document, the term "Owner" mainly refers to the Massachusetts Port Authority (Massport).	Massport NBIMS
P, Q, Project Definition	Project Phase in early design. Business planning and business plan validation (done by the client in collaboration with a project team). It concludes with the client deciding to either abandon the project or fund it incrementally or entirely.	Massport
Project Information Model	PIM - The model developed for a project.	ISO 19650-1
Project Participant	Project participants are individuals who actively engage in a project, contributing their skills, knowledge, and expertise to achieve the project's goals. This includes team members and stakeholders.	Massport
Project Success Plan	A series of activities to align Massport Conditions of Satisfaction, Lean Management tools, and BIM Uses to create the VDC project framework	Massport
R, S, T, U Record Model	A BIM Deliverable developed by the Design Team that captures major changes made during the construction phase of a project.	Massport
Responsibility Matrix	The chart that describes the participation of various functions in completing tasks or deliverables	ISO 19650-1
Shop Drawing	Submittal drawings are used for approval by the General Contractor and reviewed by the Designer. Shop drawings shall be generated from the 3D Contractor Model. These drawings shall be a 2D/3D representation of the installation intent. These drawings must be submitted per the contract documents before the completion of the coordination process.	AIA

Target Value Delivery	TVD- A disciplined management practice is to be used throughout the project to ensure that the project meets the operational needs and values of the users, is delivered within the allowable budget, and promotes innovation throughout the process to increase value and eliminate waste (time, money, human effort.)	LCI
Trade Model	A Discipline Model developed by trade/sub-contractors during the prefabrication and construction phases of a project.	Massport
V, W, X, Y, Z Whole Life Cost	Whole Life Cost is the total cost of acquiring, operating, maintaining, and disposing of an asset over its entire life cycle. Whole Life Costing optimizes decision-making across an asset's lifecycle by considering immediate capital expenditure and longer-term operational and maintenance expenses.	ISO 19650-1

1.2. DIGITAL TECHNOLOGIES INTEGRATION GROUP (DTIG)

The DTIG supports all Massport departments and projects, providing resources for building information modeling (BIM), computer-aided design (CAD) and graphics, computer maintenance management systems, geographic information systems (GIS), and the implementation of integrated workplace management systems. The DTIG manages and maintains all CAD/BIM, GIS, record, and as-built drawings. The DTIG reviews emerging technologies and updates the Massport's technology and standards.

Massport retains control of the project scope brief, development direction, and allowable costs as projects progress from inception through design and construction to operational use. The DTIG oversees Autodesk Construction Cloud (ACC) as the Common Data Environment (CDE) and reviews design models and construction drawings for compliance with content, quality, and standards. The DTIG BIM Manager is responsible for facilitating the development of the BIM Execution Plan and reviewing projects to ensure their successful execution.
Capital-Programs-and-Environmental-Affairs/DTIG

DTIG Contact Information

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1.2.1. PROJECT GOVERNANCE

The DTIG manages the Massport BIM Standard, and periodic reviews are conducted in alignment with industry development and technological advancements. The DTIG reviews digital deliverables to ensure compliance with Massport BIM Standards. Any proposed deviations from the Massport BIM Standard must be formally submitted to the DTIG for review and written approval before proceeding.

1.2.2. MODEL AND DATA OWNERSHIP AND USE

All project data becomes the property of Massport. The legal rights of ownership, including statutory and common law rights, shall be retained for the models, elements, and all ancillary materials (electronic and otherwise) developed for the project. Ownership includes a perpetual use license for all models and data for future Massport work. Massport authorization is required to publish Massport data publicly.

1.2.3. COMPETENCE AND TRAINING

Consultant teams shall be experienced and work efficiently in the required software, managing BIM in ACC and executing the necessary VDC and BIM processes. The consultant shall provide training to ensure their team's capability. DTIG-facilitated onboarding may be available for specific project teams.

2. MASSPORT BIM APPROACH

Figure 2- Terminal E Logan Airport

The Massport VDC Guide outlines the model-first project delivery - a collaborative, BIM-based design process managed within a cloud-based Common Data Environment (CDE).

BIM dimensions (3D, 4D, and 5D) enable design analysis and simulations supporting data-driven decision-making.

ISO BIM Stage 2 (BIM-S2) defines model structure, quality standards, and collaboration protocols.

The Constructor builds to the model. Design assist ensures the model is constructible, and construction documentation is generated from the model, allowing the constructor to rely on models produced by others. Upon project completion, Record and As-built models and asset data are deliverables that support Massport's asset management and operations programs. These models serve as the foundation for Massport's Digital Twin goals, supporting the Digital Transformation Roadmap.

2.1. BIM STAGE 2 REQUIREMENTS (BIM-S2)

BIM Stage 2 (Full Collaboration) represents a significant step toward enhanced collaboration, standardized practices, and seamless integration. Multiple project team members work together on shared models. Structured data is created and exchanged in standard file formats, enabling collaboration between disciplines. Models created by different parties utilize the CDE federation process and coordinate their models before being published and submitted to the CDE. Below are the primary requirements for achieving BIM-S2.

- Structured Documentation
- Project Milestones-BIM Execution Plan (BIMxP)
- Standardized Processes, Coordinated Models
- Common Data Environment (Autodesk ACC)
- Naming Standards, Data Classification Systems
- Defined Roles and Responsibilities
- Model and Data Security

ISO 19650-1 BIM-S2 (Full Collaboration) emphasizes more effective team collaboration and improved data governance. The VDC Guide and BIM Standard articulate Massport BIM-S2 requirements.

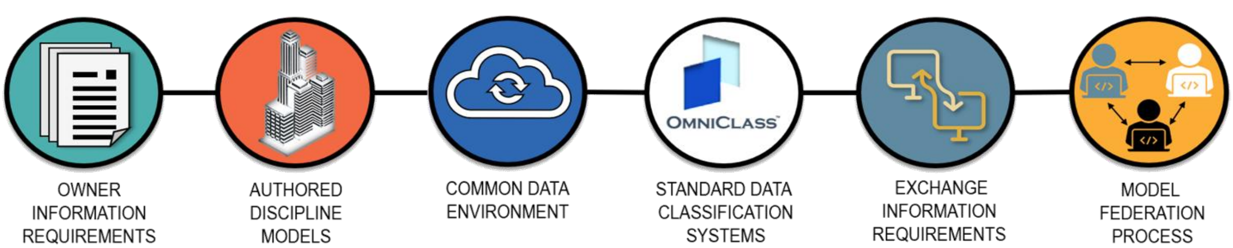


Figure 3- ISO BIM Stage 2 Requirements

Project Information Requirements (PIR)

The VDC Guide, BIM Standard, and referenced documents support Massport's BIM-S2 goals by specifying BIM requirements, including modeling structure, naming standards, and data requirements.

Authored Discipline Models

Each team is responsible for creating their discipline model, which contains the elements of a single discipline, and asset data for reporting. Discipline models are linked through fedeeration for a holistic review and model coordination. Models are defined in the BIMxP and separate for final deliverables.

Common Data Environment

Massport Project Interlink is Massport's Common Data Environment (CDE) using Autodesk Construction Cloud (ACC). Each project team shall have the prescribed version and current ACC license. Massport has an ACC Implementation Guideline for user support.

Standard Data Classification Systems

Massport utilizes several standard classification systems, including OmniClass, to identify and classify model elements. While there are many classification systems, Massport utilizes the OmniClass Classification system as its model and element classification system. A standard classification system enables electronic project data (regardless of who has created it and when) to be indexed and structured for accessibility and searchability.[2]

Exchange Information Requirements (EIR)

Models and data are shared at scheduled milestones in project development. Information exchanges support design development and Massport decision points. The design team BIM Coordinator, discipline modelers, and the DTIG BIM Manager assess whether the models comply with the standards.

Model Federation Process

ACC bridging is used for project model and data sharing, ensuring teams have up-to-date information. Stakeholders connect and share through the ACC bridge. Discipline models are shared through the ACC federation process for a holistic project review and model coordination. Discipline models are defined in the BIMxP.

2.2. VDC AND BIM MANAGEMENT

The BIM Coordinator is responsible for the BIM team's performance and utilize Lean management tools to ensure the BIM team's support for a VDC Model-first process. The BIM Coordinator will participate in the Project Success Plan and pull-plan sessions to identify modeling requirements and schedules to achieve the Conditions of Satisfaction (CoS). They with the VDC Manager to participate in the Last Planner System®, specifically pull-planning project milestones and BIM uses, create a BIMxP, support the project

[2] OmniClass- Construction Specification Institute

dashboard, and use A-3 documentation. There are additional activities for the BIM team on VDC projects that may include:

- Provide visual decision support as needed in the design process. This support may include model options, simulations, and modeling and analyses that support Target Value Delivery, design optioning, or Choosing by Advantage. Detailing and mock-ups of candidate designs. Support for estimators and QTO reporting.
- Cluster teams. The BIM Coordinator collaborates with the Cluster team to identify the relevant disciplines and modelers who may be involved in the problem-solving activity. This may require modeling options, coordination reviews, or model manipulation to support the Cluster team.
- Design Assist coordination may include construction subcontractors or the construction team (dependent on contract delivery type). In Design Assist, the models and documentation are reviewed and updated to a constructible level during the final design phase. The subcontractors may advise on the design and begin modeling for prefabrication and detailing to ensure constructability. At the end of Design Assist, the models and drawings should be complete and ready for construction.

3. TECHNICAL SOLUTIONS

This section describes the BIM-S2 processes and requirements. It includes the model management environment, software, model naming and data conventions, and processes for updating and coordinating model changes. BIM Uses are provided in Appendix A.

3.1. SOFTWARE REQUIREMENTS

Massport requires Autodesk products as its default tools, specifically Autodesk Revit, Civil 3D, and AutoCAD as authoring tools, Navisworks as a coordination tool, and the Autodesk Construction Cloud (ACC) as its common data environment.

Project teams document the software used on a project in the BIMxP. Teams must submit requests for additional software use to the DTIG BIM Manager and document all software in the BIMxP.

MASSPORT APPROVED SOFTWARE

- Autodesk Revit
- Autodesk Civil 3D
- Autodesk AutoCAD
- Autodesk Map
- Autodesk Navisworks
- Autodesk ReCap Pro
- Autodesk 3DS Max
- Primavera P6 or current version
- Synchro Pro
- Infraworks
- BIM Track
- Autodesk Construction Cloud

3.1.1. LICENSING

Massport provides the software version requirements for the project's scope of work. Project teams shall have licenses for the required software and update them per the Massport update process.

3.1.2. SOFTWARE VERSION CONTROL

The Massport DTIG BIM Manager identifies the required Revit version in the project scope and documents in the project BIMxP. Should Massport update its Revit version during project execution, the consultant and DTIG shall use the software update process.

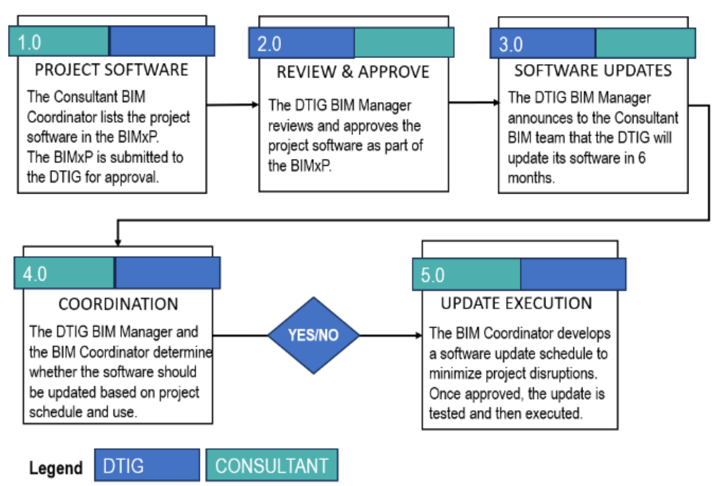


Figure 4-Software Version Update Process

Massport Software Update Process

Massport updates software on a multi-year schedule. The Massport DTIG provides a six-month notification should an update occur during a project, allowing for a review to determine whether a software update is required for the project. The project schedule and completion date inform a joint decision of the DTIG and the Consultant. Teams will review versioning to ensure that bridging and model sharing are part of any version changes.

3.1.3. AUTODESK INTEROPERABILITY TOOLS

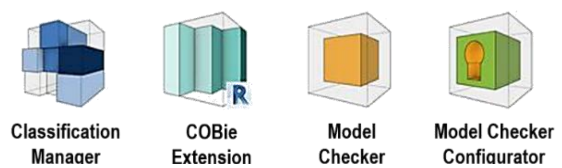


Figure 5- Autodesk Interoperability Tools

Autodesk Interoperability Tools make model and data management more efficient. The tools include the Construction Operations Building Information Exchange (COBie) Extension, Equipment Data Tool, Model Checker, Room & Area Sync, Shared Parameters Tool, and Standardized Data Tool. The Model Checker Configurator is a separate installation. The tools can be downloaded or installed directly through Autodesk Access (formerly the Autodesk Desktop App). The Autodesk Interoperability Tools are available for free download and use by licensed Revit users. https://interoperability.autodesk.com/cobieextensionrevit.php

- The Autodesk Standardized Data Tool for Revit supports OmniClass and other classification systems. Teams are encouraged to utilize this free tool from Autodesk, which enables users to quickly apply data from multiple classification systems to all elements within BIM files.
- The COBie extension enables users to export data from the model in COBie format for the system-to-system exchange of space and equipment data.
- The Revit Classification Manager supports the use of OmniClass for BIM elements and the COBie export. This interoperability and data extension can be used on Massport projects to automate OmniClass use.

3.2. COMMON DATA ENVIRONMENT (CDE)

A Common Data Environment (CDE) is the industry term for a cloud-based collaboration platform that enables organizations to share, collaborate, exchange, and store models, project information, and data both internally and externally. The *Massport Interlink* (ACC) is required for project collaboration, information sharing, and submission.

The team shall have experience in ACC use, bridging functions and models, security, and permissions management. Teams require prior approval from the DTIG BIM Manager when requesting any other CDE.

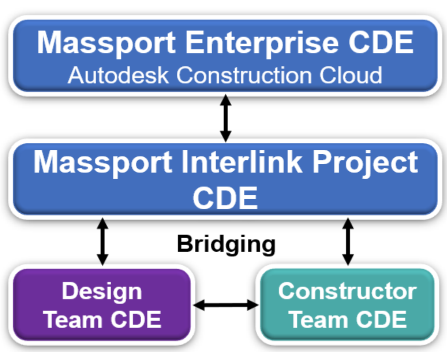


Figure 6- Massport CDE Environment

Massport has developed the *ACC Implementation Guideline*, which explains the policies and procedures for creating and managing projects on ACC. The topics covered in the guideline include, but are not limited to, bridging to MPA ACC, project folder structure, MPA shared parameters, model alignment, and the use of shared coordinates.

3.2.1. MASSPORT ENTERPRISE CDE

ACC is used as the master repository for all managed models, assets, and data files. ACC is the operational single “source of truth” for all current Record Models and is the basis of Massport's digital twin strategy.

3.2.2 MASSPORT PROJECT MANAGEMENT

Massport’s CDE is Autodesk Construction Cloud (ACC). This project site manages the project information and activities, including model sharing, review of project submissions, and as a repository for project data and deliverables. External user permissions shall be limited, and access to this environment is restricted to project personnel, approved stakeholders, and consultants. The *ACC Implementation Guideline* is the Massport reference document for ACC use.

Design and Construction Teams ACC Managers

- Design and Construction Team Responsibilities:
    - Provide at least two team members capable of managing the project ACC environment. Their responsibilities include:
  - All teams use the Massport folder structure for information exchange with Massport.
  - Managing the permission structure and bridging process
  - Overseeing information exchanges
  - Uploading, sharing, and reviewing models within ACC

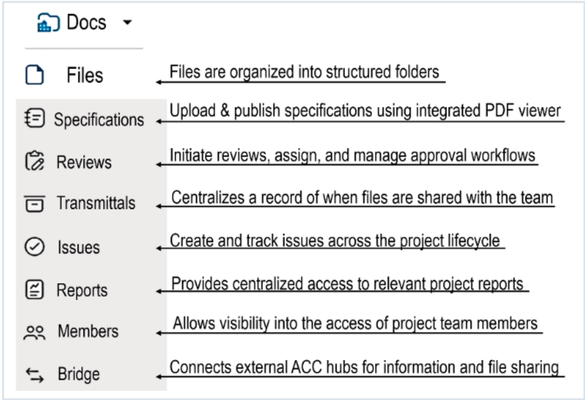


Figure 7-Massport CDE Environment

- ACC Management:
  - The design and construction teams establish and manage a company-based ACC for Work in Progress (WIP), adhering to their internal quality standards and ISO 19650-1 principles.
  - Firms may use their ACC environment to facilitate collaboration with their project consultants.

- Hosting and Sub-Consultants:
  - The Prime Design and Constructor shall host sub-consultants in their ACC environments, ensuring proper onboarding, user permissions, and conditions of service are established through formal agreements.

- ACC Bridging Process

All delivery teams shall utilize the ACC Bridge tool when sharing files with Massport. When activated at the folder level, this tool creates an active connection between the host ACC environment and the receiving ACC environment (Massport). As the host periodically copies files to the folder, these will automatically sync to the receiving ACC environment with an automated notification emailed to Massport ACC administrators.

The project teams must possess the necessary ACC licensing to enable the bridging function. The project team members must create a project folder within their ACC environment to connect to the receiving Massport ACC. Once a bridge connection is established, it is considered the only formal method for submitting BIM deliverables.

- At predetermined milestones defined in the BIMxP, the team shall share models and data in the Massport shared folder for review purposes. The primary design team is responsible for establishing other information exchange mechanisms to collect and submit engineers and subconsultants' files. Similarly, the general contractor or construction manager is responsible for collecting and submitting the sub-contractors' files.
- The Published folder is used as a record of formal milestones submittals.
- At the end of the project, the Massport project CDE becomes the archive site for the project.

Figure 8- CDE Folder Structure

3.3. INFORMATION MANAGEMENT PROTOCOLS

Consultants hosting external companies within their CDE shall manage parties at the agreed level of service to ensure efficient onboarding, procedures, and permissions. BIM development within a CDE environment is managed using the ISO protocols, provided security requirements, and data management tools.

3.3.1. ISO APPROVAL STATES AND SUITABILITY CODES

Models and drawings exist in various review, reliability, and approval states throughout the project delivery process. Teams must have confidence in the reliability and completeness of the shared models and data within the project workflows.

ISO 19650-1 has developed an approval state and use/reliability codes for team members to use from the start of the project.

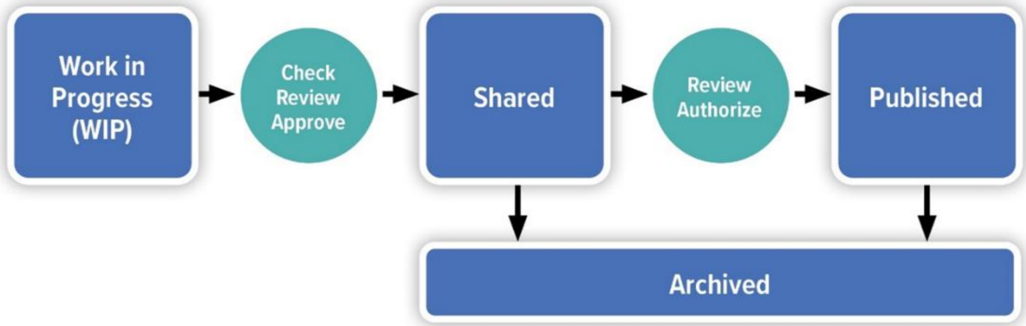


Figure 9- ISO Approval Stages

ISO 19650-1 APPROVAL STATES

Approval	Description	Distribution
Work In Progress (WIP)	Information not checked or approved yet.	Internal to discipline team members only. Not visible to anyone else.
Shared	Information is shared within the project team for a specific purpose and required reliability.	All adjacent project discipline teams. Massport DTIG and Project Management Team.
Published	Coordinated and validated information authorized as a milestone issue.	All project team members. Massport DTIG, Project Management Team, and relevant stakeholders.
Archived	Files that are no longer in circulation within project discipline teams.	Limited approved discipline team members.

ISO Suitability Codes are a standardized system identifying the intended model and information use. Suitability codes are applied on a file-by-file basis and at the discretion of the authoring party. These values are captured within files as metadata in the Massport Title Block. The design BIM Coordinator and Constructor BIM Coordinators ensure the approach is understood and implemented.

ISO 19650-1 SUITABILITY CODES

Code	Title	Description
WORK in PROGRESS (WIP)		
S0	Under development	Draft information is not fit for distribution
SHARED APPROVAL STATE (non-contractual)		
S1	For Coordination	Information shared for coordination. Ongoing work is required.
S2	For Information	Shared for information only.
S3	For Review and Comment	Suitable for review/comment and approval by Prime Consultant/Constructor
S4	For Stage Approval	Suitable for review/comment and acceptance by Massport
PUBLISHED APPROVAL STATE (Contractual)		
A1	Issued for Project Definition	The stage completed and approved by Massport for use. No comments open.
A2	Issued for Preliminary Design	The stage completed and approved by Massport for use. No comments open.
A3	Issued for Design Development	The stage completed and approved by Massport for use. No comments open.
A4	Issued for Final Design	The stage completed and approved by Massport for use. No comments open.
A5	Issued for Construction Handover	The stage completed and approved by Massport for use. No comments open.
B1	Issued for Project Definition	Partial completion. Not all contents are approved by Massport for milestone use.
B2	Issued for Preliminary Design	Partial completion. Not all contents are approved by Massport for milestone use.

B3	Issued for Design Development	Partial completion. Not all contents are approved by Massport for milestone use.
B4	Issued for Final Design	Partial completion. Not all contents are approved by Massport for milestone use.
B5	Issued for Construction Handover	Partial completion. Not all contents are approved by Massport for milestone use.
CR	As Constructed Record Document	This constructed record file meets Massport requirements for handover to facilities and Asset Management.

3.3.2. PROJECT DATA SECURITY AND BACKUP

Massport has project-specific data confidentiality, integrity, and accessibility needs. The Project BIM Execution Plan (BIMxP) shall document how the Prime Consultant and Constructor use data security protocols that align with the project scope. At a minimum, the following shall be documented within Project BIMxP:

- Data Protection- Including mitigation strategies implemented to protect systems and data.
- Data Hosting - All project data is hosted and backed up within the United States.

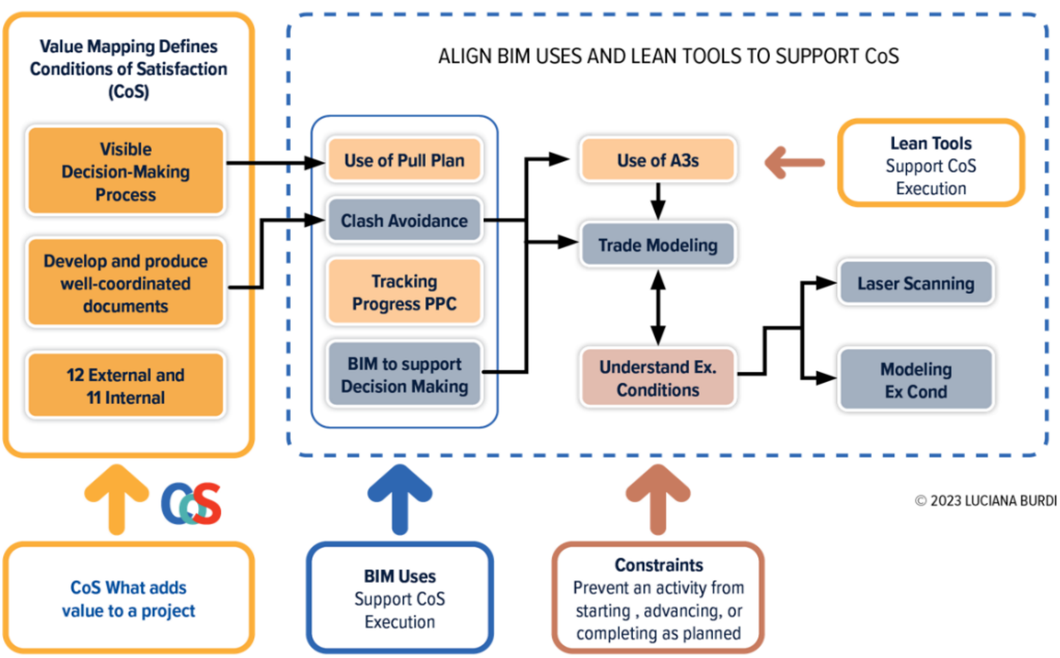
4. MOBILIZATION

The vision of project execution is defined through the Project Success Plan and documented in The Lean Deployment Plan (LDP) and the BIM Execution Plan (BIMxP). This section articulates key components of BIM mobilization including BIM uses, data classification, BIM information exchange, milestones BIM submissions, and Massport's process of deliverables review.

