APPENDIX A. MPA BIM USES

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Using the BIM Execution Plan Template (BIMxP)

Within 30 days from contract award, the prime BIM Manager will schedule a Conditions of Satisfaction (CoS) meeting. At this meeting, Lean Value Mapping will be used to identify the project Conditions of Satisfaction (CoS), and the BIM Uses relevant to the project. Prior to the CoS meeting, the BIM Manager will become familiar with the BIM Execution Plan Template (BIMxP), and Appendix A – BIM Uses, in the BIM Guide. The BIM Uses define MPA's understanding and expectations for how BIM may be used on MPA projects.

The BIMxP template has several pre-defined project Conditions of Satisfaction categories. Each category has supportive BIM Uses to be identified for project execution. The team sets a priority (1-High, 2, and 3-Low) using the CoS No. pull-down menu, and selects the responsible parties using the pull down menu.

Categories Conditions of Satisfaction	COS No.	PRIORITY	Select and Prioritize the BIM action per project requirements	OWNER	A/E	Consultant	Constructor	Sub-Contractors
Collect and use accurate information supporting project start, design options, and processes.	1.1		Project Site Modeling -Also Infrastructure					
	1.2		Model the context for the project (project area surrounding project site)					
	1.3		Utilize scanning technology to develop existing conditions model					
	1.4		Capture accurate building interiors modeled to an LOD required for project					
	1.5		Identify and document environmental site conditions					
	1.6		Model campus or multi-building facility for Master Planning					

Figure 1 - Section 3 BIMxP Conditions of Satisfaction

SECTION 4. the BIMxP template will automatically assign the priority number from the COS action on sheet 3 to a corresponding BIM Use (Section 4) In Section 4, the team will then finalize the BIM Uses for the project.

SECTION 4 BIM Use

Directions: The goal of BIM Use is to align the Conditions of Satisfaction defined in Section 3, with coorresponding BIM Uses to support the project. According to the COS priority number (left of the page) the team will determine the final BIM Uses for the project. From a Lean perspective, aligning BIM Uses to COS priorities maximizes model usefulness, model progression for decision support, and reduces over or under modeling. *BIM Uses:* For additional descriptions and requirements for a BIM Use see the MPA BIM Guide Appendix A.

About LOD: The LOD numbers to the right of the page, given the LOD range for the BIM Use however, LOD is applied to the model objects and elements. See the MPA BIM Guide

Priority number is automatically assigned to a BIM Use.

COS Priority	Final BIM Use	BIM Use No.	BIM USE GENERAL DESCRIPTION		General LOD
		1	EXISTING CONDITIONS	See Appendix A - MPA BIM Guide for Additional Requirements	LOD
2		1.1	BIM Project Site Modeling – Also Infrastructure Modeling	The project site modeled to an LOD 200 geometry showing topography, relevant surfaces, access, site utilities, major plantings to be protected, historically significant or environmentally sensitive areas	100 200
		1.2	Surrounding Site Modeling	Provides additional land modeling or imagery providing the larger context for the project site. May be used with existing site conditions model and Existing Building Models. Also used for Way-Finding and Traffic pattern modeling.	100 300
1		1.3	Laser Scanning - Existing Conditions	Laser scanning for building exterior or interior (project scope dependent). Laser scanning post processed into a BIM or hybrid file - BIM with point cloud as reference - Data determined by SOW	100 300
3		1.4	Existing Conditions- Building Interior	Existing buildings may be simple Massings, blocking/stacking models, photogrametric models, or laser scan accurate BIMs per MPA and project needs. Existing buildings carry meta-data- (Building Name, Bldg. Number, Current Use,Built Date, Occupancy State, Square Footage, Est. Value-Condition Metric- TBD)	300

Figure 2 - Section 4. BIM Uses

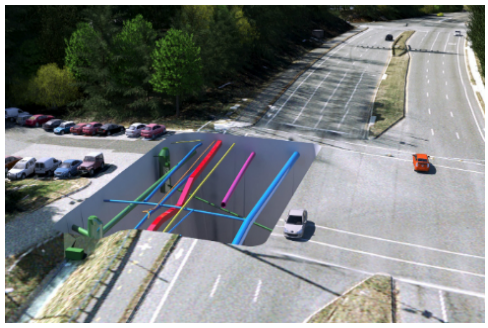
1 Existing Conditions Modeling

Existing Conditions modeling supports the gathering of existing data and modeling for project use.