Figure 10- Massport Terminal E Section

4.1. PROJECT SUCCESS PLAN

The Project Success Plan activity is defined in the VDC Guide. The BIM Coordinator plays a significant role in defining the BIM Uses that align with Lean principles and achieve the Conditions of Satisfaction.



11- Project Success Plan

Conditions of Satisfaction (CoS)

- CoS represent high-level measures of project success and should not be confused with program or project requirements, which define specific project details.
- CoS guides project execution, ensuring alignment with Massport's goals and stakeholder expectations.

Kick-Off & Agreement on CoS

- Within 30 days of the project start and the designer contract award, the following stakeholders must schedule and conduct CoS development sessions:
- Prime Consultant team
- Massport Project Manager (PM)
- DTIG BIM Manager
- These sessions aim to develop, review, and gain agreement on the project's CoS.

BIM Execution & Implementation

- BIM Coordinators and discipline-specific BIM modelers must fully understand the agreed-upon CoS to align the BIM Execution Plan (BIMxP)
- They use this understanding to develop a BIM Execution Plan (BIMxP) that aligns with project goals and ensures successful digital delivery.

4.2. MASSPORT BIM USES

The Appendix A BIM Uses table categorizes the forty-one Massport BIM Uses that align with NBIMS v4. Each BIM Use includes definitions, additional descriptions, and data to meet Massport requirements. During the development of the Project Success Plan, the team will identify the BIM Uses that meet the Conditions of Satisfaction. All BIM Uses, elements, and data are documented in the BIMxP. As part of standardizing BIM execution, DTIG developed a list of ten high-value BIM uses to be implemented in its capital projects.

- Reality capture
- Model authoring
- Model-based design simulation and analysis
- Construction sequencing (4D)
- Quantity takeoff (QTO) and estimation (5D)
- Design review
- 3D coordination
- Construction documentation and layout
- Digital fabrication
- Record modeling

In addition to the standard BIM uses, project teams should use a responsibility matrix to clearly define each team's roles and responsibilities regarding BIM delivery.

Responsibility Matrix

The Responsibility Matrix outlines high-level project tasks and responsible parties. Additional responsibilities to achieve the tasks in the responsibility matrix are developed in pull planning and the BIMxP. Additional tasks may be added to the project scope.

The responsibility matrix includes the design and construction teams, as there are duplicate activities, although completion occurs at different times throughout the project.

RESPONSIBILITY MATRIX

Legend R - Responsible Party A - Accountable for Completion
C - Consultant During Activity I - Informed Following Activity Completion

Item	Task	Massport	Design	Construction	Sub Contractor
1.1	Appoint individuals to undertake BIM management functions.	R	A	A	C
1.2	Establish the project's Conditions of Satisfaction (CoS) and BIM requirements.	R	A	A	C
1.3	Establish a Massport Common Data Environment	R	A	A	I
1.4	Identify and assemble Massport's available reference information and shared resources, *e.g., Massport legacy data or title block template*	R/A	C	C	I
1.5	Participate in the Project Success Plan	R	A	A	I
1.6	Establish the project's BIM delivery milestones and BIM Uses to achieve CoS	I	R	R	C
1.7	Establish the project's WIP Common Data Environment	I	R	R	C
1.8	Establish Massport exchange information requirements	R	A	C	I
1.9	Submit individuals to undertake the BIM management function	I	R/A	R/A	C
1.10	Establish the delivery team's capability and capacity to deliver per project BIM requirements	I	A/R	A/R	C
1.11	Develop the BIMxP	I	R/A	R/A	C
1.12	Establish the delivery team's detailed responsibility matrix	I	A/R	A/R	C
1.13	Implement the project's BIM standard	I	R/A	R/A	C
1.14	Establish the project's BIM production methods and procedures	I	R/A	R/A	C
1.15	Establish the Delivery team's exchange information requirements	I	R/A	R/A	C
1.16	Mobilize resources	I	R/A	R/A	R/A
1.17	Mobilize information technology	I	R/A	R/A	R/A
1.18	Test the project's BIM production methods and procedures	I	R/A	R/A	R/A
1.19	Generate BIM information	I	R/A	C	I
1.20	Undertake quality assurance check	I	R/A	C	I
1.21	Internal Review of the information and approval for sharing	I	R/A	C	I
1.22	Submit models for BIM Coordinator approval	C	R/A	C	I
1.23	Federation Process - Shared Models (update Suitability Codes)	I	R/A	I	I
1.24	Model Review/Coordination Shared Models	C	R/A	C	I
1.25	Archive Models	R/A	C	C	I
1.26	Submit Design Models for Massport Review and Approval	C	R/A	I	I
1.27	Design Assist - Models updated for Constructability	C	R/A	R/A	C
1.28	Shop and Fabrication Model Creation	I	C	R/A	R/A
1.29	Shop and Fabrication Model Review/Approval	C	C	R/A	R/A
1.30	Model In-field BIM Uses	I	I	R/A	R/A
1.31	Update Models with Field Changes -As-Built model	I	I	R/A	R/A
1.32	Develop Record model	I	R/A	C	C
1.33	Massport Approval Project Deliverables	R/A	C	C	C
1.34	Capture lessons learned for future projects	R/A/C	R/A	R/A	R/A

4.3. BIM EXECUTION PLAN (BIMxP)

The BIMxP is a contract deliverable documenting how BIM supports the project. Massport supplies a BIMxP template to define:

- The BIM Uses that achieve the Conditions of Satisfaction (CoS).
- The BIM coordination strategy.
- Model Progression, Element LOD[3]
  - Responsible Parties.
  - Model Review and Coordination Schedule.
  - Element data

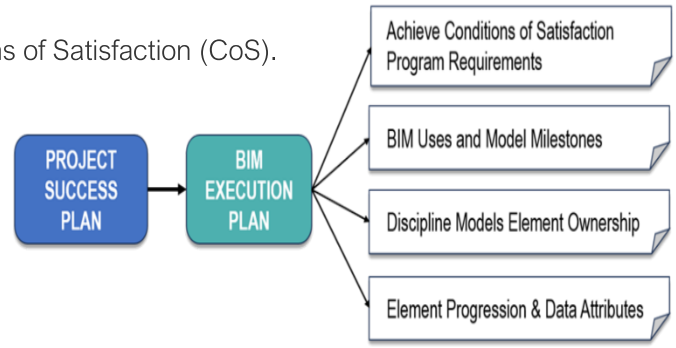


Figure 12- BIM Execution Plan

All project teams are required to follow the BIMxP to ensure their models meet the defined Level of Development (LOD) and data requirements at each project phase. The BIMxP enables better consistency, data integrity, and alignment with MPA's digital delivery and asset management objectives.

The MPA BIMxP template includes:

- Tables for collecting project and team information will be shared with all project team members and approved by the DTIG.
- A table for identifying the project's CoS aligned to the intended BIM Uses.
- A Model Progression Table specifying required LOD by project phase, data classification for all tracked elements, and discipline ownership for each of these elements.
- A BIM Data Table aligned with MPA's Asset Attribute Worksheet, listing required fields and classification systems (e.g., OmniClass, COBie).
- A table to document BIM deliverables, including deliverable packages, required files, milestones, and responsible parties.
- Tables to document collaboration and communication agreements including regular meetings, on-premise and cloud-based software use, and information exchange agreements.

The design and construction teams must:

- Use the Model Progression Table to document the development and delivery of models.
- Populate attributes as defined in the BIM Data Table.
- Apply the correct classification systems to all modeled elements.
- Coordinate with MPA's VDC team to resolve ambiguities or confirm interpretations. The BIMxP is considered a "living document" that is updated throughout the project phases or when changes in project status, modeling requirements, or roles and responsibilities necessitate an update. The design and construction teams' BIM Coordinators shall utilize the BIMxP Template.

[3] Level of Development- BIM Forum- https://bimforum.org/

BIM EXECUTION PLAN SCHEDULE

Name	Phase	Description
Massport BIMxP	Proposal Request	Massport identifies BIM scope requirements, BIM Uses, and additional data provided to the Consultants during project team selection and award.
Proposal BIMxP	Consultant Proposal	The Consultant's proposal includes a BIMxP that responds to the project scope and requirements.
Project BIMxP	Project Start	Once the project is awarded, a BIMxP is developed to respond specifically to the Project Conditions of Satisfaction and updated scope.
Contractor BIMxP	Construction Start	The Constructor updates the BIMxP for Construction, identifying the BIM Uses, information exchanges, model progression, and handovers.
Final BIMxP Submittal	Project Handover	Defines the final LOD of the Record Model elements and attribute data

Element Modeling Requirements

The BIMxP outlines modeling and data requirements across the project lifecycle. It defines how and when information should be developed and shared, ensuring that models are both geometrically accurate and information-rich.

Level of Development (LOD)

All discipline models and elements shall be fit for purpose and meet the BIM scope's modeling accuracy, performance, and use requirements for BIM Stage Two modeling. LOD refers to the graphical detail and accuracy of model elements aligned with BIMForum's LOD Specification (LOD 100–500). The element LOD shall meet the required milestone submission, review, or bid package schedule as specified. The BIM Forum periodically updates the LOD specification. Teams shall use the most current LOD specification from the BIM Forum. The specification defines LOD 100–LOD 500 for BIM geometric development.
https://bimforum.org/resource/lod-level-of-development-lod-specification/

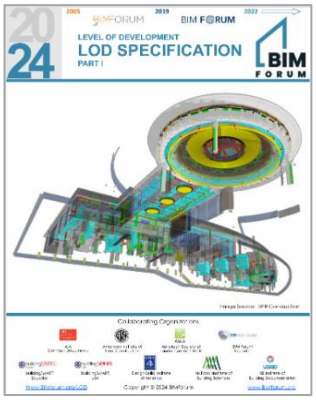


Figure 13- BIM Forum

4.4. DATA CLASSIFICATION REQUIREMENTS

Massport utilizes recognized international and national data standards, including ISO 19650-1, the US National BIM Standard, Construction Owners Building Information Exchange (COBie), and the Construction Specification Institute (CSI) OmniClass and UniFormat, to standardize data management.

4.4.1. OMNICLASS DATA CLASSIFICATION

Massport uses some OmniClass Tables for classification during projects. The following tables are listed below.

OMNICLASS TABLES

Number	Name	Description
Table 11	Entities by Function	Identify an entity's use on a project
Table 13	Spaces by Function	Used in space naming
Table 21	Elements	Used in asset naming and classification
Table 23	Products	Used in asset naming and classification

4.4.2. MASSPORT CRITICAL ASSETS REQUIREMENTS

Massport has developed a critical asset list for projects. The assets and attribute data shall be delivered per the requirements specified in the BIMxP. The critical asset data will support project BIM Uses, models and construction documentation, and Massport asset management efforts. Critical assets and data will be periodically updated through the Massport BIMxP template.

4.4.3. ASSET DATA REPORTING

The BIM deliverable shall incorporate Massport's critical asset data requirements and provide asset data reporting as deliverables at project handover. COBie or an approved reporting structure may be used. The minimum required asset attributes are in the table below. The specific asset data requirements are documented in the BIMxP.

MASSPORT ASSET DATA

Asset Data	
Manufacturer	Contract Number
Model Number	Install Date
Serial Number	P&ID Number (Tag ID)
Project Number	Purchase Price
Expected Life	

4.5. BIM INFORMATION EXCHANGE REQUIREMENTS

Project Information Exchanges are documented in the BIMxP. The exchanges define the model, data requirements, and the responsible parties. The information exchanges ensure effective collaboration and include minimum information standards to facilitate the efficient exchange of information between parties. The requirements drive consistency, interoperability, and transparency, enabling effective project delivery and the adoption of efficient digital processes.

Key Principles

The minimum criteria shall be followed to facilitate effective information exchanges:

- A CDE is used to manage all BIM deliverables and support files
- The project BIMxP schedule shall be followed
- A standardized approach to file naming per Massport Standards
- All files contain a revision in compliance with Massport Standards
- All drawings are submitted as uniquely named, individual PDFs to track revision history
- The Prime Consultant amends and re-submits if the milestone submissions do not meet Massport BIM Standards.

4.5.1. INFORMATION EXCHANGE TYPES

Information exchanges are scheduled based on BIM development, Milestones, and BIM Use execution. Throughout the project lifecycle, the types of information exchanges include:

- The design discipline team and consultants share the discipline models.

  - The exchange facilitates interdisciplinary coordination through the project lifecycle. The BIM Coordinator determines exchange formats and frequency and documents the schedule in the BIMxP.
- Milestone Submission
  - Design and construction teams share the non-model deliverables (such as COBie sheet, Point Cloud, etc.).
  - The exchange provides supplemental information to facilitate better collaboration and informed decision-making throughout the project lifecycle.

4.6. REVIT PHASES

Revit has a built-in Phase function enabling model elements to be assigned to a chronological stage of a project. It is the Prime Consultants' responsibility to ensure the following:

- Consistent naming convention across all model files/drawings
- Phases listed in chronological order
- Appropriate elements assigned to relevant phases
- Superfluous phases removed from models

REVIT PHASE TABLE

Phase Names	Description	Use
Existing	Existing site conditions within the project scope context	Mandatory
Temporary_'XX'	As required by project scope/construction methodology. 'XX' will be used to identify the stage as identified on the drawing set.	Optional
New Construction	Permanent works per project scope.	Mandatory

When used correctly, the visibility of elements can be controlled through Phase Filters and Graphic Overrides in the Phasing dialogue box. **Note:** Each BIM Coordinator shall ensure that each linked reference model is correctly mapped.

4.7. MILESTONE SUBMISSIONS

The minimum Project Information Model (PIM) is submitted for each project phase and documented in the BIMxP. The PIM is the collection of the graphical, non-graphical, and documentation required to support the delivery of the project.

Milestone Submissions by Phase

Below are the submission requirements, purpose, and schedule for milestone submissions by project phases. This applies to all Massport capital projects by default. The project-specific submission requirements is determined and documented in the project's BIMxP.

PRELIMINARY DESIGN PHASE

Exchange Category	Sub-Category	Purpose	Frequency	Formats
Project Model to Massport	Model Files	Information Only	Quarterly	Native file
Milestone Submission	Model Files, Drawings	Massport Approval	Once	IFC, Native file

PROJECT DEFINITION PHASE				
External Model Shares to Massport	Model Files	Information Only	Mid-point of the project definition phase	IFC, Native file
Milestone Submission	Model Files, Drawings	Massport Approval	Once	IFC, Native file
DESIGN DEVELOPMENT PHASE				
External Model Shares to Massport	Model Files Clash Reports Federated Models	Information Only Information Only Information Only	Monthly Bi-Monthly Bi-Monthly	IFC, Native file PDF Native file
Milestone Submission	Model Files Drawings Clash Report	Massport Approval Massport Approval Massport Review	Once Once Once	IFC, Native file PDF, Native file PDF
FINAL DESIGN, DESIGN ASSIST PHASE				
External Model Shares to Massport	Model Files Clash Reports Federated Models	Information Only Information Only Information Only	Monthly Bi-Monthly Bi-Monthly	IFC, Native file PDF Native file
Milestone Submission	Model Files Drawings	Massport Approval Massport Approval	Once Once	IFC, Native file PDF, Native file
CONSTRUCTION HANDOVER PHASE				
External Model Shares to Massport	Fabrication Model Files Fabrication Model Files Shop Models Survey Files	Information Only Massport Approval Massport Approval Massport Approval	Monthly Once Once Once	IFC, Native file IFC, Native file PDF, Native Files .rcp, Native File, Point Cloud
Model Submission	As-Built Models As-Built Drawings Asset Data Record Models Record Drawings	Massport Approval Massport Approval Massport Approval Massport Approval	Once Post Commissioning Once Once	PDF, Native Files COBie or Approved Report IFC, Native File PDF, Native File

4.7.1. SUBMISSION AND REVISION PROCESS

The DTIG BIM Manager regularly reviews model progression, modeling structure, and data standards supporting the project's success plan (PSP).

Current WIP models and documentation are maintained in the CDE according to the milestone submission requirements. Documents should be reviewed internally before submission to ensure they contain only the information required for the submission.

The DTIG BIM Manager utilizes the Revit Model Checker and visual model review to ensure compliance with standards. After each review is completed, the model owner shall update their models per the model quality assessment.

Submission & Review Process

Effective revision management for Work In Progress (WIP) models enables authors to control their work, track changes, and prevent data loss during model development. As illustrated in *Figure 9*, adopting ISO-compliant revision management enhances transparency in project submissions, allowing authors to revert to previous versions when necessary. The Massport CDE is the review and shared model environment, ensuring structured data management and control access to project files.

- Pre-Submission Review:
  - All submissions to Massport must undergo a thorough internal review process before being shared.
- File Sharing & Folder Structure:
  - All project files are shared via the ACC environment using the required folder structure.
- Submission Notifications:
  - At the time of submission, ACC generates automated notifications when files are updated in the bridge folder.
  - A formal submission announcement must also be sent to the DTIG BIM Manager and all relevant team members.

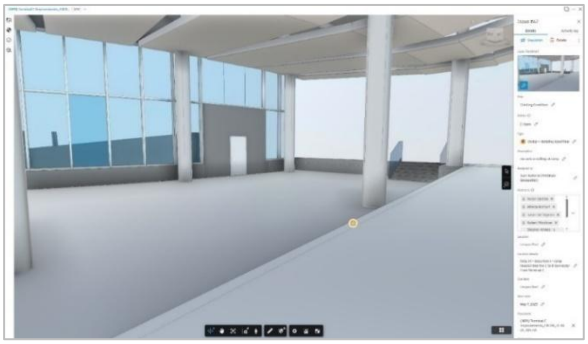


Figure 14- ACC Issue Reviewer

Model Quality & Revit Warnings

- Minimizing Revit Warnings:
  - Major deliverables must have minimal unresolved Revit warnings.
  - After each deliverable submission, three days are allocated for warning cleanup.

Controlled Information Flow & Access

- The ACC environment provides controlled release mechanisms, ensuring that:
  - Construction documents, markups, and issues are only accessible to project team members after they have been reviewed, approved, and released for their intended purpose.

Model Publishing Standards

- Each discipline-specific model must include a 3D view published with only geometry relevant to that discipline.
- Discipline-Specific View Naming & Display Settings:
  - Example: The published 3D view should be named ACC-AR for an architectural model.
  - The following elements must **not** be displayed:
- No linked files
- No CAD links
- No grids, levels, scope boxes, or lines

4.8. MODEL MILESTONE REVIEWS

Models are submitted to Massport via ACC bridging to a shared folder where the design team has editing rights. The initial review is in this folder, followed by the review of discipline models.

- An ACC review and approval workflow is used to notify participants when models are ready for review.
- Approval, comments, and rejections shall be recorded,
- The result of the model quality checking shall be recorded in the ACC-designated folder.

The design and construction BIM Coordinators are responsible for the quality control of their work. A submitted plan shall outline each model author(s) plan for quality and conformance with model standards.

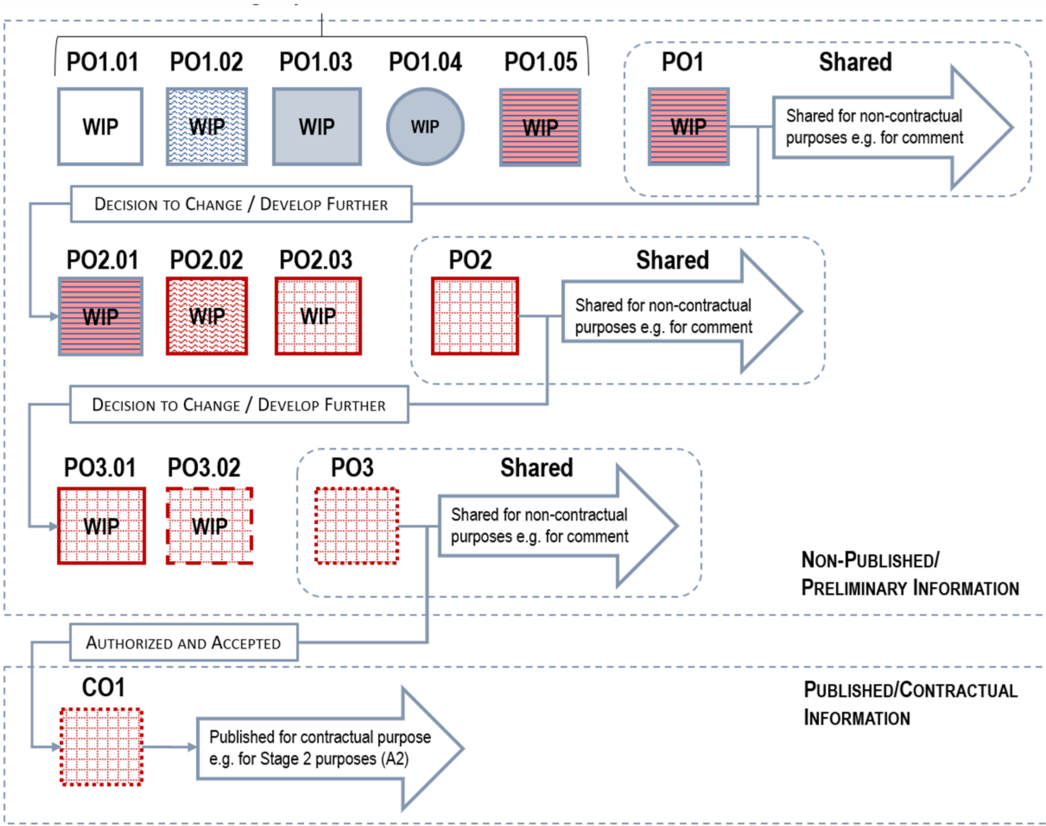


Figure 15-ISO Model Development

Massport Model Review

The DTIG BIM Manager reviews submitted models early in the project to ensure they follow model standards. The evaluation may include:

- Naming conventions are followed,
- Correct model geolocation.
- The model/file structure is followed – views are categorized correctly in the project browser.
- Asset parameters are assigned to elements per the BIMxP.
- The model meets the LOD requirements in the BIMxP,

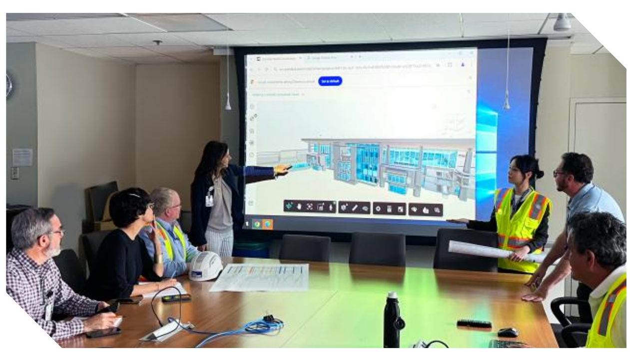


Figure 16-Model Reviews

Notification of models ready for review. Teams use the Review and Approval workflows in ACC to create an audit trail of notifications, approvals, and rejections of the models.