1.1 BIM Project Site Modeling – Also Infrastructure Modeling

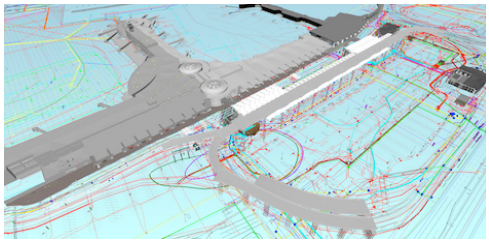
Description: An existing ground surface model of the project site and any occupying or relevant structures and utilities affecting the project. The LOD for these contextual site elements may be lower than that of the building or partial building of the project. Paving, grades, sidewalks, curbs, operational elements that cannot be disturbed and other elements supporting the project requirements as needed for the project should be shown. A separate discipline model should include new topography, site work, landscape, retaining walls and the surrounding area contributing to drainage, environ-mental requirements and roadways supporting project requirements Geo-referenced per the BIM Manager's specifications.

As may be prudent, Massport's survey unit may supplement the compiled record with an up-to-date existing conditions plan to serve as a base plan for the site design. It will include record underground utilities, actual surveyed locations of utility castings, field measured invert elevations, site topo-graphic detail, a 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 utility castings, further studies by the consult-ant may be necessary and may include subsurface underground utility engineering.

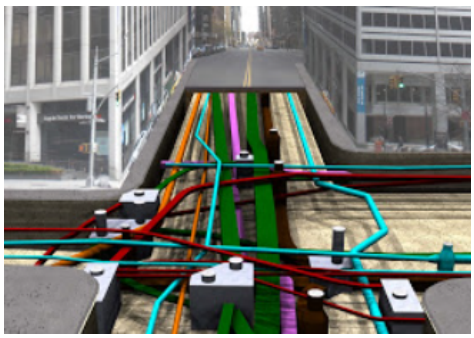


Responsibility: Project Design Team, Massport DTIG provides any existing CAD or GIS drawings. Additional Information includes Google Earth, photos, and scans.

The design team is responsible for a site model supporting the project requirements. The team will define the LOD for the site model through the project phases in the BIMxP.



At a conceptual level, a combination of CAD with 3D overlay, Google Earth with 3D overlay, photographs and Sketch-up (to be converted to Revit) may be used with the building shell for visualization, setbacks if any, site analysis and review.



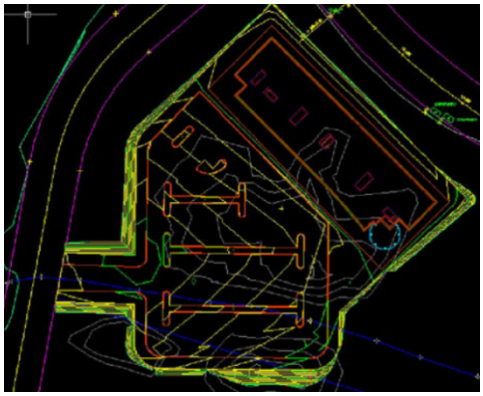
Model Elements:

LOD 200 - Generic site element modeling to include:

- Approximate size/shape of foundation element
- Approximate size/location of utilities and structures
- Approximate code and clearance requirements
- Approximate pipe material
- Rough modeling of site grading
- Local structural building grids defined in model and coordinated with global state plane coordinate system for site model (set by the BIM Manager for the entire project).

LOD 300 - Accurate for cut, fill, and volume estimations.
Changes in utilities at site are to be modeled at LOD 300. Document the

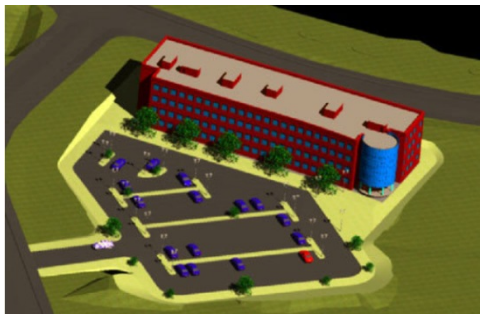
utilities to be modeled in the BIMxP.