Scheduled Information Exchanges by Teams

Teams shall schedule regular exchanges of their project models and data to share the most current and accurate information. Sharing may occur within design teams – from discipline to discipline, submissions to Massport, or with external consultants. The scheduled information exchange is documented in the BIMxP.

Model Coordination Review - ACC Issues Tool

Models are submitted for coordination and issue resolution reviews. The Issues Tool in ACC creates comments on sheets and models. Issues are created with a location pin, and comments are assigned to the appropriate person, company, or firm. Notifications are automatically sent with responses and resolutions to the comments recorded in ACC. Issues can be exported as an Excel file where required.

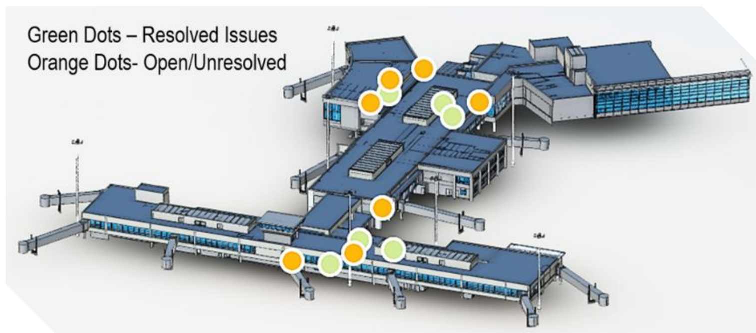


Figure 17- ACC Issue Tracking

Record Models Review

Record models submitted in addition to the above checks and requirements should thoroughly eliminate unused content, including:

- Remove unused sheets and views.
- Remove unused Design Options.
- Purged models to reduce file size.
- All duplicate elements are eliminated.
- Families are no larger than 5 MB.
- The design model will be updated to align with product selection, construction changes identified in trade models, and as-built drawings.
- 3D-ACC views and Publish Sets to remain in models.

Submission Archive

Design teams shall produce a Model Archive at the end of each project phase to preserve the model as a record that may not be altered for any reason. Phases in which model(s) are to be archived follow the BIMxP deliverables.

4.9. MODEL QA/QC

Design and construction teams will regularly hold internal single-discipline and multi-discipline quality reviews. A BIM Quality Assurance and Quality Checking (QA/QC) review evaluates the model to ensure it meets the required standards, project goals, and quality benchmarks. This process is crucial for reducing errors, improving coordination, and delivering a constructible model. At handover, the Record and As-built models support facility management.

Quality Check Criteria

- Model Accuracy- Ensure geometry and data represent real-world conditions and design intent.
- Standards Compliance- Verify adherence to project-specific BIMxP documentation, industry standards (e.g., ISO BIMS-2, NBIMS), and Massport requirements.
- Information Completeness- Check that all required data (e.g., parameters, metadata, naming conventions) are populated and correctly formatted.
- Level of Development (LOD)-Confirm that model elements meet the required LOD at each project stage.
- Model Usability- Ensure the model is navigable, logical, and structured for its intended purpose (e.g., analysis, constructability, construction sequencing, cost estimation, FM).

Deliverables include the model files, QC-generated reports, issue and resolution reviews, and any A-3 reports.

BIM Quality Checklist:

The Massport DTIG BIM Manager will periodically review the models to ensure compliance with the BIM standards. The schedule will be documented in the BIMxP.

- Model Structure:
    - All files are appropriately named and organized.
    - Worksets, views, and sheets are managed correctly.
    - Correct coordinate system
    - One Model per file rules followed
- Geometry and Components:
    - Elements are correctly placed and sized
    - No overlapping or duplicate geometry
    - Components assigned correct families/types
- Data Validation:
    - Parameters filled in per the BIMxP
    - Naming conventions followed (e.g., for rooms, levels, zones)
    - Classifications used (e.g., OmniClass) correctly applied
    - Interdisciplinary Coordination
    - Discipline models/elements coordinated
    - Clearance, access zones, areas, and spaces named, numbered, and modeled correctly
    - Performance and Optimization
    - File size optimized
    - Warnings and errors minimized
    - Unused elements, views, purged
    - Documentation and Outputs
    - Schedules, sheets, and drawings derived/aligned with the model
    - Tags, dimensions, and annotations are consistent, meet BIM standards, and are legible
    - Data exports (COBie, IFC, other approved reporting) are complete and accurate

4.10. DESIGN 3D COORDINATION

The ACC federation process shall be used as the primary coordination and issue resolution tool, improving data visibility for design modeling teams and stakeholders. The objective is to leverage the federated model over traditional 2D drawings, focusing on geometric coordination, data creation, and collaboration within the 3D environment.

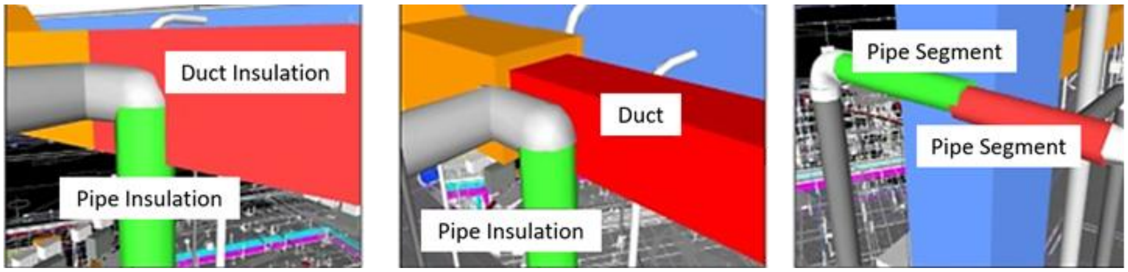


Figure 18- Clash Detection

4.10.1. COORDINATION AND CLASH DETECTION

The Design and Construction teams shall manage a regularly scheduled and thorough coordination and issue detection process, enabling an auditable process within the ACC environment or Navisworks. All discipline teams shall target zero design-driven issues before the construction phase.

Clash Detection – Design and Construction Teams

The Design and Construction teams shall formally document the clash detection approach in the project BIMxP. A Clash report will document the type of issues and resolution.

- Tolerances
- Discipline Hierarchy
- Clash type definitions (i.e., Hard vs. soft clashes, minor vs major)
- Clash test frequency/meetings
- Audit trail and close-out procedure
- Report submitted to Massport

The discipline teams shall address all resolvable minor and major coordination conflicts before model sharing. The access paths, maintenance, and clearance zones are modeled to capture these requirements.

The teams may use their preferred coordination tool, provided it can demonstrate compliance with Massport BIM Standards. ACC or Navisworks are approved tools.

Coordination and Clash Detection Requirements

Each discipline model submitted to Massport must contain dedicated 3D discipline views to enable the ACC Model Coordination module within the Massport Project CDE. Each view must meet the following criteria:

- One 3D view per sub-discipline where relevant. Refer to the File Naming Convention for further details.

- Views are named with the following codes:
  - Ex-ACC-*Discipline* Examples: Ex-ACC-AR-EXT, Ex-ACC-ME-HVC, Ex-ACC-ST-SPS, Ex-ACC-LS-XXX
- The 3D view will only contain geometry relevant to the discipline view name. Minimum view requirements:
- Revit links, CAD Imports, and annotation categories are turned off.
- Turn off non-essential worksets. Only worksets containing relevant discipline geometry should be visible.
- Design Options are set to *display only* primary.
- Phase set to show the final state of construction.
- If demolition is within the project scope, it is captured as a separate *demolition-only* phased ACC 3D view.

Before model sharing, audit the 3D views for compliance. Each ACC 3D view is included in the published set, ensuring the views are visible in each published model. The ACC 3D views are maintained throughout the project lifecycle.

The design and construction teams must ensure compliance before sharing models with Massport.

4.11. FILE NAMING CONVENTIONS

The naming convention must be standardized across all parties delivering Massport projects To enable the comparison and optimization of data across numerous assets. All files shall use the following ISO 19650 naming convention for model and documentation files.

General Naming Convention Rules

The following characters shall be avoided to ensure compatibility with external databases.

- \ / : * ? “ < > | [ ] & $, . { } @
- Spaces

Unless noted otherwise, the dash character (-) separates fields. All words within each field shall be *PascalCase* (capitalized first letters for words and no spaces). Ex. PrecastConcrete.

4.11.1. FILE NAMING STRUCTURE

The model naming convention consists of a concatenation of five fields. All fields are mandatory. Refer below for a detailed description of each field.

Figure 19-Naming Convention

FILE NAMING CONVENTION FIELD DETAILS

Field Name	Characters	Description
Project Number	8	Project number assigned by Massport.
Originator	3	Code representing the company authoring the file contents.
Discipline	6	The discipline content within the model file.
Building/Location	Varies	Massport currently uses the building/location code. If not applicable, use XX.
Form	3	The type of file, e.g., 3D model

PROJECT NUMBER CODES

Massport assigns a project number, which requires 8 characters.

Code	Project Number
A4320000	A432
L1433C02	L1433C02
L1332C02	L1332C02

ORIGINATOR CODES

The code represents the company authoring the file contents.
3 characters are required. The Prime Consultant confirms the originator's code with Massport DTIG at the project kick-off.

Company Name	3 Ltr. Abbreviation
BIM Roadmaps	BRM
WSP	WSP
Mott McDonald	MMD

DISCIPLINE CODES

The discipline code identifies technical content within the file using six (6) characters. The Consultant's prerogative is to split models to a more granular level of information, i.e., Sub-discipline level, depending on project size, complexity, and procurement. The sub-discipline coding structure is provided to standardize this approach. Contact the Massport BIM Manager should additional codes be required for the project scope.

DISCIPLINE CODES (Parent discipline Sub-discipline)

Code (PDS-D)	Description	Code (PDS-D)	Description
AR-EXT	Architecture – Exterior Envelope/Shell/Canopies	ME-XXX	Mechanical - Overall
AR-FFE	Architecture - Furniture, Fixtures & Equipment	PL-DRN	Plumbing - Drainage
AR-FIN	Architecture - Interior Floor/Ceiling/Finishes	PL-XXX	Plumbing - Overall
AR-ROF	Architecture - Roof	ST-SBS	Structure - Substructure
AR-WYF	Architecture - Wayfinding	ST-SPS	Structure - Superstructure
AR-XXX	Architecture Overall	ST-XXX	Structure - Overall
BH-XXX	Baggage Handling - Overall	SV-XXX	Survey - Overall
CV-ETW	Civil - Earthworks, Grading	TC-ACC	Telecommunications - Access Control
CV-PVT	Civil - Pavement	TC-AVS	Telecommunications - Audio/Visual Systems

CV-STR	Civil - Structures	TC-BAS	Telecommunications – Building Automation Systems
CV-XXX	Civil - Overall	TC-SEC	Telecommunications – Security Systems
EL-FAS	Electrical - Fire Alarms	TC-XXX	Telecommunications - Overall
EL-LGT	Electrical - Lighting Fixtures	TW-XXX	Temporary Works - Overall
EL-POW	Electrical - Power Distribution	UT-EED	Utilities - Electrical Distribution
EL-XXX	Electrical - Overall	UT-ECS	Utilities - Exterior Communication & Security
EN-XXX	Environment - Overall	UT-FSS	Utilities - Fuel Supply System
FP-XXX	Fire Protection - Overall	UT-WSD	Utilities - Water Supply & Distribution
LS-XXX	Landscaping - Overall	UT-XXX	Utilities - Overall
ME-EVT	Mechanical - Elevators, Escalators, Lift Equipment		

Building/Location Codes

Massport uses the spatial identifier to locate the scope of the project area. The field will typically be a concatenation of *Campus**Massport Asset No*. **Note:** The zoned exterior Massport identification strategy is currently undefined. The DTIG BIM Manager approves the standardized approach.

BUILDING NUMBER CODES

Code	Description
CHMOR003	Charlestown Wind Technology Testing Center
EB034A	East Boston SeaTow
H035	Hanscom MPA T-Hanger 35 E Row
H038R	Hanscom T Hangar 38 H Row
L013	Logan Campus. Building 13 (Cargo Building 13)
L037A	Logan Campus. Building 37A (Substation/ Lift Station)
LBLEX	Logan Express Facilities Braintree
LT31B	Utility Tunnel between Terminal A and Terminal B
LXX	Logan Campus. No building applicable
LZZ	Logan Campus. Multiple Buildings
SBCON007B	South Boston Wharf Switch House 1
W005	Worcester Euro-American Air Freight

FORM

Form is an ISO 19650-1 term for information types. The Codes denote the type and content of the file information.

FORM CODES

Code	Description	Code	Description
AGD	Agenda	M2X	Model 2D - Existing Conditions
ANL	Analysis	M3A	Model 3D - As-Built
AUD	Audit	M3D	Model 3D - Design Model
CER	Certificate	M3R	Model 3D - Record Model
CHO	Change Order	M3S	Model 3D - Shop/Fabrication Model
CKL	Checklist	M3X	Model 3D - Existing Conditions

CLC	Calculation	MAN	Manual
CMS	Comments Sheets	MCM	Model - Coordination
CON	Contract	MOM	Meeting Minutes
COR	Correspondence	PCL	Point Cloud
DRA	Drawing - As-Built	PMT	Permit
DRD	Drawing - Design Drawings	PPT	Presentation
DRR	Drawing - Record Drawing	REG	Register
DRS	Drawing - Shop/Fabrication Drawings	REQ	Requirement
DRX	Drawing - Existing Conditions	RFI	Request for Information
FRM	Form	RPT	Report
GUI	Guide/ Plan	SKT	Sketch
INP	Inspection Record	SPC	Specification
INR	Instructions	STD	Standard
INV	Invoice	SUB	Submittal
M2A	Model 2D - As-Built	TEM	Template
M2D	Model 2D - Design Model	TRM	Transmittal
M2R	Model 2D - Record Model	TRN	Training Documents
M2S	Model 2D - Shop/Fabrication Model	VAR	Variation
M2X	Model 2D - Existing Conditions	WTY	Warranty

4.12. FILE NAMING EXAMPLES

The following tables include examples using the file naming convention. The first table is for 3D model files. The second table displays the same naming convention for other file types.

3D MODEL NAMES

Proposed Name	Content Description
L1413C02-MMD-AR-EXT-L013-M3D	Logan Building 13 - Architecture Core Shell – Design Model
L1413C03-MAC-ME-HVC-L013-M3S	Logan Building 13 – Mechanical HVAC – Fabrication Model
L1413C03-MPA-ST-XXX-L013-M3X	Logan Building 13 – Structural Overall – Existing Conditions

4.12.1. DRAWING FILE NAMING CONVENTION

Massport uses a platform called Adept as an electronic data management system to store all PDF drawings. All drawings must comply with the following requirements to meet Adept standards.

- Project#-Sheet#.pdf
- Where Sheet# = One character discipline prefix + 3 digits

OTHER FILE NAMING CONVENTION EXAMPLES

Type	Content Description	Proposed Name
Photo	Photo taken outside Terminal C Main Terminal as part of an inspection	L1437C02-MPA-AR-XXX-L022- INP
Report	Main report for the design of substation/lift station	L1437C01-MPA-ST-XXX-L037A-RPT
Excel	Excel file with the calculations required for the design of the substation/lift station	L1437C02-MPA-ST-XXX-L037A-CLC
Point Cloud	Point cloud for the survey of terminal C.	L1437C02-MPA-LB22-A02-E15-PCL

5. MODEL AND DOCUMENT STANDARDS

Model consistency is essential for diverse teams to utilize the same model effectively during project execution and to achieve post-project operational use. A standardized modeling process streamlines the generation, exchange, and sharing of model-driven information between Massport stakeholders, DTIG, design and construction teams, fabricators, and asset managers. This section outlines the minimum requirements for creating model value throughout the project lifecycle.

Massport's Model-first modeling requirements support the development of a constructible model for field use. The model's constructability and Level of Development (LOD) are vetted during the design and design assist processes.

- Each model author produces information supporting informed decision-making.
- A reliable and transparent modeling process supports the use of models by future team members throughout the project lifecycle.
- Base standards are maintained throughout the design and construction phases.
- The model environment shall be transparent and follow Massport requirements.

5.1. MODELING PRACTICES

The design team shall develop a constructible model useful during construction. Below are the minimum best practice requirements for all Massport models.

- All discipline models shall be created as separate models and compiled using the ACC federation process for model review and approval. Typically, the Prime Consultant model is the base model for review and coordination. The base model will be determined at the project's start.
- Models typically contain one building only. Note: Massport may define large buildings with multiple building numbers. Massport will strictly provide the building boundaries for the project model setup.
- All objects are modeled per design intent and construction requirements. Ex. Walls modeled to floors. Multi-story walls shall not be used unless part of the actual design.
- Modelers shall use the objects and elements developed to represent the specific building components. Ex. The wall tool for walls, window objects, and column elements. Elements are placed using the correct model categories to aid the identification of the object, such as a concrete beam modeled as a structural framing member.
- Discipline models shall be aligned, elevated, and positioned in compliance with Massport's Campus Control Model Guideline.
- Avoid using generic model categories or masses.

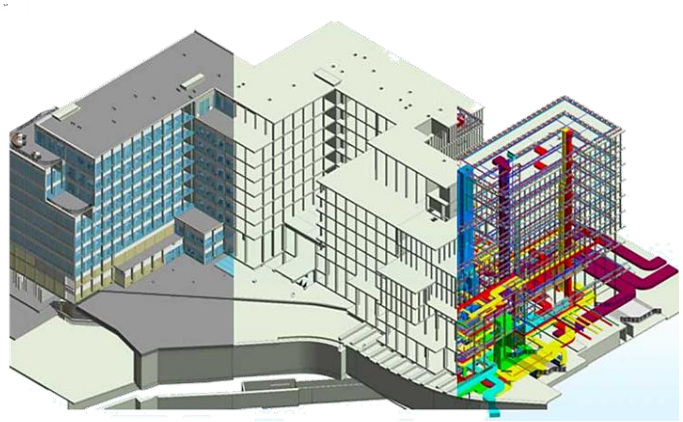


Figure 20- Discipline Model Federation

- Models should be complete and not rely upon 'typical' drawings to represent repeated instances.
- Drawings are derived from the model. The models and construction drawings shall be consistent at the time of issue.
- Models shall be reviewed, and all duplicate elements removed.
- All objects/components shall be individually selectable and unique rather than only available via a group selection (i.e., Multiple isolated elements are not modeled within one sketch).
- LOD per project stage requirement. Manufacturer families shall be avoided during design stages to minimize model bloat and ensure the level of design maturity is adequately communicated.
- The 3D Model should contain only the associated package scope.
- When creating families, use the appropriate family template. Element geometry shall be modeled at the origin to enable the logical placement of design elements within the model environment.
- Minimize the use of groups to reduce file size.
- The BIM Coordinator shall establish the floor elevation protocol to model the technical discipline and trade models at the correct elevation. The standard is at the top and bottom of the floor structure.

5.2. MODELING TOLERANCES

Elements shall be modeled within 1/8 inch of the actual built location in design development. Automated dimension strings shall be used to retain associativity. If construction layouts are used in the field, the modeling and laser teams shall review the tolerances required for system components.

5.3. COORDINATES & UNITS

Massport requires models to be correctly placed in 3D space using the real-world coordinate system for the building grid supplied by the DTIG BIM Manager. The BIM Coordinator shall establish the project-shared coordinate system across all model data files to allow them to be referenced without modification. Once established, spatial coordinates shall:

- Be changed by mutual consent of the team and the Massport DTIG BIM Manager, then promptly published to all team members.
- Any model(s) of existing buildings relevant to the project shall be converted into the coordinate system used for each designed building.
- Revit workflow dictates that building models be created orthogonal to the screen and at zero elevation. The project models utilize real-world coordinates, true heights, and shared coordinate systems established by the BIM Coordinator in the site model. The model shall use the true height above the project datum.

5.3.1. FAMILIES

The BIM Coordinator shall vet downloaded manufacturer Families before loading into a project to eliminate unnecessary levels of detail and parameter sets that are not directly related to the construction of the geometry within the family. The following are requirements for families within Massport models:

- Don't "over-model." Utilize minimal modeling geometry by leveraging visibility settings.

- Set the detail levels for plan and elevation representations (coarse, medium, or fine) and view-specific display options in the Visibility settings.
- Use families instead of groups whenever possible. Groups take time to update all group instances.
- Use OmniClass Table 21 as a reference for family naming. Don't use "Family" in the name. Don't use the OmniClass numerical codes in the name.
- Create families in the category that describes the element functionality. DO NOT create families in the Generic model or Generic Annotation Categories unless approved by the DTIG BIM Manager.
- If the components are repeated, create family components instead of in-place families to reduce model size. When an in-place family is copied (which may cause additional problems), an entirely new entity is created each time instead of just a reference to the type information from the first instance. Copying duplicates the element size rather than the smaller reference size.
- The room calculation enables the correct association of assets with rooms or spaces.

5.3.2. SHARED PARAMETERS

Shared parameters are created within a family or the project environment and can be used across multiple families. They can be tagged, scheduled, and exported to ODBC (Open Database Connectivity)

The BIM Coordinator will manage shared parameters across multiple models and modelers to limit duplication and deletion errors. The project team shall refer to the MPA Revit template to review the required shared parameters.

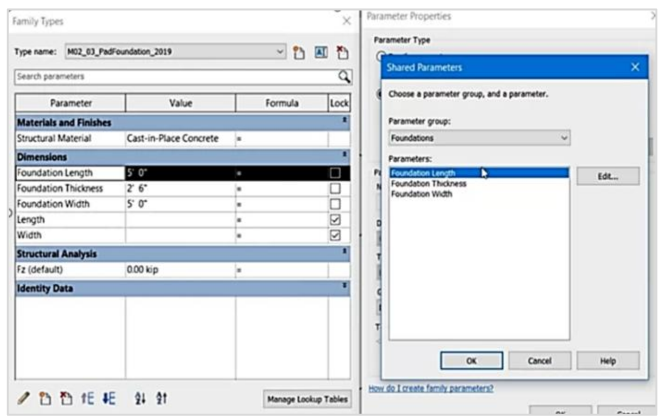


Figure 21- Shared Parameters

5.4. DESIGN OPTIONS

Design Options help develop solutions during the early design stages. The Prime Consultant shall follow these best practices.

- Primary options shall be communicated to all teams for coordination purposes.
- Redundant options are removed once the preferred solution is selected.
- Additional lean tools may be used to understand the cost of the design option and other variables.

5.5. MASSPORT CONTROL AND LEGACY MODELS

Massport provides information relevant to the project. This may include:

- Existing Control and Legacy Models
- Massport Content Library
- Massport Revit Template

- Massport Splash Screen

This information is available through the DTIG Site - Templates and Support Files:
https://www.massport.com/business/capital-improvements/capital-programs-and-environmental-affairs/dtig

5.6. MODEL, REVIT NAMING CONVENTIONS

For BIMS-2, the model, file, and element naming conventions follow Massport standards. To achieve the highest BIM maturity level, where data is exchanged regularly between different disciplines and organizations, a predefined and agreed-upon naming convention is mandatory for project success.

Applying a standard naming convention to directories, files, parameters, and elements shared among the teams reduces misunderstandings and errors when exchanging data.

Stakeholders scan and access files to collect or modify data stored within them. A naming standard for files and folders facilitates the direct access and retrieval of stored information.

5.6.1. ROOM NUMBERING STANDARD

Massport has developed a Room Numbering Standard Document. (Massport Digital Technologies Integration Group.) The document establishes a standard for assigning room numbers within MPA buildings. The format and the selection of specific room numbers are specified.

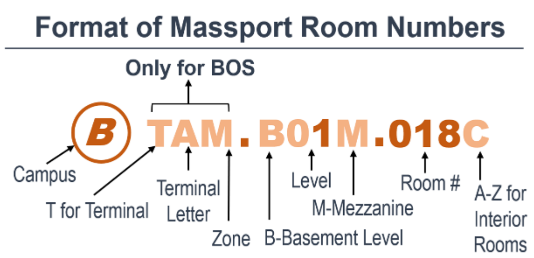


Figure 22-Numbering Standard

- Room- An area within a building bounded by full height (i.e., floor to ceiling), walls, doors, and/or barricades to holes within a floor that provide access to other floor levels.
- Room Number- A unique number that conforms to this standard, applied to a room within the Massport property and project.
- Spaces/Areas - An area within a building used for a common purpose. Spaces need not be bound by walls, doors, or other physical features. Spaces can contain or be contained by rooms.
- Floor Level- A portion of a building where structural elements, architectural features, assets, and amenities generally fall on the same horizontal plane.

5.6.2. SPACE NAMING STANDARD

Massport may require room and area naming standards. This will be reviewed in the project scope of work and refined in the project BIM requirements.

5.6.3. MODEL VIEW NAMING CONVENTION

All model views are assigned a prefix corresponding to their function, as defined in the following table.

Prefix	Name	Description	Convention
Wo-	Working View	Uncontrolled user-defined views for modeling and internal team uses.	Wo-*UserInitials*-*Description*
Ex-	Export View	Controlled views prepared for model exports to other formats, e.g., DWG, IFC, NWC, as well as cloud sharing.	Ex-*Discipline*-*Description*

Pr-	Presentation View	Controlled views used to support non-contractual visualization, e.g., Renders, displaced views, published views	Pr-“ViewType”-*Description*
Sh-	Sheet View	Controlled views are placed on sheets as a formalized contractual deliverable.	Sh-*ViewType*-*Level*

5.6.4. VIEW TITLES

View titles shall be defined in the BIMxP.

5.6.5. WORKSET NAMING STANDARD

A standard Workset naming convention is required on projects. The number (1, 2, 3) and the type (System, Model, Link) are required. The final field is a discipline designator or a brief description.

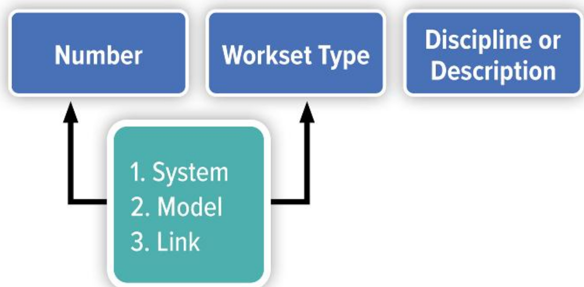


Figure 23- Workset Naming Standard

Worksets

Active workset: 2 MODEL_Exterior (Not Editable) ☐ Gray Inactive Workset Graphics

Name	Editable	Owner	Borrowers	Opened	Visible in all views
1 SYSTEM_Basepoint	No			Yes	☐
1 SYSTEM_Matchlines	No			Yes	☑
1 SYSTEM_Reference Planes	No			Yes	☑
1 SYSTEM_Scope Boxes	No			Yes	☑
1 SYSTEM_Shared Levels and Grids	No			Yes	☑
2 MODEL_Ceilings	No			Yes	☑
2 MODEL_Entourage	No			Yes	☐
2 MODEL_Equipment	No			Yes	☑
2 MODEL_Exterior	No			Yes	☑
2 MODEL_Finish	No			Yes	☑

Figure 24- Workset Example

5.7. DRAWING REQUIREMENTS

The minimum best practice required by Massport includes using the Massport CAD Standard.

- When a view of the model is split across construction sheets, the BIM Coordinator shall set the extent of the view for all disciplines to follow.
- Models and sections shall be developed with directional references for review and use.
- All sheets shall be numbered according to the Massport CAD Standard and indexed in PDF format.
- All drawings should be derived from 3D model elements, excluding schematics and typical details. All typical details used shall accurately convey the design intent of the model.

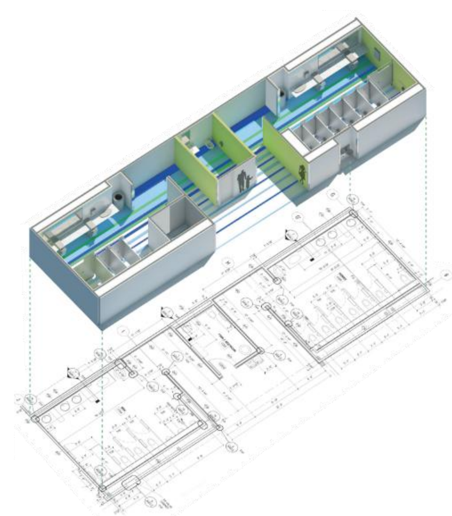


Figure 25- Model to Drawings

- Device Symbols - A plan symbol is hosted to its 3D element and must remain aligned in all documentation to ensure that the location and quantification remain accurate.

Drawing Scale

The drawing scale must be shown on all sheets, including plans, elevations, sections, and details. Each drawing must include graphic scales. The scales of projects may vary according to their type. The DTIG BIM Manager will approve any request for scale changes within a project. The following designated scales are typically required as a minimum.

SCALES FOR DRAWING SHEETS

Name	Dimension	Name	Dimension
Floor Plans	1/8"=1'0"	Mechanical/Toilet Rooms	1/4"=1'0"
Building Sections	1/8"=1'0"	Roof Plans	1/16" or 1/8"=1'0"
Refl. Ceiling Plans	1/8"=1'0"	Elevations	1/8"=1'0"
Wall Sections	3/8", 1/2" or 3/4=1'0"	Site/Civil Plans	1" = 20' or 40'

Fonts and Lettering

A minimum letter size of 1/8 inch for notes and 1/4 inch for titles for half-scale production.

- All lettering must be in vertical CAPITALS.
- The text font is Arial Narrow for notes
- Arial Narrow for titles.

5.8. DOCUMENTATION REQUIREMENTS

The BIM Coordinator shall review and utilize the Massport CAD Standards and conventions for construction documentation.

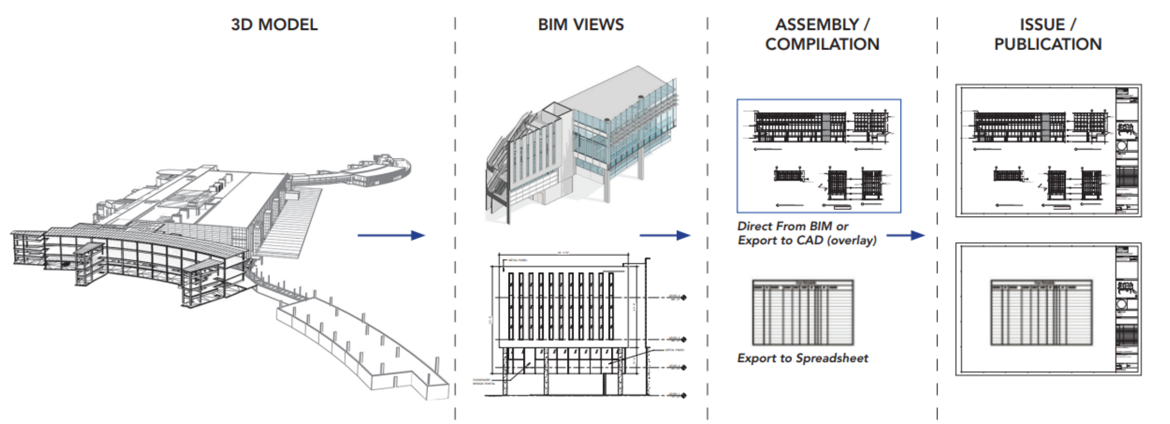


Figure 26- Model Derived Drawings

5.8.1. TEXT CONVENTIONS

A minimum letter size of 1/8 inch for notes and 1/4 inch for titles shall be used to reproduce them in one-half of their size. All lettering must be in vertical capitals. The text font is Arial Narrow for notes and titles.

TEXT SIZE REQUIREMENTS

Annotation Type	Text Size	Notes
Title blocks	3/16" – 1/4"	Project name, Sheet titles
View Titles	1/8" – 3/16"	Section, Elevation, Plan titles
General notes	1/8"	Body text for notes
Dimensions & Tags	3/32" – 1/8"	Should be readable at scale
Room names & numbers	3/32" – 1/8"	Consistent across plans

LINE WEIGHTS REQUIREMENTS

Text Height	Line Weight	Usage
Thin (LW 1)	0.18 mm	Detail lines, hatching
Medium (LW 3–5)	0.25–0.35 mm	Object outlines, annotation leaders
Thick (LW 6–9)	0.5–0.7 mm	Section cuts, major outlines
Title Block Lines	0.35–0.5 mm	Borders, logos
Grid Lines	0.25–0.35 mm	Should be visible but not dominant

5.8.2. DIMENSIONS

The dimensions in modeling and documentation shall be associated and remain linked throughout the project. EQ./EQ. shall not be used for new design elements and drawings.

5.8.3. LINE STYLES AND WEIGHTS

The internal software BIM Line Style defaults shall be used instead of the NCS and Massport Linetype definitions. The BIM Coordinator has the discretion and responsibility to edit the default line weight values in the BIM software so that printed documents accurately reflect the graphic intent of NCS and Massport standards.

5.8.4. SYMBOLS

2D symbols shall align with any element represented. Symbols used follow the Massport CAD Standard or the National CAD Standards.

North Arrow

An arrow indicating true north is shown at the upper left-hand side of all floor plans drawings, including site/civil, architectural, structural, plumbing, fire protection, mechanical, and electrical drawings.

Document Schedules

Schedules are derived from the model, with additional information provided by the project team member responsible for schedule data. Information shall be organized in every schedule in a similar format, with a heading, a mark column, distinguishing characteristics, and a notes column. Numbers and note legends are recommended for schedules with duplicated note information in the note column to minimize the size of the schedule.

HEADING			
MARK	ITEM DESCRIPTION	DISTINGUISHING FEATURE	NOTES
			1,2
			3
			5
			2,3
			4

Figure 27- Schedule Form Example

5.8.5. TITLE BLOCK AND BORDERS

All project sheets must be created using one of the Massport Title Blocks and Contract Borders provided by Massport DTIG. The Massport Title Block and Information shall be adapted for BIM use by the Design Team. The DTIG team provides it through the DTIG site. https://www.massport.com/business/capital-improvements/capital-programs-and-environmental-affairs/dtig

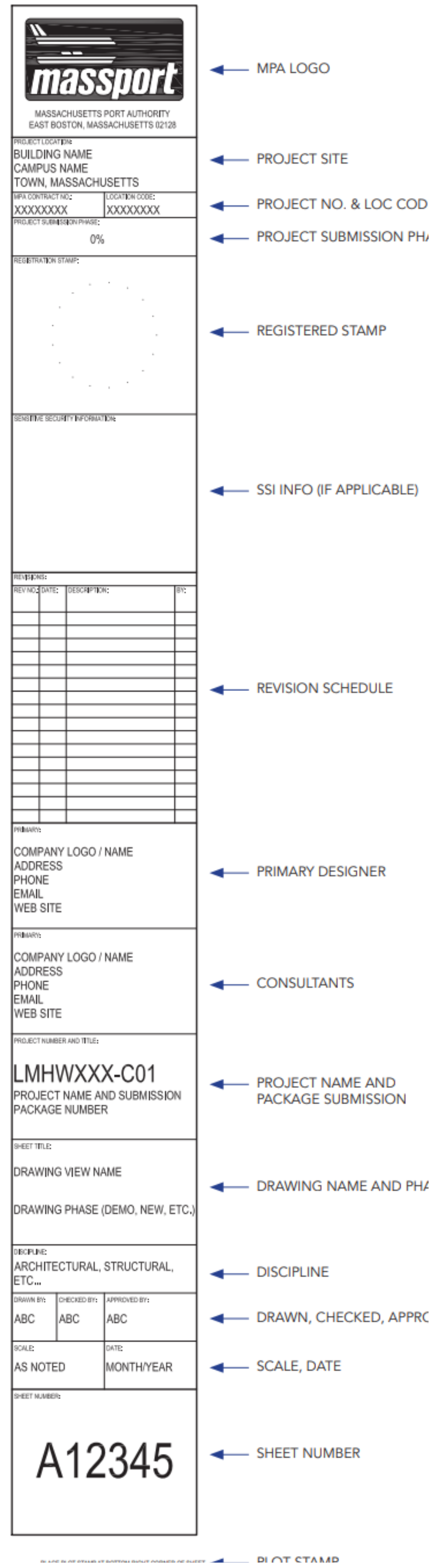


Figure 28- Title Block

Size / Margins

The outside dimensions of both preliminary and final working drawings must be either 24 x 36 inches, 30 x 42 inches, or 36 x 48 inches. The Project Manager designates the appropriate drawing size. Within these dimensions, drawings must have a ½-inch border on the top, bottom, and right sides and a 1-inch border on the left side of the sheet.

Title Sheet

A title sheet must accompany each set of drawings unless Massport waives this requirement. The title sheet should contain an accurate indexed list of applicable drawings. Legends, graphic symbols, and general notes must appear on the first sheet of each discipline's drawings. Discipline sheet sequencing shall follow the NCS standard. United States National CAD Standard, v5 - Uniform Drawing System, Module 1 - Sheet Identification

Sheet Identification, Sequence, and Index

All drawing sets must include a complete index on the cover sheet that lists individual sheet titles and numbers for all disciplines in the set. This naming convention shall follow the National CAD Standards (NCS)

Legends, graphic symbols, and general notes must appear on the first sheet of each discipline's drawings. Discipline sheet sequencing shall follow the Massport CAD standard based on the NBIMS/NCS standard.

Key Plan

The key plan must be shown in the lower right-hand corner of all sheets, along with floor plans, elevations, and building sections. The plan must identify the area depicted on the sheet. The Key plan orientation must match the floor plan orientation on the same sheet. All drawings in a set must be oriented in the same direction.

Plan Views

All drawings in a set must be oriented in the same direction.

APPENDIX A. BIM USES


Photo © Robb Williamson / AECOM

APPENDIX A. BIM USES

Massport's BIM Uses define activities that maximize BIM capabilities on projects. The descriptions in this appendix represent the minimum BIM Use deliverable.

The Massport BIM Uses:

- Establish a common understanding of how BIM may be used for desired outcomes on projects,
- Provides a framework for project-specific BIM use.
- Align with NBIMSv4 and ISO international principles.

The BIM Coordinator and discipline modelers participate in the Project Success Plan, identifying BIM Uses that achieve the project Conditions of Satisfaction (CoS). Any project team may recommend additional BIM Uses to support a project. All project BIM Uses are to be documented in the BIMxP.

MASSPORT BIM USES

BIM Uses	Massport Use Cases
1. Reality Capture	Building Interior, Environmental Conditions, Infrastructure, Utilities Conditions
2. Model Authoring	*Discipline models include* Architectural, Baggage Handling systems, Conveyance, Structural, Mechanical, Plumbing and Fire Protection, Electrical and Alarm Systems, Interiors, Tenant Build-out and Alteration, Civil Infrastructure, Utilities, Site Conditions, Temporary Work.
3. Model-based Design Simulation and Analysis	*3D simulations and system analysis, including* Energy, Environmental, Structural, Lighting, Occupancy and User Experience, Space Programming, Sustainability and LEED
4. Construction Sequencing (4D)	4D Scheduling, Logistics, and Site Planning
5. Quantity Takeoff (QTO) and Estimating (5D)	QTO, Model-based Estimating, Budgetary Costing
6. Design Review	*Design review, including* Constructability, Safety, Code Compliance, Quality
7. 3D Coordination	Clash Detection, Clearance Checking
8. Construction Documentation and Layout	*Construction documentation, including* Detailing and Mock-ups, Shop Drawings, In-field Layout
9. Digital Fabrication	Pre-fabrication and Assembly, Machine Guidance, and Robotics
10. Record Modeling	Record and As-built model deliverables, CAD Floor Plans, As-Built Construction, Asset Information Development, Commissioning and Handover,

A1 REALITY CAPTURE OVERVIEW

Accurate and verifiable existing conditions are crucial for developing reliable project models. Existing conditions are captured at the project start and throughout construction to document as-built conditions. This section provides general information for all Reality Capture BIM Uses.

NATIONAL BIM STANDARDv4

Collect current information about the built environment to include in the model.

Related Terms:

Existing Condition modeling, Laser Scanning, Integrated Surveying, Photogrammetry, and 360 imagery.

Reality Capture Tools:

- Unmanned Aerial Systems to create a photogrammetric model
- Laser scanners to create a point cloud
- Total station data collection to create a GIS dataset
- Thermal camera to map energy leaks
- GPR to create a sub-surface model
- 360 aerial cameras to validate QA/QC Consistency Control
- AI-enabled photogrammetry to establish installed quantities

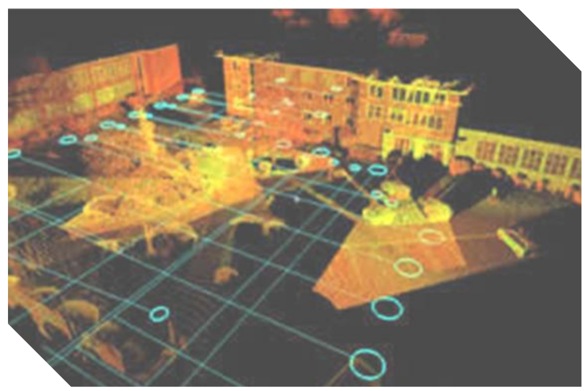


Figure 29-Site Building Capture

Benefits

- Reduced risk of differing site / built environment asset conditions
- Reduced reliance on field verification – reducing effort and rework
- Increased model and documentation accuracy
- Reduced exposure to unsafe conditions during data capture
- Ability to verify record information against as-built conditions

Responsible Parties

Massport DTIG and Survey Unit support the design and construction consultants or approved trade contractors. The teams shall have experience in laser scanning or the appropriate reality capture technology, surveying, modeling, GIS data management, model/point cloud data integration, and model management within the Autodesk Construction Cloud, as specified in the project scope of work.

The laser scanning task may be subcontracted to the design and/or construction team or contracted to a third party and, in some cases, to the Massport survey team. Massport has the approval of who and how the reality capture is executed.

Inputs

Massport supplies existing and relevant historical data files at the start of the project.

- Record Data, drawings, and models
- Survey data
- Reference Database Export
- Subsurface Scanning (GPR and EM)
- Above Surface Scanning (LiDar)

Existing Conditions Meeting

All reality capture tasks require a coordination meeting with the Massport PM, the scanning party, the BIM Coordinator, the Survey Manager, and other responsible parties to determine the "survey control points" for capture activities, required content, and model development requirements.

- Determine the level of accuracy of the data supporting the end-users.
- Identify necessary disciplines (and required LOD for each discipline) to be captured to support intended use cases.
- Which systems (and what level of detail of those systems) is necessary to be captured to support future steps
- Apply needed point cloud and model coordination and alignment.

The team shall use point cloud development software (editing and viewers) compatible with Revit Architecture, MEP, as required for any scanning and modeling scope. The software is documented in the BIMxP.

General Deliverables

Based upon the specific BIM use, the team tests and submits approved files to the Autodesk Construction Cloud (ACC) project. The point cloud, capture technology files, Navisworks, and .rvt file integration testing before BIM development.

- Existing Conditions model
- Point Cloud file
- Native files from other approved capture technologies
- Reports
- Photos, Drawings
- GIS data

A1.1 REALITY CAPTURE - GENERAL

3D laser scanning is a regularly used technology that creates dimensionally accurate point cloud files of existing conditions, assessment data, and new construction. Laser scanning in design and construction encompasses site surveys, as-built documentation, design validation, quality control, and the preservation of existing data.

Massport Laser Scanning Guide

Massport has developed a guide for laser scanning. [Massport-Laser-Scanning-Standard-Guidelines-Operating-Procedure.pdf]

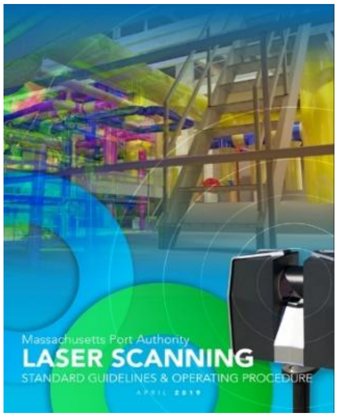


Figure 30- Laser Scanning Guide

Laser Scanning Workflow

Figure 31- Laser Scanning Workflow

- Required Coordination Meeting:
  A coordination meeting determines the reality capture technology (LiDar, imagery, etc.), method (Terrestrial Laser Scanning, Drones, etc.), content, schedule, and approved survey points before scanning activities begin.
- Scan Project:
  The point cloud is captured by laser scanners or LiDAR systems and imported into software like Autodesk ReCap and CloudCompare.
- Point Cloud Optimization:
  Teams remove unnecessary data, including items outside the area of interest (e.g., vehicles, plants). The software filters out unwanted points for accuracy. The remaining points are sorted by features or surfaces, like walls, floors, and ceilings. Grouping points for specific components increases modeling efficiency.
- Generate a "Mesh":
  If required, teams may connect the points with polygons (usually triangles). These meshes represent the surfaces and geometry of the scanned object or environment.
- Add Textures and Materials:
  Teams may create textures. Examples include concrete walls, glass, tiled floors, or ground, as specified in the project scope.
- Converting to Solid Geometry:
  For CAD or BIM applications, the point cloud may be converted into solid geometry (like parametric objects) compatible with Autodesk Revit for detailed editing and analysis.
- QA/QC Validation and Refinement:
  The generated 3D model is compared to the point cloud for accuracy and verification. Adjustments are made to improve precision or align specific features.
- BIM Development from the Point Cloud:
  Not all scanned elements need to be modeled, but this decision is defined in the laser scanning scope and the BIMxP

Responsible Parties

The scanning team and the design and construction BIM Coordinators are responsible for capturing, creating, manipulating, and integrating models and point clouds.

Deliverables

Point cloud files tested for model integration. Files submitted to project ACC.

A1.2 REALITY CAPTURE BUILDING INTERIOR

Laser scanning and other tools are used to develop spatially accurate representations of existing spaces, building interiors, system components, and equipment for various project applications.

Laser scanning captures existing conditions and the interior's state at different construction stages, facilitating the identification of discrepancies between the existing conditions, design models, and construction. Promptly addressing discrepancies enables corrections before issues escalate during various phases of the project.

Reality Capture Considerations:

- Attend the coordination meeting to determine the scope, content, and data accuracy that support the capture conditions. Determine the systems and level of development (LOD) needed for future tasks.
- Verify the Tolerance and Accuracy of the captured data. Point cloud creation and cleanup, Revit integration testing: the scans' overall aggregated file size and team capability to handle such files.
- Installation coordination contractors ensure that components, such as HVAC systems, plumbing, and electrical wiring, are installed without conflicts or overlaps to prevent issues. This visual information helps to resolve issues quickly and avoid delays and potential change orders.

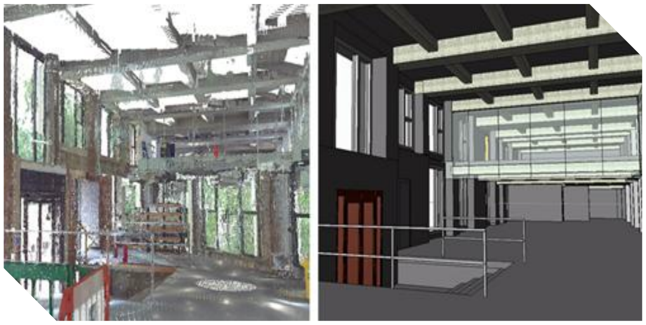


Figure 32-Interior Scan and Model

- Progress modeling Scans taken at various construction stages enable teams to track progress and compare it against the project timeline.
- Facilitating prefabrication laser scanning ensures that dimensions are exact so prefabricated components fit properly when installed (e.g., prefabricated walls, MEP, casework, modular systems).
- Quality, Safety, Code Compliance- Laser scanning provides a comprehensive interior record as a reference for inspections and quality control.
- Scans for future renovations create a valuable digital archive for future renovations or facility management. This data supports the development of digital twins and reduces the labor required for surveys. During construction, the team provides As-built documentation of the new construction as per the scope.
- Scan to BIM production adheres to Massport BIM standards, utilizing the LOD for model elements as defined in the project's BIMxP. Not all scanned elements are modeled. Modeled elements are defined during the Coordination Meeting.