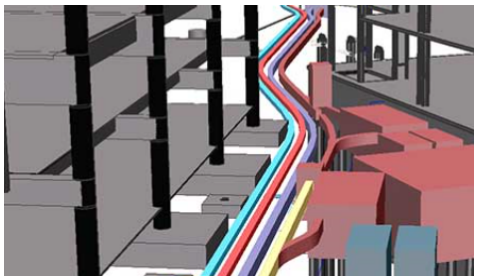
Utilities include:
Utilities should be modeled to face of structure and connection

- Pipe drainage system (including storm water removal)
- Sewage systems
- Electrical lines
- Communication lines (copper, fiber, co-axial)
- Gas lines and fuel lines
- In-ground heating or cooling lines
- Pneumatic lines

Color Code Requirements
The American Public Works Association (APWA) Uniform Color Codes shall be used for modeling elements



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 materi
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

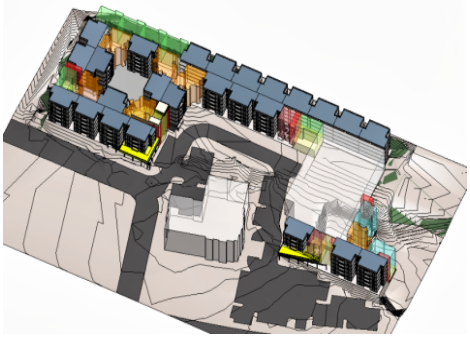


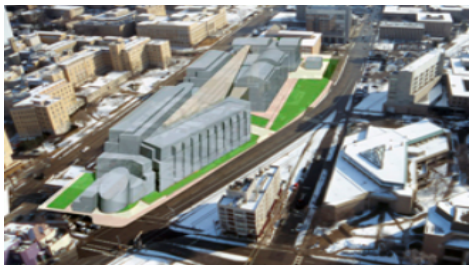
Data Requirements: OmniClass and Federal Aviation Administration (FAA) data standards shall be used for airport modeling.

Deliverables: Civil 3D, Revit. Navisworks Design model may be linked to site model for other BIM Uses.

Software: Sketch-Up, Revit, Revit MEP, Autodesk Civil 3D, Navisworks, BIM 360 (in review). "Software" includes add-ins and add-ons that supplement or augment the mentioned packages.

1.2 Surrounding Site Modeling





Description: Surrounding site modeling includes the area and infrastructure adjacent to the project site necessary for project analysis, review, or decision support. **Examples:** Line of sight, Sun Shadow Analysis (heliodon), and Future Master Planning. New and or temporary traffic patterns, access, and construction logistics may require surrounding site modeling.
A local structural building grid may be defined in the model and coordinated with global state plane coordinate system for the site model. (Set by the BIM Manager for the entire project – See Survey Control Points in BIM Guide). [1]

Responsibility: Design Team, Civil Engineer, Massport DTIG provides existing information. The design team is responsible for a site model supporting the project requirements. The team will define the LOD for the site model through the project phases in the BIMxP. The Design model is linked to site model for other BIM Uses.

Model Elements: LOD 100 - 200: CAD with 3D overlay, Google Earth with 3D overlay, photographs and Sketch-up (to be converted to Revit) may be used with building shell for visualization, setbacks if any, and site analysis and review. New roadways, bridges are to be modeled for BIM based reviews. The team shall document the software used for modeling and any additional tools for BIM based construction documentation.

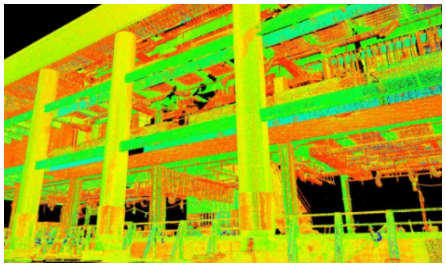
Data Requirements: OmniClass and Federal Aviation Administration (FAA) data standards for airport modeling.

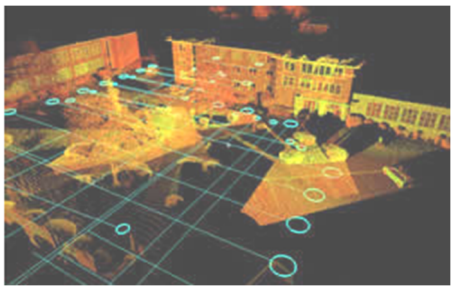
Deliverables: BIMs integrated with project site model. Site model may

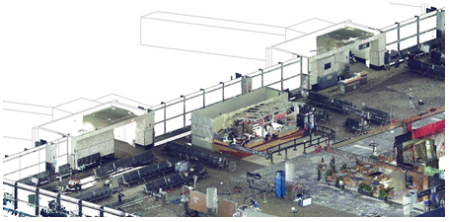
Software: Sketch-Up, Revit, Revit MEP, Autodesk Civil 3D, Navisworks, BIM 360 (in review)

[1] Note that the Survey Manager will be the BIM Manager's immediate professional source for control points. The responsibility for standardizing on the control points and making the control points known to the BIM team(s) rests with the BIM Manager under the heading of "coordination" responsibility.