Responsible Parties

Massport PM, Survey, DTIG BIM Manager, design team, interior designer, scanning team, and construction team during construction

Deliverables

Point cloud file – Registered positioned point clouds conforming to the defined coordinate system. Model and point cloud testing and file submission to project ACC.

A1.3 REALITY CAPTURE ENVIRONMENTAL CONDITIONS

The point cloud provides a comprehensive "snapshot" of the site's current state- site, environmental details, terrain features, vegetation, existing structures, and utilities.

Benefits

Capture technologies document a variety of environmental conditions.

- Topography:
  Scanning identifies changes in elevation, slopes, or geological features. This data ensures that construction plans account for the land's natural contours, reducing excavation errors and improving planning for foundation work.
- Environmental Analysis:
  Scans may include data on vegetation, water bodies, or protected areas to assess potential environmental impacts. This data helps ensure that construction complies with environmental regulations and minimizes ecological disruption.

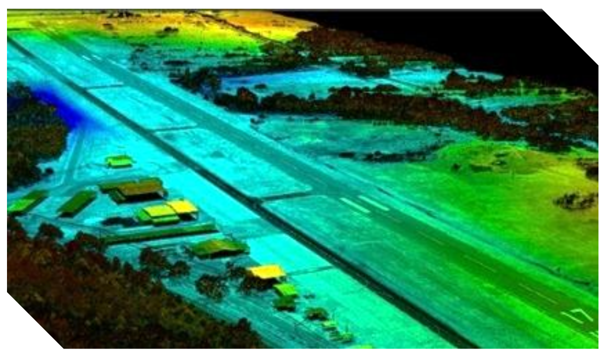


Figure 33- Environmental Scan

- Noise and Dust Monitoring:
  Some laser scanning systems can integrate with sensors to monitor environmental factors, such as noise levels or dust accumulation, in and around the site. This data helps contractors address concerns related to occupational health and community impact.
- Weather Impact Assessment:
  Documents the effects of weather on the construction site, such as areas prone to flooding or wind erosion. Helps construction teams plan effective drainage systems and protective measures.
- Progress Tracking:
  Repeated laser scans during construction phases allow teams to compare environmental changes over time. This is useful for tracking soil displacement, erosion, or the impact of construction activities on nearby areas.

Responsible Parties

Responsibility and coordination are managed through the engineering team, construction team, or an approved trade contractor, with coordination between the Massport Survey, the capture team, and the consultant BIM Coordinator.

- Attend Coordination Meetings
- Determine the use of existing survey points or the positioning of new survey points per MPA requirements.
- Determine the BIM Use information and purpose/s
- Determine the level of accuracy of the data supporting the conditions capture
- Which data and required level of development (LOD).
- Verify tolerance and accuracy of data capture.

Data Requirements

Data requirements are defined in the project scope and refined in the coordination meeting.

Deliverables

A tested and approved point cloud file for BIM .rvt integration submitted using the project ACC. Deliverables include any additional capture files, such as photos, drawings, and GIS data, which may be required.

A1.4 REALITY CAPTURE INFRASTRUCTURE

Capture existing infrastructure conditions for assessments, new construction, and as-built documentation– aiding in design planning, expansions, repairs, safety improvements, and projects.

- Bridges, identifying structural issues like cracks, deformation, or misalignments identified for maintenance and retrofit projects.
- Roadways, lanes, curbs, and drainage systems.
- Scanning industrial infrastructure to identify machinery, piping, and equipment layout, facilitating maintenance and process optimization.

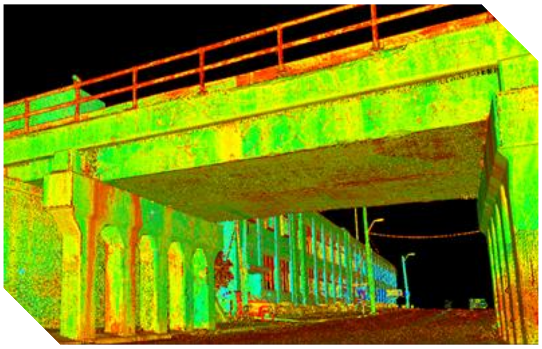


Figure 34- Infrastructure Scan

Benefits

- Scans provide detailed representations of infrastructure details, simplifying the analysis of complex conditions.
- Better communication among stakeholders.
- Scanning documents features and conditions, aiding sustainable infrastructure development and management.
- Detailed analysis is possible in safe conditions.
- Provides accurate data for project modeling, reducing modeling effort.

Responsible Parties

Responsibility and coordination are managed through the engineering team, the construction team, or an approved subcontractor. Coordination between the MPA Survey department, the capture team, and the BIM Coordinator is necessary to determine the use of existing survey points or the positioning of new ones, as required by Massport.

- Attend Coordination Meeting

- Determine the capture technologies
- Accuracy of the data supporting the conditions capture
- Which systems and LOD are required to support future uses
- Verify tolerance and data accuracy.
- Test and verify model integration

Data Requirements

The capture's content and accuracy are identified in the coordination meeting.

Deliverables

Deliverables include a reviewed and approved point cloud file integrated with the project BIM .rvt file using the project ACC for submission. Additionally, photos, drawings, and GIS data may be submitted.

A1.5 REALITY CAPTURE UTILITIES CONDITIONS

Ground-penetrating radar (GPR) detects subsurface utility conditions, while laser scanning captures utility information—other tools aid in mapping utility networks within buildings and capturing "as-built" data. Thermal imaging can detect heat signatures, active utilities, electric lines, or leaks. Cameras inserted into pipes or conduits capture visual data about the internal conditions of their contents. This data supports modeling and provides data on existing conditions for assets.

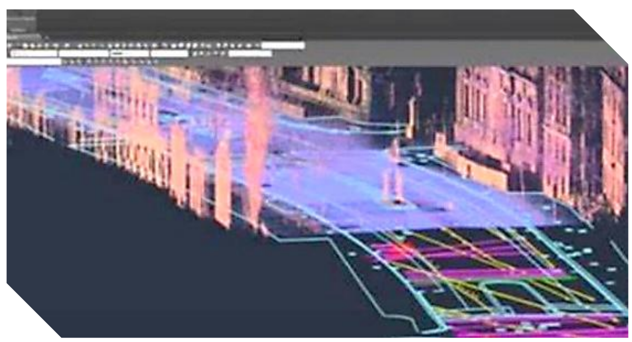


Figure 35- Utilities Capture

Benefits

- A non-invasive method to capture underground data without excavation.
- Extremely accurate and high-resolution capture methods for above-ground, underground, and interior conditions, identifying utility locations, depths, asset condition data, and potential issues and conflicts.
- Capture information used to develop accurate project models efficiently.

Responsible Parties

Responsibility and coordination are managed through the engineering team, the construction team, or an approved subcontractor. Coordination between the MPA Survey department, the capture team, and the BIM Coordinator is necessary to determine the use of existing survey points or the positioning of new ones, as required by Massport.

- Attend Coordination Meeting
- Determine the accuracy of the data supporting the conditions capture
- Which systems (and what level of detail (LOD) is required to support future uses

- Verify tolerance and data accuracy.
- Test and verify model integration

Data Requirements

The engineering, design, and construction teams collaborate with the project managers, survey, and utility maintenance groups to determine the data required to support the project, utilizing the best tools and processes.

Deliverables

Deliverables include a reviewed and approved point cloud file integrated with the project BIM .rvt file using the project ACC for submission. Additionally, photos, drawings, and GIS data may be required.

Figure 36-Utilities Capture

A2 MODEL AUTHORING OVERVIEW

NATIONAL BIM STANDARDv4

Develop a design BIM using authoring software with 3D and attribute information for a built environment asset leveraging an object library of parametric elements.

The modeling teams are responsible for developing the discipline models utilizing Autodesk Revit or Civil 3D for infrastructure. The modeling teams develop design models to meet the project Conditions of Satisfaction (CoS).

Discipline models are used for various purposes, including design development, analysis, constructability, safety, and quality throughout the project phases. These models are the basis of the VDC model-first process- where the contractor builds to the model during construction. Model elements are assigned their respective discipline, level of detail (LOD), and data requirements in the BIMxP.

Related Terms

Design Authoring and Briefing, Modeling, Discipline Modeling, Model Generation, Generative/Parametric Modeling, Design to Maintain, Product Selection, Product Library

Benefits

- Design Options development
- Prerequisite for other BIM Uses- analysis, QTO, simulations, model review/coordination
- Automates model changes throughout model views
- Improve ability to communicate and visualize design intent.
- Improve collaboration and coordination between project stakeholders.
- Enhance quality control of design, cost, and schedule by utilizing model data.

Data Requirements

Data requirements are defined in the BIMxP. Massport has developed critical asset data, model parameters, and attributes. Additional data is developed based on project scope and BIM Use requirements.

Responsible Parties

3D modeling is created, managed, and utilized throughout the project lifecycle by the design and construction teams —the BIM Coordinator and discipline modelers. During construction, the constructor, BIM Coordinator, shop, and fabrication modelers are involved. Additional responsibilities include:

- Participate in the Project Success Plan - Identify BIM Uses meeting the Conditions of Satisfaction
- Develop the model element breakdown, model progression, and LOD in the BIMxP.
- Develop models meeting Massport BIM standards
- Define the required discipline models for the project.
- Develop design options and support Cluster teams

- Create models with associated attributes and facility data
- Manage models in the project ACC
- Federation process- Each discipline modeler creates and maintains their respective discipline models throughout the project phases. The models are manipulated, coordinated, and managed using the ACC bridging and federation processes.
    - Models use ACC model review or Navisworks to ensure quality and compliance with the BIM Standard.
    - Reviews are held following a predetermined schedule in the BIMxP.

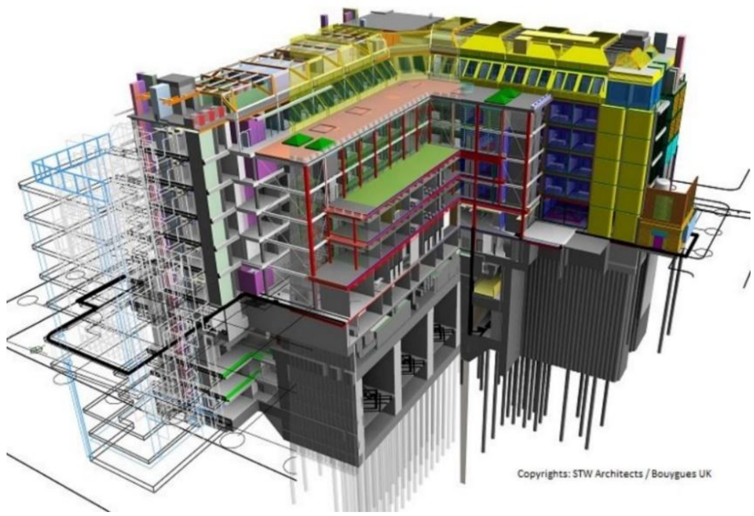


Figure 37- Discipline Modeling

Deliverables

Discipline model file Revit or Civil 3D files.

A2.1 ARCHITECTURAL MODELING

The architectural model serves as the baseline for model creation as design intent is developed. Other discipline models may serve as the base model, depending on the project scope.

The elements assigned to the architecture model, LOD, and model progression are defined in the BIMxP. This model may serve as the foundation for the ACC model federation process, supporting model coordination reviews, clash avoidance, and model checking.

Model Content

- Modeling elements are dimensionally accurate and modeled to a defined LOD using the correct objects and elements. Architectural elements include doors, windows, openings, walls, stairs, spaces, and areas. Interior, Exterior Soffits, overhangs, sun control elements, parapets, screening elements, and architectural precast elements.
- Partitions and walls are dimensionally accurate and modeled with the correct assemblies, graphic fills, naming conventions, attributes, and finishes for each wall type.
- Floor, ceiling, and roof systems are dimensionally accurate (with slopes as needed) and modeled with the correct assemblies, graphic fills, naming conventions, attributes, and finishes for each element. Floor-to-floor dimensions are used to coordinate with structural and other discipline models. All ceiling elements will be coordinated in a composite reflected ceiling plan.
- Assembly data supporting construction documentation, 3D detailing, shop and prefabrication models for quantity-take-off (QTO), estimating, and analysis.

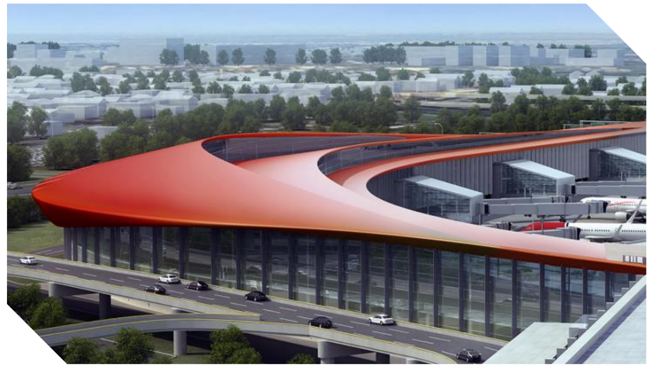


Figure 38- Logan Terminal E

- Soffits, openings, louvers, diffusers, and other building elements required for visualization, QTO, and Schedules.
- Vertical shafts, elevators, stairs, ramps (railing systems), and other horizontal and vertical conveyance systems. The overall extent of stairs and loading docks, including railings, will be modeled. Intermittent railing members may also be modeled.
- The elevator shaft clear space will be modeled to the worst-case clear width, depth, and height, as specified by the preferred possible vendors; however, elevator cabs and major equipment may also be modeled. Nominal elevator cab size and overrun shall be included in parameter values, including hoist beam capacity.
- Escalators and moving sidewalks shall be modeled to the worst-case clear width, depth, and height, as provided by the preferred possible vendors.
- Model architectural spaces. Use the Massport numbering standard.
- Model mechanical equipment clearance zones for access, service space requirements, meter readings, clear space required by relevant code authorities, and operational elements needing service space. Zones modeled as transparent or translucent solids are named and classified. This space is coordinated with MEP domain specialists and discipline modelers.

Figure 39- Space Modeling

- The architectural or interior discipline model encompasses interiors, casework, shelving, interior built-in elements, furnishings (including furniture systems- fixed and loose furniture), fixtures, and equipment (FFE) materials and finishes.
- Specialty equipment, including food service or baggage handling equipment, are included in the architectural model if not supplied by others.
- Modeling LOD and data supporting other BIM uses, such as budgetary estimates, estimates, visualization, space validation conformance, and other discipline models.
- Massport Room Numbering Standard, naming or functional designations, and secure space designations.

Responsible Parties

The design BIM Coordinator and architectural modelers develop design options during the preliminary design phase, ensure the correct model content, and support BIM Uses and element LOD to create the design intent model and construction documentation.

The team maintains model standards and quality, coordinates with other discipline modelers to resolve conflicts, and updates the model in response to project changes.

Deliverables

The native. rvt model submitted to the project ACC. Issue logs and resolution from regularly scheduled reviews. Model content for BIM Uses and derived construction documentation.

A2.2 BAGGAGE HANDLING SYSTEMS MODELING

Provided by an approved third party, specialty consultant.

- Model all conduit and ganged runs 2" or greater.
- Model carousels, conveyors, hangers, supports, anchors, and seismic bracing.
- Sleeves/penetrations (vertical and horizontal)
- The baggage handling equipment contractor shall identify, under a separate drawing layer, access doors and accessibility requirements for code and maintenance purposes for the above-listed items.
- Model any in-contract element that may impact coordination with other disciplines.

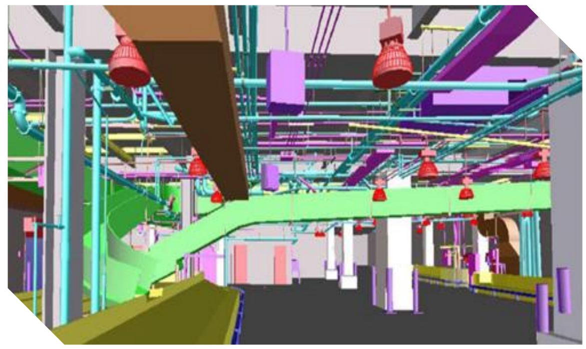


Figure 40- Baggage Handling System

Responsible Parties

The design and construction teams coordinate with the baggage system manufacturer and installers throughout the project lifecycle.

Deliverables

Baggage system models and drawings, installation documentation, Massport asset data, and manufacturer documentation for commissioning.

A2.3 CONVEYANCE SYSTEMS MODELING

Includes moveable walkways, escalators, elevators, trains, trams, and people movers. Construction Phase modeling requirements include:

- Model all conduit and ganged runs 2” or greater.
- Model all moving walkways, railings, beltways, carousels, and roller conveyors.
- Model hangers, supports, anchors, and bracing.
- Sleeves/penetrations (vertical and horizontal)
- Tracks and track clearances
- Massing model of cabs for clearance verification
- The Conveyance Contractor shall identify access doors and accessibility requirements for the above-listed items under a separate drawing category for code and maintenance purposes.
- Model any in-contract element that may impact coordination with other disciplines.

Responsible Parties

The design and construction teams coordinate with the product manufacturer and installers throughout the project lifecycle.

Deliverables

Conveyance system models and drawings, installation documentation, Massport asset data, and manufacturer documentation for commissioning. Any warranty information or Operation and Maintenance (O&M) manuals may also be submitted as separate deliverables.

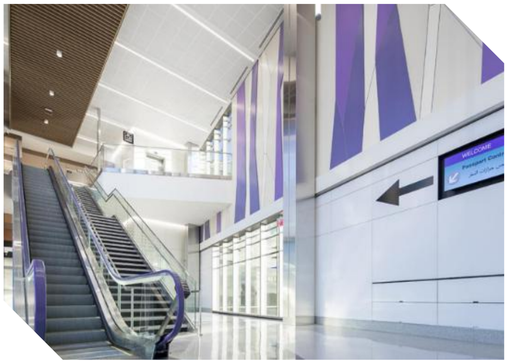


Figure 41- Logan Escalator Model

A2.4 STRUCTURAL MODELING

A structural system discipline model of existing or proposed design. The system, detailing responsibilities, and modeling LOD are documented in the BIMxP. Model Content

Modeling includes the (proposed and/or existing) specified structural system, modeled elements to correct size, materials, and defined tolerances- ready construction detailing. Elements are assigned a LOD and documented in the BIMxP.

- Framing, steel columns (correct shape & size), steel joists (C-joists, open web, joist girders, steel beams (correct section shape and size)
- 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 embeds will not be modeled but will be documented in trade subcontractor models and drawings.
- Applied fire protection 1" must be accounted for through modeled geometry or parameters to identify clearance requirements for clash detection.
- All cast-in-place concrete, penetrations, and openings of significant size and shape will be modeled and indicated on the structural drawings and concrete pours. Slab camber may be modeled. Chamfers at corners may be modeled or shown in detailed drawings. Foundations – Define foundation type, structural foundation walls
- Option modeling may include steel reinforcement, embeds in concrete, additional steel elements, angles for openings, channels for mechanical units, metal decks, and elements required for coordination, quantity takeoff (QTO), and clash avoidance.
- Edges of all slabs and penetrations of structural systems will be accurately located in the model.
- Slab thicknesses and elevations will be modeled. Include slopes in floors equal to or greater than ¼":12." Accurately model all roof members' slopes.
- 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 are not modeled.

- Miscellaneous metals such as elevator hoist beams, rails, and intermittent rail support steel for the elevator are modeled.
- Identify required clearances/"no-fly zones" with solid transparent (50%) placeholder clearance objects for access issues, code issues, and constructability.
- Show the size and thickness of housekeeping pads. (May be shown in structural or HVAC model

Responsible Parties

The design BIM Coordinator, discipline engineers, and structural modeling team develop design options and update the model according to reviews and changes throughout the design phases.

- Structural modeling is a basis for additional BIM Uses
- Coordination reviews with architecture and mechanical models and all other models.
- Coordinate with Shop modelers, approve shop models, prefabrication
- Code review

Data Requirements

Specifications and attributes for structural elements are defined in the BIMxP.

Deliverables

Native .rvt structural models, design option modeling, mock-ups and details, specifications.

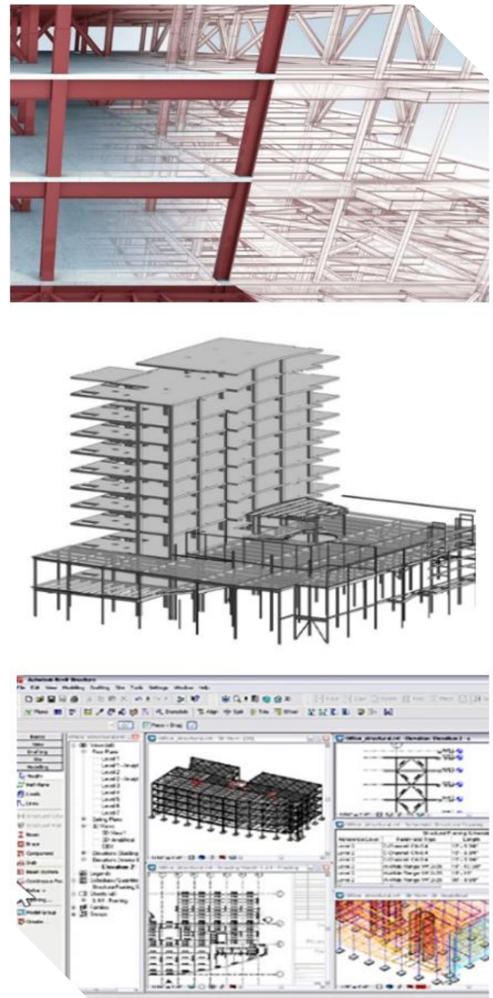


Figure 42- Structural Modeling

A2.5 MECHANICAL MODELING

Mechanical discipline model, supporting analysis, documentation, detailing, and fabrication. The various HVAC and fuel system elements LOD are defined in the BIMxP.

Model Content

- Equipment modeled according to actual product dimensions.
- Modeled for project BIM Uses- design options, performance analysis, QTO, construction documentation, 5D, prefabrication, commissioning, and handover.
- Modeled equipment- fans, VAV's (Variable Air Volume) compressors, chillers, cooling towers, air handlers, and other equipment required.
- LOD 200 – Generic elements, approximate size, shape, and location. Shaft requirements in the model. Maintenance space requirements.

- LOD 300 – Design intent elements: Dimensionally accurate elements, equipment, duct work, air supply location, connections, piping, valves, and insulation. Actual wall and floor penetrations. Allowance for hangers. All elements required for BIM use, estimation, and analysis.
- LOD 350-400 – The manufacturer, fabricator, and contractor develop shop models and drawings as necessary for prefabrication field installation. Finalized data requirements in the Commissioning and As-Built model
- Model ducts and air-handling equipment. Ducts are modeled to the outside face dimension of the flanges and insulation. Duct joints do not have to be modeled. Dampers are modeled.
- Equipment clearance/access zones are modeled as semi-transparent solids.