1.3 Existing Conditions – Laser Scanning







Description: 3D laser scanning (based upon approved survey control points) produces dimensionally accurate and detailed 3D point clouds of existing facilities and assets. The point cloud data can be integrated into BIM authoring software for model development and Navisworks for review. Survey points allow the model and the scan to be accurately aligned to the State coordinate system for MPA use.

Responsibility: Laser scanning may be a sub-contracted part of the architect, constructor, or CM scopes of work, or to a third party. The MPA survey team may also provide laser scanning. MPA has approval.

- **Coordination Meeting for Survey Control Points:** A coordination meeting between MPA PM, the scanning party, the BIM Manager, Survey Manager, and other responsible parties to schedule "survey control points" for laser scanning activities, scan creation, and model development.

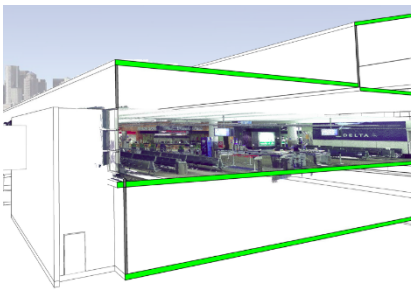
- **BIM Development from the Point Cloud:** BIM production will follow Massport BIM Guide standards, and the LOD and model elements defined in the project BIM execution plan. Not all scanned elements will be modeled.

Deliverables: The 3D point cloud, BIM as specified in the BIMxP, Navisworks and .rvt file.

Software: Identify point cloud development software (editing and viewers) and deliverable specifications to Massport. Result must be suitable for use in Revit Architecture, MEP, as required for scanning and modeling scope. Identify software in the BIMxP.

References: MPA's *Exhibit 36 Survey Control Plan.pdf* in *Massport Capital Programs Dept. Manuals, Volume 1 Operating Guidelines, Volume 1 Exhibits.*

1.4 Existing Conditions Modeling – Building Interior



Description: A spatially accurate model of existing spaces, building system components, and equipment. Data necessary for design option decisions may be required as part of BIM development. The model can be used for design options, design coordination, analysis, and client decisions.

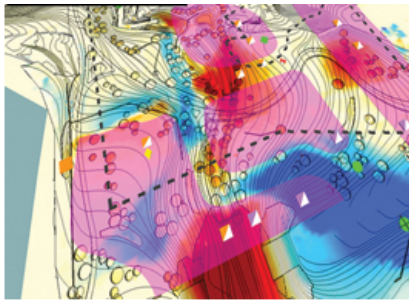
Model Development: The model can be developed from existing documents, site measurements, or laser scanning. Assets and spaces are typically LOD 300. Modeling follows MPA BIM Guide and BIMxP development.

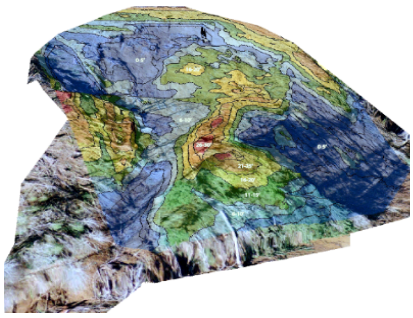
Responsibility: Modeling and optional laser scanning may be part of the architect, constructor, or CM scopes of work, or sub-contracted to a third party. The MPA survey team may also provide laser-scanning resources. MPA has approval. (See Laser Scanning BIM Use for laser scanning requirements)

Deliverable: Native file (rvt), data/QTO report (COBie format or spreadsheet)

Software: Revit Suite (architecture, MEP, structure) per building elements and systems modeled. Point cloud editor and viewer.