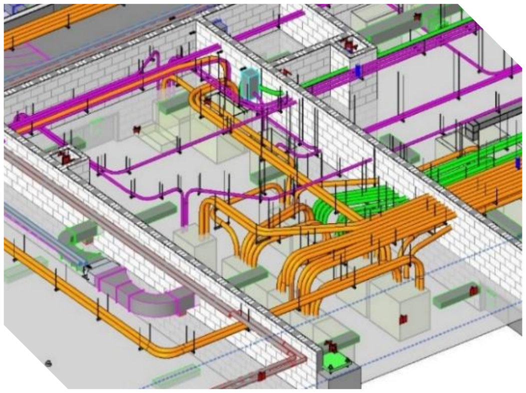


Figure 43- Mechanical Modeling

- Any piping associated with the mechanical equipment will be modeled. Pipes are modeled to the outside diameter of the pipe or pipe insulation (whichever is greater). Fittings and connections may not be modeled in the Design Intent model, but they are shown in the fabrication model.
- Show the size and thickness of housekeeping pads. (May be shown in structural or HVAC model)
- Any electrical elements associated with the HVAC system are modeled per the electrical modeling requirements.
- This model depicts the ductwork and piping, representing the actual condition at the time of construction completion. The construction documents may not include specific dimensional locations for ductwork and piping. To the extent that location can be determined from the construction documents, the model will reflect that location.
- Identify required clearances with solid, transparent (50%) placeholder clearance objects to address access, code, or constructability issues.
- Spaces should be coordinated with the Architectural Rooms
- Mechanical systems will be modeled to a level that maintains system continuity and coherence. This applies to piping, ductwork, air-handling equipment, and process piping. (Electrical continuity to systems should be modeled in the electrical model)

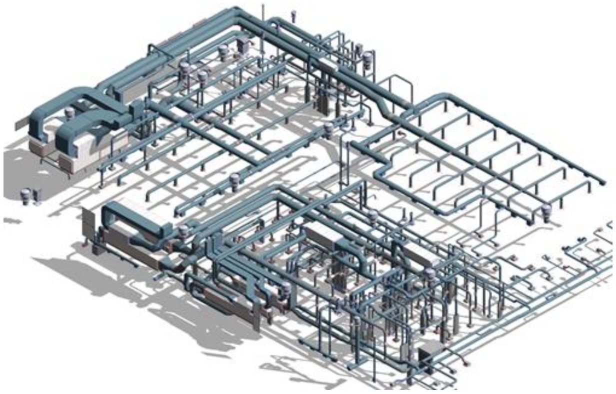


Figure 44- Mechanical System Model

Responsible Parties

The BIM Coordinator, mechanical discipline modelers, and mechanical engineers. Additional team members for BIM Uses, estimators, and coordination with other discipline teams. Construction teams use models for prefabrication, shop models, fabrication, estimating, and construction sequencing.

Data Requirements

Building systems and equipment are critical assets. Massport has defined the required asset data for model elements. Teams will create elements with associated asset attribute data per the BIMxP. Data may be required for BIM Uses (analysis, documentation, and prefabrication)

Critical Asset Data	
Manufacturer	Contract Number
Model Number	Install Date
Serial Number	P&ID Number (Tag ID)
Project Number	Purchase Price
Expected Life	

Deliverables

Revit model files submitted to the project ACC. Coordination review reports, equipment lists, and asset data identified in BIMxP.

A2.6 PLUMBING AND FIRE PROTECTION MODELING

Separate discipline models - System modeling for the design intent model, construction documentation, and coordination with other discipline models. Elements LOD and data requirements are defined in the BIMxP.

Model Content

Figure 45- Plumbing Model

- All plumbing equipment will be modeled according to its overall height, width, and depth.
- Plumbing and gas piping, specialty gas, and equipment. Pipes are modeled according to the outside diameter of the pipe or the diameter of the pipe insulation, whichever is greater.
- Plumbing fixtures should be coordinated with the architectural model to avoid duplication.
- Piping 1” or greater - smaller piping will be modeled if in ganged runs.
- The pipe slope is modeled. Fittings and connections will not be modeled.
- All valves and cleanouts are modeled with full access to them.
- Any access zone requirements will be modeled as solids.
- Piping systems will be modeled to an LOD that maintains system continuity. Plumbing systems must be continuously connected to the model. Because some plumbing fixture families may be in the architect’s model, create connector placeholder families with parameters for cold water fixture units, hot water fixture units, waste fixture units, and pipe diameter. These are set up at the beginning of the project to match the plumbing fixture schedule and the fixture load, as specified in the applicable plumbing code.

Fire Suppression

The following requirements are for fire protection modeling:

- All components 1” or greater will be modeled. This includes all piping, valves, fire pump, standpipes, and sprinkler heads.
- Any access zone requirements will be modeled as solids.

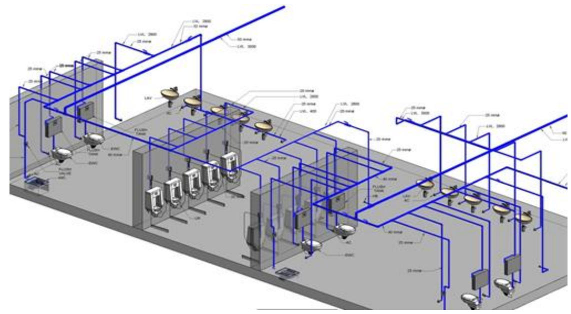


Figure 46-Plumbing Modeling

Data Requirements

Data and schedules for construction documentation and commissioning data per project requirements defined in the BIMxP.

Responsible Parties

The design team's BIM Coordinator, engineers, and discipline modelers are responsible for design options and modeling throughout the project phases.

Deliverables

Revit model files submitted to the project ACC. Coordination review reports, equipment lists, asset data identified in BIMxP, and plumbing legends.

A2.7 ELECTRICAL AND ALARM SYSTEMS MODELING

A separate discipline model/s of the primary components of electrical, lighting, alarm, and building automation systems (BAS) controls.

Figure 47-Electrical Lighting Modeling

Model Content

- Data, power, and telecommunications: Interior and exterior transformers, emergency generators, main and distribution panels, switchgear, and access clearances. Main IDFs, outlets, switches, junction boxes. Include BAS devices and controls, as well as electrical building products, for QTO.
- Model all conduits, pipes, penetrations, and ganged runs 1" or greater. Ganged runs shall include a model element representing the mass of the piping.
- Model the cable trays, access zones, and equipment.
- Lighting: Permanently mounted fixtures, lighting controls, switches, junction boxes. Moveable plug-in fixtures are not modeled unless used in visualization.
- Light fixtures will be modeled to their overall dimensions, and access will be provided through the interstitial space.
- Plug load calculations for QTO or estimates.

Figure 48- Electrical System Model

- LOD 200- generic lighting and performance data for schematic analysis.
- LOD 300-350- actual fixtures with the correct location, performance, and load data.
- Fire Alarm and Security Systems: input devices, notification devices, associated equipment and access clearances, emergency lighting and permanently mounted fixtures, and electrical power-off buttons.
- Space and maintenance access requirements shall be modeled.
- Model the power feeds to equipment and switch gears.
- Consider modeling switches and outlets when coordination with architectural, FFE, or interior elevations is required.
- Any access zone requirements will be modeled as solids.
- Identify required clearances with solid, transparent (50%) placeholder clearance objects to address access, code, and constructability issues. Electrical systems will be modeled to a level that maintains system continuity and integrity.

Security, IT, Airport Special Systems, Audio/Video

The security, IT, airport specialty systems, major audio/video equipment, devices, and conduit are modeled.

- Model all conduit and ganged runs 1" or greater.
- Model hangers, supports, anchors, and seismic bracing in shop models.
- Sleeves/penetrations (vertical and horizontal)
- Access doors and clearance requirements for code and maintenance. Model any in-contract element that may impact coordination with other disciplines.

Responsible Parties

Design team BIM Coordinator, electrical engineer, architect, and lighting designer. Coordination with stakeholders.

Data Requirements

- Major equipment manufacturer data: Electrical phases, Load, Voltage, System Type
- Generators, solar panels, wind turbines, output voltage, system type, generating capacity
- List of equipment for storing electricity:
  - Uninterruptible power supplies (UPS), connected load
  - Emergency lighting battery units, exit signage
  - General-purpose electric demand in/for building:
  - Power density for lighting, appliances, equipment, and outlet requirements

Deliverables

Revit files submitted to project ACC, panel and equipment schedules, data defined in BIMxP, QTO for estimating, and electrical drawings showing the physical size and location of elements in the electrical system, including final electrical specifications.

A2.8 INTERIORS MODELING

Modeling of interior design options, materials and finishes, details, furniture, fixtures, casework, equipment (FFE), furniture systems, signage, and wayfinding.

Ska

Figure 49- Interior Modeling

Model Content

- Interior partitions, soffits, ceiling grids,
- Architectural details
- Furniture, fixtures, equipment (FFE)
- Raised floor, ramps, and other elements for disability code compliance
- Signage and way-finding
- Option - Survey Control Points: Survey control points identified during pre-construction should be aesthetically integrated into the final floor design finishes, such as brass, steel, or other permanent material markers, for future facility work.

Responsible Parties

The design team includes a BIM Coordinator, discipline modelers, coordination with additional architects, an interior designer, a lighting consultant, and a furniture contractor. Coordinate with the electrical engineer for lighting outlet placement, telecommunications, and surveyors.

AECO

Figure 50-Interior Model

Data Requirements

The data requirements for Massport assets are outlined in the BIMxP. Elements modeled to support quantity take-offs (QTO), estimates, and LEED reporting

Deliverables

Revit model files submitted to project ACC. Renderings and model views requested for design review. FFE schedules, Material, Finishes Schedules, LEED report.

A2.9 TENANT BUILD-OUT AND ALTERATIONS MODELING

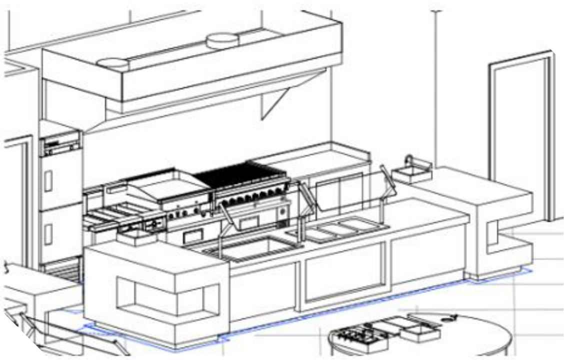


Figure 51- Tenant Model

Tenant projects include simple kiosks to new hotels. The tenant works with the Massport Tenant Coordinator to identify an appropriate space, scope, and requirements for tenant documentation, including BIM. The tenant will follow the Massport BIM Standard and review tenant documentation standards with the DTIG BIM Manager.

Massport will use its BIM Decision Matrix and the Tenant Guidelines to determine the level of BIM use. Microsoft Word - Guide to Tenant Construction - Massport Owned 10-14-22.docx

▪ Model Content

All new building elements installed in existing spaces, including equipment, new MEP systems, and specialty items, are modeled at LOD 300 for review by the Massport Tenant Coordinator.

- Food Service design will conform to all applicable codes.

▪ Responsible Parties

The tenant designer, Massport Tenant Coordinator, DTIG BIM Manager, fabricators, and installers.

Massport DTIG provides existing information that is available for the tenant space.

▪ Data Requirements

The tenant design teams follow the Massport Tenant Design Guide.

▪ Deliverables

Revit model files, CAD files, construction documentation, and specifications per the confirmed delivery method.

Figure 52- Tenant Space Model

A2.10 CIVIL INFRASTRUCTURE MODELING

Massport uses VDC and BIM on civil and infrastructure projects. Massport aims to develop digital twins of its properties and infrastructure assets (digital representations of physical and functional characteristics, such as bridges, tunnels, airfields, walkways, transportation structures, and water treatment plants). Combined with Civil 3D's roadway and site modeling capabilities, the project team can effectively model the entire project environment.

- Massport's survey unit may supplement the relevant information with an up-to-date existing conditions plan, which will serve as a base for site design. It may include recorded underground utilities, actual surveyed locations of utility castings, field-measured invert elevations, site topographic details, a Digital Terrain Model (DTM), and a horizontal and vertical control network for the project.
- In cases where the record of underground utilities is inconsistent with the surveyed locations of utilities, further reality capture of existing conditions may be necessary, including subsurface underground utilities.

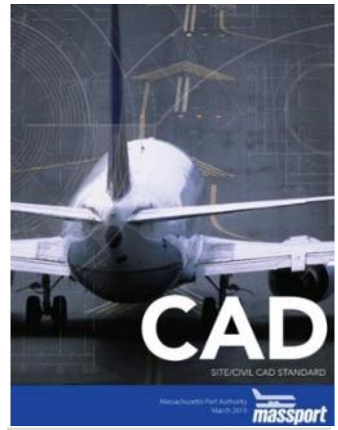


Figure 53-Massport Infrastructure Guide

Benefits

Civil BIM design enhances the efficiency, accuracy, collaboration, and sustainability of civil engineering projects, leading to improved outcomes and reduced costs. Site modeling supports additional BIM Uses and analyses.

- Line of Sight, Security
- Sun Shadow Analysis (heliodon),
- Master planning,
- New or temporary traffic patterns, access
- Construction logistics.

Model Content

Project site model and any occupying or relevant structures and utilities. The LOD for these contextual site elements may be lower than that of the project structures. The LOD is defined in the BIMxP.

Figure 54- Infrastructure Model

- Discipline models may include new work, topography, site work, landscape, retaining walls, and the surrounding area, contributing to drainage, environmental requirements, and roadways that support project requirements. These models are to be geo-referenced according to the design team's BIM Coordinator's specifications.
- BIM infrastructure incorporates data, material specifications, LEED, assessment data, and environmental impact analysis reports. It includes the project site models of existing and new infrastructure assets.
- Paving, grades, sidewalks, curbs, operational elements that cannot be disturbed, and other elements supporting the project requirements are modeled.

Responsible Parties

The design team comprises the BIM Coordinator, modelers in the civil and infrastructure disciplines, and civil and structural engineers. Massport DTIG provides any existing models, CAD drawings, or GIS drawings. Additional information from the survey group may include Google Earth, photos, and point clouds.

Data Requirements

Local structural building grids shall be defined in the model and coordinated with the global state plane coordinate system. (Defined by Massport Survey Group and DTIG BIM Manager).

- The construction team may use CAD files for in-field layout, robotics, or machine guidance. A coordination meeting will finalize the requirements for these files.

Deliverables

The Civil 3D and Revit files. The Revit discipline models, site models. The ACC federation process supporting BIM Uses—files for machine guidance, as specified.

A2.11 UTILITY MODELING

Utility discipline models are a high priority in Massport projects. These models are delivered on an accelerated schedule. Most utility modeling involves capturing existing conditions before modeling begins.

Benefits

- Accurate record of utilities
- Compliance with project criteria
- Accurate Load Calculations and System Sizing,
- Optimized Routing and utility network design

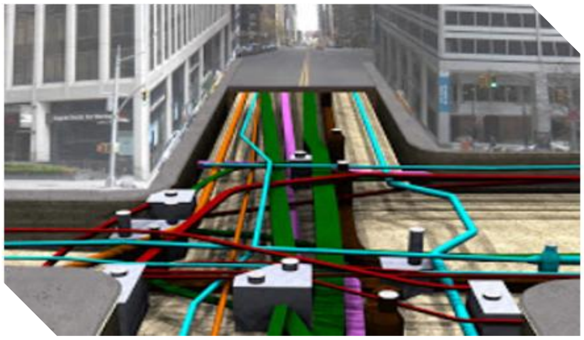


Figure 55- Utility Modeling

Model Content

Minimum modeling requirements if applicable. Additional elements may be required per project site and scope.

- Stormwater removal
- Sewage systems
- Electrical lines
- Communication lines (copper, fiber, co-axial)
- Gas lines and fuel lines
- In-ground heating or cooling lines
- Pneumatic lines
- Other project-identified utilities are defined in the BIMxP.
- Utilities are modeled to the face of the structure and connection. Accuracies of ±2" are required for z values and the grade of gravity sewerage pipes. The correct objects and element families will be used, with the assigned asset data defined in the BIMxP.

Responsible Parties

The design team includes a BIM Coordinator, civil engineers, and discipline modelers. The team determines the required LOD. This is documented in the BIMxP.

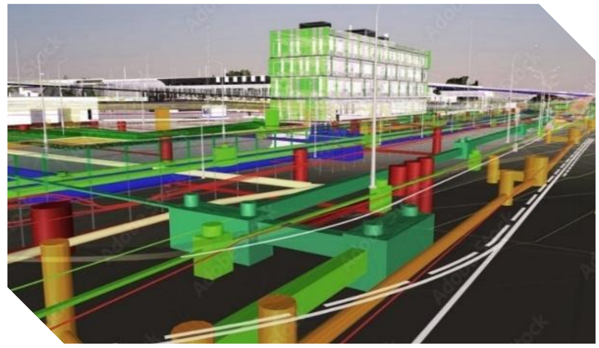


Figure 56-Utility Modeling

Data Requirements

Pipes are labeled using industry-standard naming and color coding. The American Public Works Association (APWA) Uniform Color Codes shall be used for modeling.

Colors	Color Code Requirements
RED	Electric power lines, cables, conduit, and lighting cables
ORANGE	Telecommunication, alarm or signal lines, cables, or conduit
YELLOW	Natural gas, oil, steam, petroleum, or other gaseous or flammable material
GREEN	Sewers and drain lines
BLUE	Drinking water
PURPLE	Reclaimed water, irrigation, and slurry lines
PINK	Temporary survey markings, unknown/unidentified facilities
WHITE	Proposed excavation limits or route elements.

Deliverables

Revit and Civil 3D files(Revit, Revit MEP, Autodesk Civil 3D) submitted to the project ACC site.

A2.12 SITE CONDITIONS MODELING

A process in which the project team develops a 3D model of the existing conditions of a project site, buildings, and infrastructure relevant to the project. This model can be developed using various methods, including laser scanning and conventional surveying techniques, depending on the specific information required and the method that is most suitable for the task.

Figure 57- Site Model

Once created, the model can be queried for information, whether for new construction, refurbishment, or a modernization project. The design team develops a site model supporting project requirements. The team defines the ground surface model and the relevant facilities, infrastructure, assets, and utilities to be modeled.

The team defines the LOD for the site model through the project phases in the BIMxP. LOD may change during design phases to support BIM Uses.

- 2D representation

- Block forms only (LOD 200)
- Detailed modeling (LOD 300)
- Photorealistic modeling

Model Content

The team develops a ground surface model of the project site, including any occupying or relevant structures and utilities that affect the project. The LOD for these contextual site elements may be lower than that of the project structures.

- Paving, grades, sidewalks, curbs, operational elements, and relevant elements supporting the project requirements should be modeled at the defined Level of Development (LoD) in the BIMxP.
- A separate site model should include new topography, site work, landscape design, retaining walls, and the surrounding area, all of which contribute to drainage, environmental considerations, and roadways that support the project requirements.
- The model should be geo-referenced according to the project specifications.
- Incorporate a reference point defined relative to true north.
- Subdivide large sites into individual building sites, as required, to suit project requirements.

Model Extent

- Within property boundaries
- Site plus immediately adjoining buildings and features
- A defined precinct beyond the site

Figure 58-Logan Site Model

Model inclusions and exclusions

During the Coordination meeting, decisions will be made to determine the inclusions and exclusions of the modeling scope. Items to consider:

- Existing structures, finishes, vegetation
- Existing utilities: surface and/or subsurface
- Subsurface features
- Geotechnical conditions

Responsible Parties

The design and civil engineer BIM Coordinator and discipline modelers. Coordination with Massport GIS, Survey Group, and Laser scanning group or sub-contractors. DTIG supplies existing information at the project start: existing scans, models, and GIS data.

Deliverables

Revit and/or Civil 3D files submitted to the project ACC.

A2.13 TEMPORARY WORK MODELING

Model non-permanent elements in a model necessary to construct a project. Also-Construction Systems

- Structural modeling tool develops scaffolding plans.
- Model authoring tool to establish temporary onsite offices.
- Structural detailing tool to design temporary shoring.

Figure 59-Temporary Work Model

Benefits

- Components and installation sequences are simulated and coordinated with the design model and construction sequence, and their performance is analyzed in detail.
- Increased safety, productivity, and constructability
- Identify modularization, preassembly, and prefabrication opportunities
- Automated quantities for costing and inventory of reusable components

Model Content

Temporary Works include but are not limited to concrete formwork, scaffolding, excavation systems, temporary shoring, temporary heating and cooling, temporary lighting, on-site temporary offices and facilities, and other engineered temporary construction systems.

- The temporary work model is reviewed in conjunction with the design model, and the sequence of the temporary installation is compared with the construction sequence to minimize conflicts between all project components.
- The structural components of the temporary structures are coordinated with the project's permanent structural components to detect and eliminate clashes.

Responsible Parties

The contractor, BIM Coordinator, and construction modelers. Subcontractor responsible for assembly of temporary work. The modeler participates in a review process to remove conflicts.

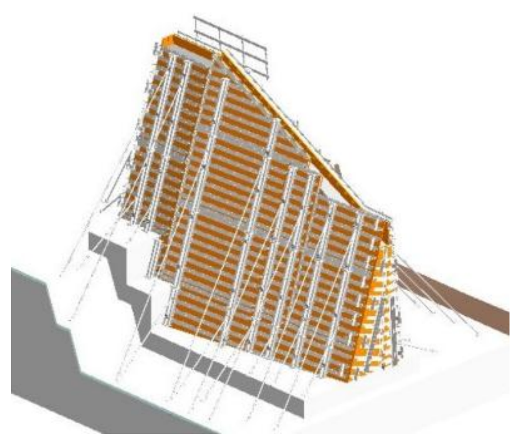


Figure 60-Temporary Work Model

Deliverables

Temporary works model and, if applicable:

- Construction sequence
- Revised site logistics/utilization
- Revised prefabrication information
- Project (out-of-service) timeline information

A3 DESIGN SIMULATION AND ANALYSIS OVERVIEW

Simulations and analysis empower design teams and Massport stakeholders to make informed decisions, identify design improvements, resolve conflicts, and ensure compliance with the project Conditions of Satisfaction, Code, and performance requirements.

Simulations, 4D project scheduling, and 5D cost estimation are widely used process examples of 3D models populated and combined with additional information to drive improvements in design and sustainability.

NATIONAL BIM STANDARDv4

Examine and evaluate a built environment asset design to assess its functionality and compliance with various criteria and requirements.

The PM and design team determine when an analyst (estimator, structural engineer, sun study software operator) is needed for various activities and include them in the pull plan activities.

Benefits

A benefit of BIM is the ability to aggregate design geometry and data, with the capability to quantify, analyze, simulate, and report information for informed decision-making. Model performance, various design and system analyses, and critical information reporting can be updated as the model changes. Examples include:

- Energy performance and simulation
- Structural analysis
- Lighting, daylighting, and sun studies
- Sustainability and LEED assessment
- Environmental simulations, resiliency evaluation, disaster planning, carbon impact analysis, and NetZero compliance
- Costing and quantity reporting

Some analyses require an iterative and collaborative approach and the recognition of limitations and uncertainties inherent in the analysis process. By considering these characteristics, project teams can ensure accurate and reliable analysis outcomes, leading to optimized design decisions and improved project outcomes.

When using BIM for design analysis, establish a clear scope and objectives, ensure data accuracy and quality, model level of detail (LOD), and utilize team expertise and analysis tools.

Deliverables

- PM and team will define the BIM-based simulations and analysis required in the Project Success Plan. Teams will follow the requirements for the specific type of simulation and analysis.
- Model and data information exchange for simulation and analysis. ·
- Simulation, reports, images, or other output for decision support.

A3.1 ENVIRONMENTAL AND SUSTAINABILITY ANALYSIS

Environmental analysis helps identify potential project impacts on the environment and ensures compliance with regulations. These identify environmental conditions on the project.

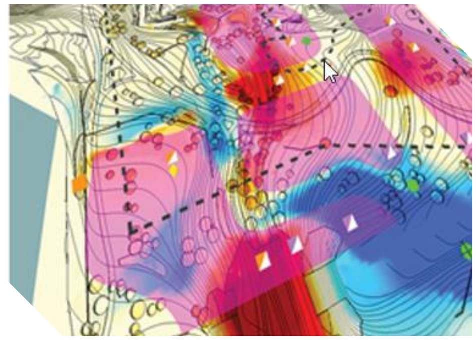


Figure 61-Environmental Analysis

A BIM-based approach supports the visualization and management of subsurface conditions, enabling engineers to effectively assess soil properties, groundwater levels, and potential hazards.

- Site Analysis - assess the site's physical characteristics, including topography, soil quality, and existing vegetation.
- Environmental Impact Assessment (EIA)- analyze factors such as air and water quality, noise levels, and biodiversity, providing a comprehensive overview of the project's impact.
- Sustainability Assessment- focuses on the long-term sustainability of the project. Simulate energy efficiency and waste management practices to promote environmentally sound construction methods.
- Regulatory Compliance- analysis ensures the project adheres to local, state, and federal environmental regulations. It involves reviewing permits and compliance with environmental laws.
- Risk assessment- identifies potential environmental hazards associated with the project. It evaluates the likelihood and consequences of adverse environmental events, guiding mitigation strategies.

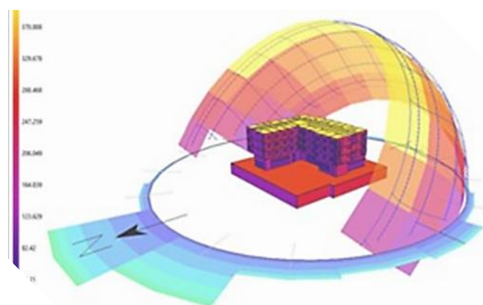


Figure 62-Sun Studies

By utilizing 3D models, stakeholders can collaborate more efficiently, ensuring that geotechnical data is accurately represented and accessible throughout the project lifecycle.

Benefits

- Sustainability, Master Planning, Environmental Remediation, LEED Certification,
- Visualization and simulation of environmental conditions, issues, and recommended solutions.
- Ability to perform multiple simulations to achieve the best resolution.

Model Content

The modeled site may include soil type and condition, soil borings, protected lands, underground storage tanks, and test wells (wetlands, marshes, animal habitats, topographical barriers, brownfields) based on the type of analysis. Project buildings may be included for sun studies and wind analysis.

The information exchange data, including the site, discipline models, and modeled elements required for the analysis, is defined in the BIMxP. The Massport Survey or GIS Groups may provide existing data.

Responsible Parties

The design team includes a BIM Coordinator, civil and environmental engineers, discipline modelers, and analysis software operators. Additional geotechnical consultants, geologists, and consultants with GIS, survey data, and point cloud manipulation experience. These consultants assess environmental conditions, analyze ecosystem data, and develop strategies for environmental protection and sustainability.

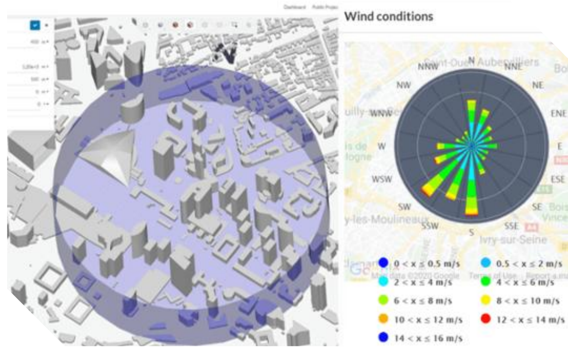


Figure 63- Wind Conditions Analysis

Deliverables

Analysis models, simulations, presentation images, and analysis reports.

A3.2 OCCUPANCY AND USER EXPERIENCE

Passenger simulations analyze and predict the movement and behavior of individuals within environments. These simulations leverage models, passenger data, and analytics to create realistic representations of how crowds behave in different scenarios.

Benefits

By accurately predicting crowd behavior and movement, airports can enhance the passenger experience and optimize facility design for improved operational functionality.

Figure 64-Occupancy Studies

- Passenger flow analysis, crowding,
- Navigating terminals, checkpoints, and boarding gates
- Design and operational optimization
- Wayfinding, line of site
- Emergency and security movement and evacuations
- Behavioral analysis – how passengers respond to the environment

Model Content

The simulation discipline models and the required elements are defined in the BIMxP and documented in the information exchange for the simulation. Example: wayfinding signage, interior build-out, lighting, conveyance systems (moving side-walks, escalators, elevators)

Responsible Parties

BIM Coordinator, discipline modelers, analysis software operators, Massport airport/airline stakeholders, and the DTIG BIM Manager. Consultants in wayfinding, safety, and security as needed.

Deliverables

BIM Use definition, workflow diagram, and elements in BIMxP. Analysis models, simulations, presentation images, and analysis reports.

A3.3 SPACE PROGRAMMING

Designers and engineers use model area and volume calculations to integrate space, performance, and cost data. Such model calculations and analysis support ongoing program validation, performance, and costing of design options, Target Value Delivery, and Choosing by Advantage.

BIM supports precise measurement and analysis of the size, function, and spatial relationships of designed areas.

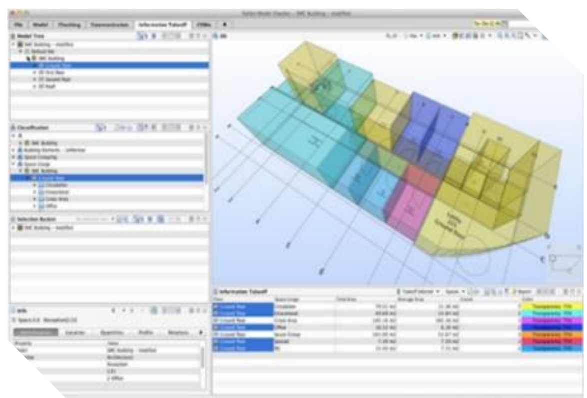


Figure 65-Space Programming Validation

Benefits

- Area quantities are used for schematic sq.ft. costing
- Area and volume calculations support mechanical calculations for the efficient design of building systems
- Color coding visually identifies space functions and relationships

Modeling Considerations

- A pre-check of the model structure and completeness for space analysis
- Measure spaces/areas by space type, occupant, or function
- Assess and document the differences between areas calculated in the model and those required in the project space program.
- Teams analyze model spaces and bounding elements, including floors and stories, using model-checking, quantities, and reporting functions.

Model Content

Massport utilizes the Building Owners and Managers Association (BOMA/ANSI) standards for mixed-use properties, specifically the Standard Method of Measurement Z65.6-2021 or any updates identified by the DTIG BIM Manager at the project's inception.

Rooms- numbered using the Massport Numbering Standard
[BOS Room Numbering Standard V1.0 20210319]

- Areas are part of the architecture model.
- Areas are created for each occupied level—spaces 6 sq. ft. or larger- named in the area.
- Areas are calculated at the Finish Floor (AFF) for all levels and spaces. Area plans are labeled for space identification and calculations.
- The area plans are used to compare model areas to the programmatic areas required for the project scope and the model tool.

SPACE NAMING CONVENTIONS

- Airline Operations
- Baggage Handling
- Circulation
- Common Area
- Retail Common Area
- Storage
- Concessions
- Concessions Support
- Gate Hold Rooms
- Concourse
- Retail Rentable Area
- Airport Operations
- Major Vertical Penetration
- MEP / IT
- Non-Public Restrooms
- Public Restrooms
- Retail
- Unassigned
- Additional Areas use OmniClass Table 11- Spaces (BIMxP Template)

- Categorize as public, private, or secure space designation.

Responsible Parties

The design team, architecture, and interior discipline modelers. A mechanical engineer may be involved if volume calculations are used for building systems design. The design team generates a report of deviations for review and subsequent addressing.

Deliverables

The architecture and interior models include spaces with required attribute data, naming, and numbering requirements, as well as plans, images, and space calculation reports.

A4 CONSTRUCTION SEQUENCING (4D) OVERVIEW

Model-based scheduling, or BIM 4D, integrates a 3D model of a construction project with the fourth dimension: time. It combines the physical aspects of the project (geometry, spatial relationships, and components) with the construction schedule (tasks, durations, dependencies). This 4D sequencing creates a visual simulation of the construction process over time.

BIM 4D scheduling enables stakeholders to visualize the construction sequence, enhancing their understanding of the schedule and identifying potential conflicts or inefficiencies. This capability is essential when construction sites are adjacent to operational areas of the airport.

Linking schedule data (from software like Primavera or MS Project) to 3D models enables better coordination among design, engineering, and construction teams. It helps detect and resolve clashes, logistical issues, and out-of-sequence work before construction begins.

A4.1 CONSTRUCTION SEQUENCING (4D)

Teams use the model, schedule information, and simulation (4D) software to graphically visualize and simulate the timing and/or sequencing of planning, construction, installation, and occupancy activities during the project lifecycle.

Figure 66-Construction Sequencing

These simulations test site logistics plans, material locations, the installation order, temporary equipment, new traffic patterns, and safety considerations. The sequencing helps teams integrate the planning of human, equipment, and material resources with the model to improve scheduling and cost-estimating functions.

Related Terms:

4D Modeling, Phase Planning (4D), Constructability, Schedule Visualization, Sequencing, Site Utilization Planning, Construction Simulation, Construction Logistics, 4D Scheduling, 4D BIM

Benefits

- Visualize and validate the schedule for trades
- Constructability sequencing analysis
- Construction Plan forecasting for review
- Create dynamic occupancy plans for evaluating swing space and potential conflicts.
- Identify and resolve spatial and sequencing conflicts ahead of the construction process.
- Visualize construction activities for safety.

The team defines the modeling elements and the scheduling team for sequencing in the information exchange.

Model Content

The team defines the modeling elements and scheduled groups for sequencing in the information exchange. Data includes a mapping of time to elements.

Responsible Parties

Design and Construction BIM Coordinators, discipline modelers, and schedulers with 4D experience to manage and modify model integration and sequencing. The Scheduler will use an approved 4D scheduling application for the tasks.

Deliverables

Project schedule, 4D simulation, sequence visualizations, and recommendations required for decision support.

A4.2 LOGISTICS AND SITE PLANNING

BIM construction planning and logistics encompass 4D construction sequencing and site visualization for informed decision-making. This includes equipment management, vehicles, materials, and work team organization. Logistics analysis helps manage conflicts between an active airport and the construction site activities.

Figure 67-Site Logistics Analysis

The modeling capabilities of BIM enable simulations and performance analysis of systems, ensuring they meet the design intent before actual installation. Analysis may include energy modeling and systems performance evaluations.

These analyses integrate the project model process with the fourth dimension of time, enhancing project management in the construction phase. It allows stakeholders to visualize the construction schedule, providing a comprehensive view of a project's progress.

The BIM Coordinator and discipline teams collaborate with the scheduler and 4D modeler to input data into the approved analysis software, developing the logistics simulation. Once developed, the simulation can be repeated as new data becomes available.

Benefits

- By simulating construction sequences, project managers can identify potential bottlenecks, optimize workflows, and allocate resources more effectively.
- Increases coordination between airport activities and construction requirements and schedule
- Reduces risk and addresses safety concerns
- Supports informed decisions by stakeholders through visualization and simulation
- Real-time schedule and performance monitoring

- **Model Content**

The model content will be defined in the information exchange and documented in the BIMxP. The BIM Coordinator and the scheduler will review the models to determine the scheduling.

- **Responsible Parties**

Project PM, design team BIM Coordinator, Construction team scheduler, and 4D modeler. This analysis is coordinated through pull planning sessions to maximize the benefits of this activity.

- **Deliverables**

4D simulations, images, and reports. The native .rvt model and schedule integration file may be required, depending on the project scope. Multiple updates to the 4D schedule will be part of the pull plan activity.

A5 QUANTITY TAKEOFF AND ESTIMATING OVERVIEW

Quantity takeoffs (QTO) refer to extracting detailed material and component quantities directly from a BIM model. This process supports cost estimation, procurement, and project planning throughout the design and construction lifecycle.

BIM quantity takeoffs are a core part of modern, data-driven design and construction management, supporting more informed decision-making and optimized project outcomes. BIM-based Quantity Take-Off (QTO) increases efficiency and accuracy compared to manual methods. Errors are reduced when quantities are derived from the model, and frequent updates to quantities are possible as the design changes, helping designers design within budget.

Benefits of QTO

Because models are rich in data and geometry, all quantities can be extracted from a model. (e.g., volume of concrete, number of doors, square footage of flooring, costs) can be extracted with high precision. In design, QTO supports:

- Support early cost estimation- Preliminary takeoffs can be generated from conceptual or schematic models to help inform budgeting and design decisions.
- Enable design iteration analysis- As the design evolves, quantity takeoffs update automatically, enabling real-time impact analysis on costs and material needs.
- Improve interdisciplinary coordination- BIM integrates architectural, structural, and MEP components, minimizing errors and redundancies in takeoffs.

During Construction:

- Detailed construction planning- Contractors use the data for scheduling, sequencing, and logistics, ensuring the right materials are on-site at the right time.
- Accurate procurement- Automated quantity data reduces the risk of over- or under-ordering materials.
- Progress tracking and verification- Quantity takeoffs from BIM can be compared with actual site progress to monitor performance and verify subcontractor claims.
- Integration with cost estimation and 5D BIM- Quantity data is fed into cost management tools, enabling dynamic budget control tied to model elements.

A5.1 MODEL-BASED ESTIMATING (5D)

5D BIM promotes collaboration between architects, engineers, contractors, and cost estimators by providing a centralized, data-rich model.

Teams extract project, site, and asset quantity information to support required cost estimates throughout the project. The quantities extracted from the model are used to establish the cost of design options, preliminary estimates, construction budgets, and/or bids.

Cost data (the fifth dimension) may be integrated into the model used in the design and construction process. It enhances the capabilities of 3D modeling by linking building model components to cost-related information, enabling more accurate and dynamic project cost estimation, budgeting, and financial planning.

Designers and estimators can simulate different design alternatives and instantly see the cost implications of each scenario, aiding in Target-Value delivery and Choosing by Advantage for informed decision-making.

Beyond initial construction costs, 5D BIM can include operational and maintenance costs, helping stakeholders understand the total cost of ownership over the building's lifecycle.

Benefits

- BIM estimating reduces the time for take-offs and quantities
- Real-time cost feedback during design development
- Increased accuracy of model takeoffs and quantities
- Reduced risks of conflicts between design and estimate

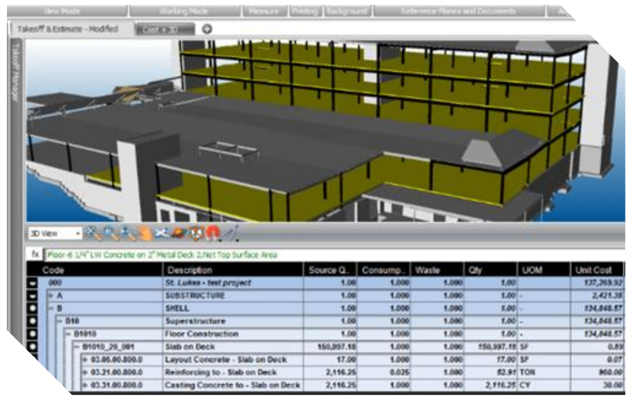


Figure 68-Model-based Estimating

Related Terms:

5D, Quantity Take-off, QTO, Cost Estimating, Engineers Estimate, Cost Analysis, Total Cost of Ownership

Model Content

The quantified model elements and the data developed for the information exchange. Data requirements are developed as part of the information exchange. Basic information includes the element type- name, and classification for grouping. The required data is based on the level of costing and estimating, from schematic to actual installed pricing.

Responsible Parties

The design team, BIM Coordinators, and estimators with a background in estimation and model data. Coordination meetings with the design BIM Coordinator and estimator plan workflows, scope, and model data requirements for estimating information exchanges. The Estimator may work with Cluster teams for specific discipline estimates, Target Value Delivery, or Choosing by Advantage activities.

- BIM modelers and estimators determine and verify what data is model-based.
- Review model elements for correct grouping and labeling; for example, a floor element could be used to model a ceiling, but it would not report the correct information.
- Elements are quantified and mapped into a cost accounting solution to update cost estimates throughout the design. This process progressively increases accuracy from preliminary schematic square footage costing, Lifecycle Cost Analysis, and First Cost Estimates to provide a total cost of ownership.

Deliverables

Quantity take-offs (QTO), with required attribute data needed for estimates. ,rvt files, tab-delineated files, spreadsheets, bill-of-materials, and the estimating software estimate

A5.2 BUDGETARY COSTING

Budgetary costing in design and construction calculates the financial resources required for a project during its initial planning stages. Factors such as materials, labor, and overhead costs are used to create a preliminary budget for analyzing project feasibility. Accurate budgetary costing helps stakeholders understand potential costs, allocate resources effectively, and ensure the project remains financially viable throughout its lifecycle.

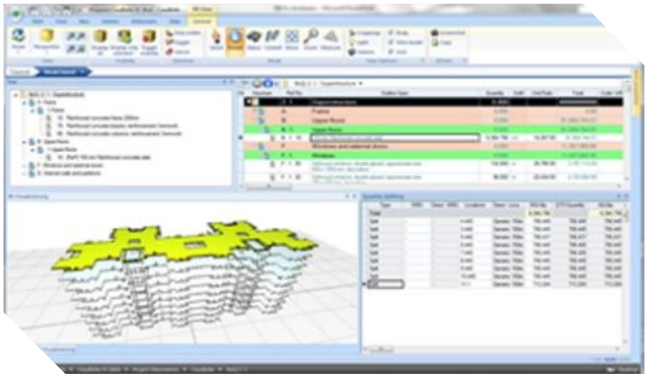


Figure 69-Costing Analysis

BIM is used in design options and review, Target Value Delivery, and Choosing by Advantage—quantities are derived from building objects, elements, and symbols in the model based on phase and granularity of the costing.

BIM budgetary costing may utilize spaces and major building elements with historical cost data, project type, region, construction type, and quantity takeoff (QTO) to calculate budgetary estimates.

Benefits

- Real-time costing of design options
- Costing supports Target Value Delivery and Choosing by Advantage

Model Content

The defined elements are part of an information exchange developed for the costing analysis. The data requirements are coordinated with the costing software requirements.

- Budgetary costing is refined as the model progresses. Costing data from areas, volumes, and progress to cost data assigned to modeled elements.
- Schematic costing may use areas with historical costing.

Responsible Parties

Design BIM Coordinator, discipline modelers, and estimators. The constructor may coordinate with the design team during pre-construction, supplying costing data.

Early costing may use quantities from the model in a costing tool. The estimator team will identify the software used in the BIMxP.

Deliverables

Model costing reports,.xlsx files,

A6 DESIGN REVIEW OVERVIEW

Massport Model-first design and construction requires the model to be constructable and ready for use in construction. The model reviews involve the structured evaluation of digital 3D models to ensure accuracy, completeness, coordination, and compliance with project requirements.

- Verify that the model meets the design intent and Massport's Conditions of Satisfaction.
- Identify clashes or inconsistencies between disciplines (e.g., structural, architectural, mechanical, and electrical [MEP]).
- Ensure that all components are correctly modeled, data-rich, and meet Massport's modeling and data standards.
- The design meets all applicable safety and code requirements

Benefits

Massport expects models to be reviewed for Constructability, Safety, Code Compliance, and Quality.

- Ensuring that the design can realistically be built as modeled.
- Verifying that necessary metadata (e.g., material, dimensions, performance specs) are embedded in components.
- Ensuring that modeling adheres to building codes, port facility requirements, and other industry-specific standards.

A6.1 CONSTRUCTABILITY DESIGN REVIEW

A constructability review combines automated and visual model reviews to identify design errors and omissions, ensuring models accurately reflect the appropriate LOD and an optimal design that meets Massport's Conditions of Satisfaction, which include performance, schedule, and allowable costs.

Figure 70-Constructability Review

Massport's Model-first project delivery requires teams to use design review tools and processes to develop constructible models. The reviews are conducted to identify any constructability issues, spatial constraints, and sequencing issues. For example, virtual walkthroughs are used to understand potential installation concerns between existing and newly built environment asset systems.

Benefits

- Reduce design errors and omissions.
- Better production planning with all contractors.
- Project checking rules- leading to better design quality.
- Automatically identifying interferences within design, construction, maintenance, and temporary elements.

Model Content

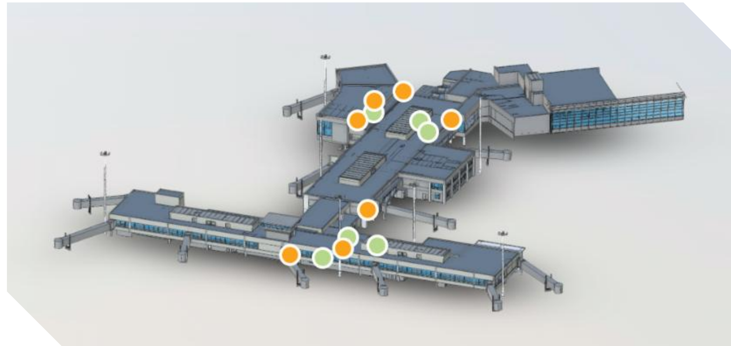


Figure 71- ACC Model Issue Tracking

Models are reviewed for constructability issues in a systematic process that prioritizes issue resolution. The model analysis and model precedent are defined in the issue resolution log and report. Examples:

- Site existing conditions vs. new constructions
- Potential interferences between permanent model elements/systems and temporary works.
- Any data requirements are defined in the model/ element table in the BIMxP.

Responsible Parties

Design team BIM Coordinators and discipline modelers, DTIG BIM Manager, Construction BIM Coordinator, and Fabricators as needed.

Deliverables

ACC Coordination or Navisworks may be used for design and model reviews, addressing issues, and resolving problems. The updated model file with the issues resolved.

A6.2 MODEL SAFETY REVIEW

Safety reviews identify and mitigate potential code and safety risks throughout the project lifecycle, from design through construction. Safety reviews visually communicate code and occupant safety issues, risk zones, sequencing challenges during construction, and hazards to eliminate or mitigate issues.

Benefits

- Design for Safety (DfS): Assessing the design to eliminate or minimize hazards (e.g., reducing work at height, access for maintenance).
- Construction Safety Planning: Identifying safety risks based on construction sequences and temporary work.
- 4D Safety Simulation: Using 4D BIM to simulate site logistics and access, highlight high-risk activities, and plan safety measures (e.g., barriers, scaffolding).
- Supports risk assessments and safety plans
- Reduce site accidents and develop safer workflows and construction methods to enhance overall safety.

Figure 72- Safety Modeling

- ### Model Content

Content is based on the review scope. The teams will use the federation process to view the discipline models supporting the review. Additional data will be identified in the scope.

- ### Responsible Parties

The design and construction teams will manage the reviews depending on the scope and project phase. Safety code compliance reviews happen throughout the project lifecycle. Construction sequencing simulations may be used to identify issues.

- ### Deliverables

Safety review files, simulation files, safety risk reduction reports, and mitigation plans.

A7 3D MODEL COORDINATION OVERVIEW

3D Coordination contains rule-based model elements that check for and resolve conflicts or clashes between different building systems, components, or spaces before construction begins. This helps prevent costly errors, delays, RFIs, and on-site rework, ensuring the feasibility and constructability of the design model.

A7.1 CLASH DETECTION

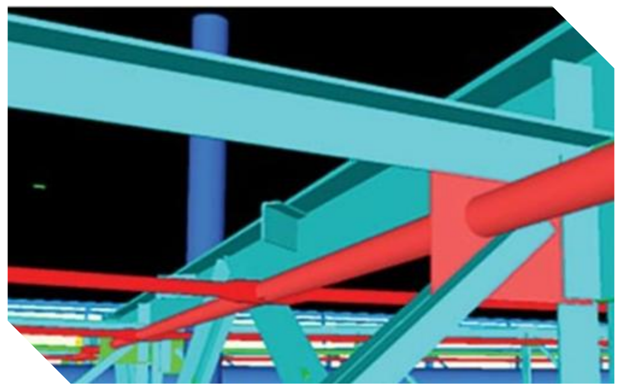


Figure 73-Clash Detection

Teams will periodically use the ACC federation process and coordinate the discipline models to identify and remove errors.

A clash occurs when two or more elements in a 3D model occupy the same space or interfere with each other in a physically impossible way.

- Hard Clashes- physical overlaps of model elements
- Soft Clashes- clearance issues or spatial tolerances, such as insufficient maintenance clearance space.
- Industry best practice has teams schedule coordination reviews throughout the project design and construction process. Individual discipline models are reviewed before federation with other discipline models for design coordination reviews.
- Coordination review meetings require the BIM Coordinator to create a meeting agenda that identifies the participants, decision-makers, and discipline models to be reviewed.
- To validate the project's constructability, teams verify the design layout and spatial arrangement of systems by applying construction means, methods, and additional spatial constraints (such as code requirements, maintenance access, and clearances). Model changes are based on system priorities and cost-effectiveness that meet project requirements.
- Approved Clash Detection software is used to identify interferences in MEPFP systems before prefabrication.
- Coordination software to align structural and architectural elements during design development.
- Clash detection to mitigate potential clashes between site utilities, landscaping elements, and building systems.

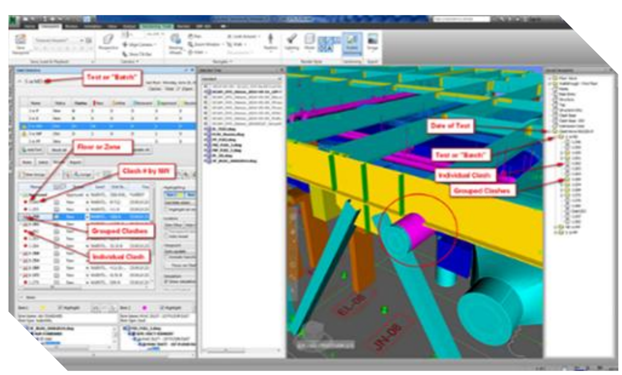


Figure 74-Clash Detection

Benefits:

- Reduces costly rework and delays on-site
- Reduce defects in construction phases and in both below-ground and above-ground assets and services. (Note: models are rarely clash-

free; the team and Massport will define critical items and priorities to resolve conflicts and develop the best constructible design).

- Improves coordination among disciplines
- Enhances construction quality and efficiency
- Enables better decision-making in the design phase

Responsible Parties

The design and construction teams' BIM Coordinators and discipline modelers. Experience in clash detection software – ACC, Navisworks, Solibri, or other approved tools.

Deliverables

Clash reports and issue resolution reports from ACC or software used for clashes. Models updated with the hard and other necessary clashes resolved by the team.

A7.2 CLEARANCE CHECKING

Provide a visible space or volume element for checking minimum height requirements, as well as access space for equipment installation and maintenance.

For example, this modeling activity covers major equipment requiring defined access or maintenance space. The clearance space object shows equipment in the design intent models and how it can be maneuvered into the designated spaces during construction and accessed once installed.

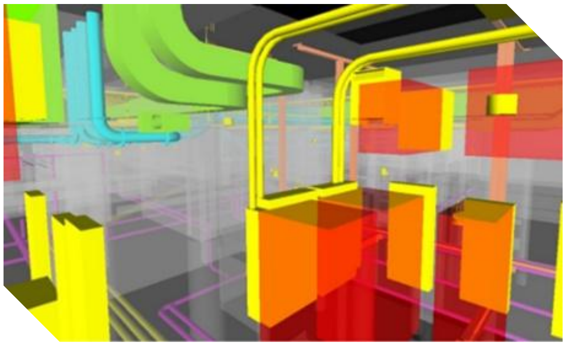


Figure 75-Clearance Checking

Benefits

- Supports maintenance review of equipment during design
- Removes conflicts for maintenance cycles
- Supports continuity of operations.
- Analyzes replacement path/s and accessibility of large equipment
- Ensure compliance with safety and constructability requirements.

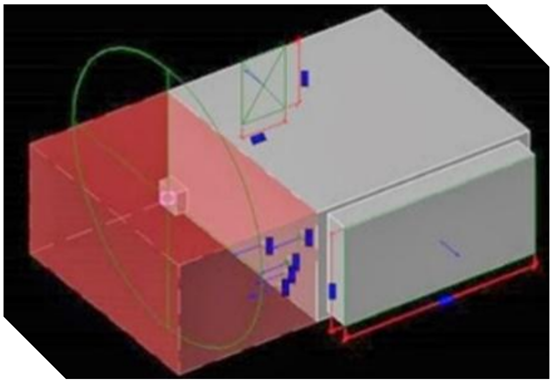


Figure 76- Equipment Clearance Space

Model Content

Building systems discipline models. Critical assets equipment defined in the BIMxP.

The bounding area is a 3D semi-transparent shape showing the clearance area. It is accurately named to avoid conflicting with reporting activities. Shapes should be grouped so they can be hidden for other BIM uses.

Responsible Parties

The design BIM Coordinator and discipline modelers are responsible for these elements in their models. The modelers review the equipment and maintenance space as part of the clash avoidance process. The facilities team will review the visualizations and views of the model, showing them to the maintenance and access space for approval.

Deliverables

Discipline native file with appropriately named clearance elements.

A8 CONSTRUCTION LAYOUT OVERVIEW

Shop drawings, detail modeling, and in-field layouts support Massport's model-first approach during construction. Construction drawings and construction documentation are detailed graphical representations of the project to be built. The drawings, details, layouts, and documentation are derived from the model. The model and the drawings ensure that all parties understand the project and its execution. Drawings can support in-field fabrication and assembly.

Construction Documents (CDs) are a required output at the end of the design process. The final CD set should be developed from a model. Construction Documents (CDs) are derived from the model. Views are automatically generated in the BIM file by the authoring software. Assuming no software errors, this automatic generation benefits the team's coordination and development of the CDs because the unity of the model provides consistency in construction document views. The generated documents include plans, exterior elevations, interior elevations, sections, and reflected ceiling plans. Schedules and legends generated from the model will be as sound as the input data. 3D detailing and color-coding are enhancements that improve communication.

Undergoing various review processes and quality control checks, including visual checking by the modelers, clash detection by the design team and CM, and model checking for quality in a model-checking program.

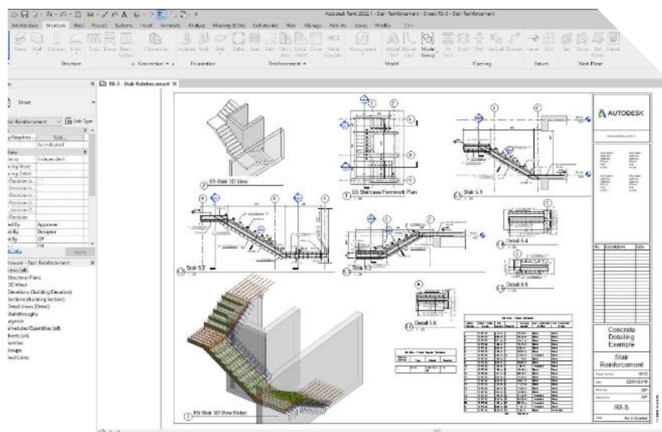


Figure 77- Model 3d Construction Detailing

Benefits

- Better coordinated construction documentation
- Model views, 3D detailing in construction documents
- Better material schedules
- Pre-construction fabrication opportunities

Documentation Content

- CD Generation:
  Construction documents (CDs) are not the primary driver of the BIM process but rather a required output during the design phase. The final CD set should be developed from the model that has undergone various review processes and quality control checks. These include visual checking by the modelers, clash detection by the design team, and review by the Constructor team.
- 2D/3D Details:
  Details derived from the model are better coordinated than generic 2D details created traditionally by documenting a mental visualization effort. The details shall use the model as a basis for detailed drawings whenever possible. These details will be created over the active 3D geometry. 3D axonometric and perspective details are recommended in addition to standard 2D

details because they often capture and convey more information than 2D views, particularly the relationships among sections and elevations.

- Schedules and Legends:
  Those generated from the model will be as accurate as the input data. 3D detailing and color-coding are enhancements that improve communication.

Responsible Parties

Design BIM Coordinator, discipline modelers, Construction BIM Coordinator, subcontractors, fabricators for shop model reviews and drawings, the specifier, and other model authors.

Deliverables

Deliverables per Massport Drawing and Publishing requirements in the BIM Standard and project BIMxP

- Design Intent model for construction use
- Construction documents
- As-built drawings at project handover
- In-field layout and redlines
- Discipline models with elements detailing (structural, electrical, interiors, etc.)

A8.1 DETAILING AND MOCK-UPS

Models are used to explore constructability, assembly, and installation details.

During design, design assist, and construction, teams develop detailed models of specific areas and assemblies to improve design and coordination for fabrication and construction.

This stimulates discussion between consultants, contractors, and subcontractors to optimize the design constructability. Systems considered: foundation, facade, connection of different materials, installation details, MEP and mechanical spaces, roof/wall connections, and interior details.

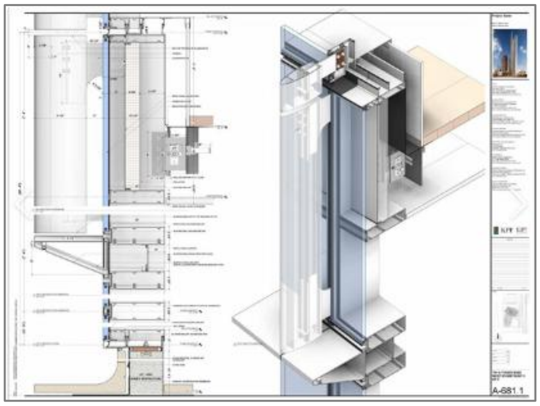


Figure 78- Model Detailing

Benefits

- Improved design constructability
- Reduced delays in construction
- Construction documents improved with the inclusion of 3D details.
- Better communication with stakeholders, product and materials manufacturers, fabricators, and
- Constructor team.
- Reduced cost in design by reducing the need for physical mock-ups
- Increased design awareness and coordination, reducing risk and errors

Model Content

Content depends on the details defined in a Cluster Group responsible for detail requests.

Data Requirements

Data is dependent on detail. It may include manufacturer detailing product specifications.

Responsible Parties

Design team, BIM Coordinator, and discipline modelers, as well as any material suppliers (e.g., window manufacturers), CM, and subcontractors during design assistance.

Deliverables

Detail model views and images for review and construction documentation.

A8.2 IN-FIELD LAYOUT

Model-based layout and robotic on-site model printing effectively move the model plan to the field.

Benefits

- Enhances communication of the design to the field
- Faster, higher quality construction layout
- Reduced errors in construction
- Better collaboration between design and construction teams
- Reduced cost and change orders

Figure 79-In-field Layout

Model/Documentation Content

Layout technologies provide plug-ins for BIM tools, including Autodesk Revit and Trimble FieldLink. The design team coordinates with the construction team to ensure that the necessary information for field layout is included in the construction documents and project model.

Data Requirements

Layout tools can add notes and QR codes, materials, outlets, and light locations to request this information in plans.

Responsible Parties

Early in the design process and design assist, the construction team works with the design team to ensure the effective use of in-field technologies.

Deliverables

CAD files per layout tool requirements, layout native files. Verified field layout. Printed plans in the field according to the technology.

A8.3 SHOP DRAWINGS AND MODELS

Construction documentation includes creating shop-drawings and clash-resolved models with high LOD for efficient on-site construction. The drawings illustrate the process by which the components will be fabricated, manufactured, assembled, and installed. Shop models and drawings provide detailed solutions to drive CNC machines for component manufacturing and assembly.

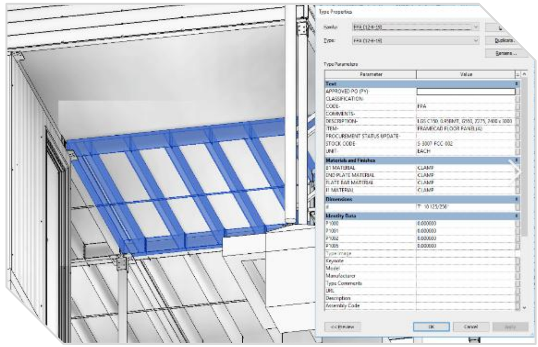


Figure 80-Shop Modeling

Shop models are typically created for structural steelwork, reinforcement, building services equipment, lifts, appliances, ductwork, piping, plumbing, windows, cabinets, electrical and data layouts, and fire protection. Others may be specified.

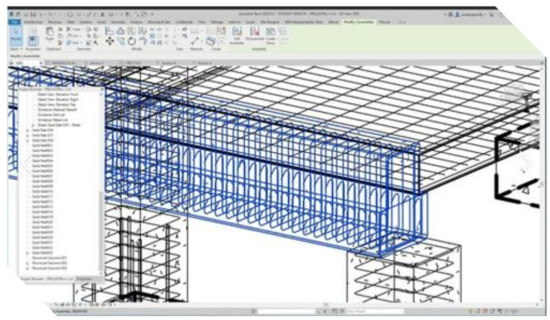


Figure 81- Model Detailing

Benefits:

- Better coordination between design intent through construction fabrication, assembly, and installation.
- BIM/CAD detailing solution to drive a CNC machine.
- Higher quality through visual review
- Reduce field changes
- Prefabrication support
- Quantities can be produced from shop models
- Detecting additional design errors before construction saves time, money, and labor costs

Model Drawing Content

Shop models and drawings are produced at a defined LOD, typically 350-400—coordination among the coordinated models produced by the constructor BIM Coordinator, subcontractors, or fabricators. The model data is developed to coordinate with the fabrication and machining of components.

Responsible Parties

Shop drawings are prepared by contractors, sub-contractors, suppliers, product manufacturers, or fabricators. The Design BIM Coordinator and discipline modelers will coordinate with the constructor team and review the finished shop models and drawings.

Deliverables

.Rvt shop models or approved file types for fabrication. Models and drawings for review before construction.

A9 DIGITAL FABRICATION OVERVIEW

Integrating BIM and prefabrication in construction projects offers numerous advantages that enhance efficiency and quality while mitigating costs and risk. Pre-fabrication coordinates and manages the off-site fabrication of building components and systems. It combines the power of detailed digital models with manufacturing processes to improve efficiency, accuracy, and quality in construction. Common opportunities for prefabrication include:

- Mechanical, Electrical, and Plumbing (MEP) modules
- Wall panels, façades
- Structural steel frames
- Bathroom or kitchen pods
- Modular rooms or units

The collaborative BIM process should ensure that the fabricator's deep knowledge and associated efficiencies are embedded into the construction model(s). The following construction trades (at a minimum) shall provide fabrication models:

- Structural Steel,
- Mechanical System Duct MEP subcontractors (incorporate vendor models if available),
- Curtain Wall Building Envelope Systems (rain screens, pre-cast panels, glazing systems),
- Casework and furniture systems—any additional fabrication models generated by the subcontractor.

Figure 82- Prefabrication Model Installation

A9.1 PREFABRICATION & ASSEMBLY

BIM supports construction execution, assembly, and installation. With the contractor's assistance, a model-first process requires the design team to create a constructible model that serves as the blueprint for actual construction. The Contractor builds to the model, maximizing BIM use and making construction more effective. BIM supports automation, fabrication, and robotic opportunities in the field.

Benefits

- Increased quality of design, manufacturing, and installation
- Modular and Lean Construction process improvements
- Using manufacturer BIM objects (simplified if necessary) reduces design time.
- The indoor environment protects the components from climate extremes and destruction.
- Reduces site logistics- managing time and materials on-site
- Reduces safety concerns
- Reduced environmental impact

Prefabrication and 3D Printing

Industrialized construction using off-site facilities to manufacture components in a safe and controlled environment.

Prefabrication is a positive opportunity in the industrialization of the construction industry. It includes modeling the proposed building components for fabrication, visualizing and simulating the logistics of their placement within the project structure, and the logistics of maintenance, repair, and eventual replacement in situ, beyond fabrication and shop drawing coordination.

Pre-fabrication occurs in the factory, allowing site preparation to proceed in parallel. With off-site construction, fabricators can utilize 3D printing for custom and complex elements, leading to improved construction times and enhanced waste management.

Model Content

Doors, wall panels, floor panels, stairs, windows, walls, roof trusses, room-sized components (such as bathrooms), mechanical systems, and infrastructure bridge components are potential options for prefabrication. The manufacturer creates parametric objects with correct specifications for quality control.

Responsible Parties

Design team BIM Coordinator, Discipline modelers, Constructor, fabricators, and manufacturers of the prefabricated components. The potential for prefabrication and the decision to prefabricate occur early in the design process.

Deliverables

Models, drawings, and components across the supply chain —from design teams to fabricators and construction team installers.

A9.2 MACHINE GUIDANCE & ROBOTICS

Automated Machine Guidance (AMG) using model and CAD data to operate machinery in the field for various construction tasks. An equipment operator using AMG can perform grading or paving operations with increased safety, efficiency, and accuracy, resulting in reduced dependency on grade checkers, fewer reference stakes, and other surface control points.

Figure 83-Automated Robotic Layout

The determination that a project is suitable for AMG should be made early on in the project development process. The BIM Coordinator meets with the AMG software manager to determine the model data content required for AMG.

Benefits

- AMG workflows improve design, survey, and construction operations.
- The process improved quality and safety. Decreased duration and cost

Model Content

Data is saved to the AMG software according to the requirements of the AMG software manager. The BIM Coordinator and discipline modelers meet with the AMG software manager to determine the data content required for AMG use. A 3D Digital Design Model (DDM) based on an accurate and original ground Digital Terrain Model (DTM)

Figure 84- Machine Guidance

Data Requirements

Criteria for use of AMG -Projects greater than 5,000 cubic yards of earthwork or paving. New alignments. A good Global Navigation Satellite System (GNSS) environment for receiving satellite signals or enough line of sight for successfully using Total Station controlled systems.

Deliverables

An approved model file is supplied to the AMG software manager.

A10 RECORD MODELING OVERVIEW

Project handover of deliverables formally completes a project and transitions documentation from the project delivery team to Massport. These deliverables ensure that the project is finalized and meets contractual, regulatory, and operational requirements. The design and construction teams assemble and submit the documents and files to the ACC.

BIM HANDOVER DELIVERABLES

BIM Deliverables	Description	Responsible Parties
As-built Drawings	Final drawings reflecting all changes during construction	Contraction and Design Teams
As-built Model	Final model reflecting all changes during construction	Construction Team
Record Model	Final design intent model updated with major changes made during construction	Design and Contraction Teams
Asset Data Report	The list reported from the As-built Model	Design and Contraction Teams
Scan-Point Clouds	Documentation scans of building system installations	Construction and Scanning Teams
Commissioning Report	Verification of system performance per design	Commissioning Agent

The design and construction teams, the commissioning agent, and the Massport DTIG BIM Manager will coordinate activities to finish the required documentation. Additional non-BIM documentation includes inspection and punch lists, operation and maintenance (O&M) manuals, manufacturer warranties, maintenance schedules, certificates of completion, and commissioning verification reports.

- **Benefits**
  - Ensures an efficient transition to building operations
  - Facilitates maintenance and asset management
  - Minimizes disputes and future liabilities
  - Fulfills contractual and legal obligations

A10.1 RECORD AND AS-BUILT DELIVERABLES

The (Design Intent) Record Model, As-Built (Record) Model, and associated documents (drawings, point clouds, CAD files, etc.) are required contract deliverables at the final stages of the construction phase. Record and As-built models provide accurate data on a completed project. These models serve as the foundation for facility and maintenance management, operations planning, and the development of digital twins. A list of discrepancies between the scan data and the as-built model would be generated, and team members could validate the results and update the as-built model as necessary.

- **Benefits**
  - Supports Massport project Close-out
  - Deliverables support Massport operations and maintenance
  - Models used for asset information model development
  - Supports Digital Twin and virtual campus goals

Record Model Content

The Record model shall accurately represent the project's final design intent, incorporating changes made based on construction and information related to the architectural, structural, programmatic, and MEPF elements, as well as other required systems.

- Reflects the final design intent (reflecting significant changes made during construction)
- Elements typically have a LOD of 300; however, elements shall match the LOD documented in the BIMxP.
- Primarily serves as the formal archived representation of the project

As-Built Model Content

At a minimum, the As-built model shall accurately represent the project's built conditions.

- Elements are typically a higher LOD (350-500). All submitted model elements and asset data shall match the LOD defined in the BIMxP and shall comply with the BIM Standard requirements.

The design consultant and the constructor are responsible for establishing an ongoing collaborative process throughout the project and ensuring the modeling and data development are completed for handover to Massport.

CAD Floor Plans

Massport may require floor plans CAD files from the Record Model. The DTIG BIM Manager may provide an AutoCAD template to save the files. Massport's facility management and leasing applications use these drawings.

Figure 85-CAD Floor Plans Leasing

Benefits

- Accurate and standardized floor plans for use in facility space management.
- Update facility space management

Responsible Parties

The design and construction teams share responsibility for Record and As-built deliverables. The construction team provides as-built changes to the design team, allowing them to update the Design Intent model. The construction team is responsible for delivering as-built documents, including models, redline files, and point cloud data.

Deliverables

Record and As-built Revit model files 2D AutoCAD floor plan files. Report on spaces.

A10.2 COMMISSIONING AND HANDOVER

Commissioning is a performance and quality control process that documents and tests a project's fulfillment of specifications and performance requirements. The owner specifies the measurable requirements at the start of the project.

The Commissioning Agent (CX) acts in the owner’s interest to verify that the requirements are met throughout the project. Systems are monitored for performance, staff training is provided, and issues are resolved. Commissioning uses models on mobile devices for field viewing and editing. This information supports facilities management and systems management.

Figure 86-Model in Commissioning

Benefits

- Improves coordination and communication between project participants.
- Systems and systems are tested and verified promptly to resolve issues during the project schedule. Fewer defects and deficiencies in the project.
- Optimizes performance and sustainability per the facility and building system specifications
- Start the use with trained staff.
- Minimize operating costs and maintenance.
- Support continuous condition assessments and efficient data collection and maintenance.

Model Content

The CX coordinates the use of project models with the design and construction BIM Coordinators to assess the data requirements for BIM-enhanced commissioning. This is continuous communication as the models are developed throughout the project lifecycle.   The DTIG BIM Manager determines whether the Record or As-built model is the basis for commissioning. Teams may use the Revit Data Exchange with the approval of the DTIG BIM Manager.

Deliverables

- Commissioning Equipment Start-up reports
- Installation checklists
- Functional tests results
- LEED commissioning
- Balancing reports
- O&M data
- Training materials

A10.3 ASSET INFORMATION DEVELOPMENT

Massport data constitutes a strategic asset of significant economic importance, and effective management is necessary to realize its full value. Massport is implementing an innovative asset lifecycle management program developing Digital Twins within a multi-building virtual campus. As part of the Record modeling process, project teams may be tasked with adding additional data to the Record or As-built models or providing a separate deliverable, as specified by Massport for the asset requirements. This task and commissioning activities support Massport's BIM-enhanced asset management program in operations.

Benefits

- Team's familiarity with the project model at handover
- Allows for the timely creation of asset models
- Support facility and asset management activities
- Seamless data transfer into Massport's CMMS and other asset management systems
- Additional resources supporting Massport on project handover

> Facility management encompasses multiple disciplines to ensure functionality of the built environment by integrating people, processes, and technologies to meet business goals. IFMA

Model Content

Models and data content are provided in the Massport scope of work. A coordination meeting with the Massport DTIG BIM Manager and Asset Manager will refine the data and model requirements.

Responsible Parties

The design team discipline modelers on the project model. Massport DTIG BIM Manager and Asset Manager. The Constructor team BIM Coordinator and modelers for the As-built model.

Deliverables

Data-enriched Project Models, Asset datasets (such as COBie), and other approved data files.

FIGURE TABLE

Massachusetts
Port Authority Capital Programs

2025