1.5 Geo-technical, Environmental





Description: This covers a visual, dimensionally accurate model of the geo-technical analysis report supporting project scope and requirements. Modeled, located, and identified elements may include: soil borings, protected lands, underground storage tanks, test wells, (wet lands, marshes, animal habitats, topographical barriers, brown fields)

Responsibility: Responsibility typically falls to the civil engineer, as identified and documented in the BIMxP. Geo-technological information is the responsibility of the engineer, as identified and documented in the BIMxP. Modeling may be created by a third party or other member of the engineering team

Data Requirements: Geo-technical data will be defined and documented in the BIMxP.

Model Elements: Site and land elements are to be defined to support the project requirements.

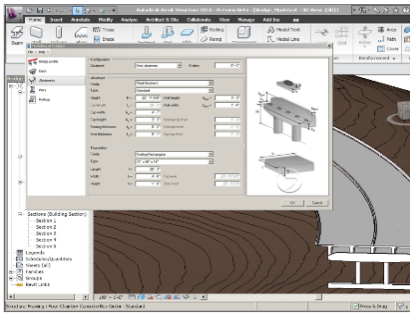
Software: Software includes Civil 3D, Revit Architectural, Navisworks, and other software documented as required by BIMxP.

1.6 Site Modeling – Horizontal Construction

Description: Roadways, raised bridges and walkways, and transportation structures are all examples of horizontal modeling needs on MPA projects. Combined with Civil 3D roadways sites, the project team can effectively model the total environment of MPA facilities. As with vertical construction, horizontal structural modeling is done with product and building element objects and elements. These objects can be analyzed with ROBOT.

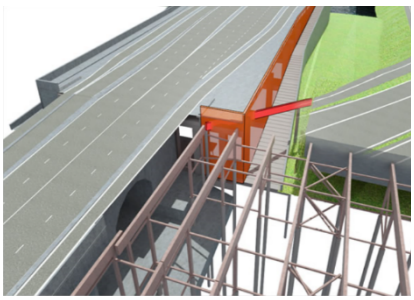
A separate discipline model that includes new topography, site work, landscape, retaining walls and surrounding area contributing to drainage, environmental requirements and roadways supporting project requirements. Geo-referenced per the BIM Manager's specifications.

As may be prudent, Massport's survey unit may supplement the compiled record with an up-to-date existing conditions plan to serve as a base plan for the site design. It will include record underground utilities, actual surveyed locations of utility castings, field measured invert elevations, site topographic detail, a 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 utility castings, further studies by the consultant may be necessary and may include subsurface underground utility engineering.



Responsibility: Project Design Team, Massport DTIG provides any existing CAD or GIS drawings. Additional Information includes Google Earth, photos, and scans.

The design team is responsible for a site model supporting the project horizontal construction requirements. The team will define the LOD for the site model through the project phases in the BIMxP. At a conceptual level, a combination of CAD with 3D overlay, Google Earth with 3D overlay, photographs and Sketch-up (to be converted to Revit) may be used with the building shell for visualization, any setbacks, site analysis and review.



Data Requirements: OmniClass is used for most project types. The OmniClass fields for families in Revit will be used.
Local structural building grids shall be defined in model and coordinated with the global state plane coordinate system. (Defined by the BIM Manager for the entire project).

Model Elements
General description and LOD 200 - 350

- Bridge or structure building elements
- Columns
- Foundations
- Communications
- Other discipline building elements

Horizontal Structures:
LOD 300 – 350

- Foundations or Pilings
- Columns, walls, parapets
- Girders, Superstructure, Deck

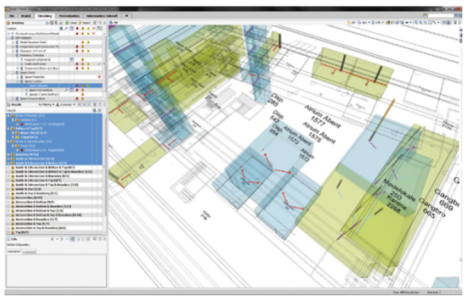
Deliverables: 3D Site Model in Civil 3D. Utilities in Civil 3D and Structures in Revit. Revit Design model in Navisworks may be linked to site model for other BIM Uses.

Software: Revit, Revit MEP, Revit Structure, Autodesk Civil 3D, Navisworks, "Software" includes add-ins and add-ons that supplement or augment the mentioned packages. Additional packages compatible with 3D dwg may be submitted for approval.

2 Design and Building System Authoring

Each discipline team shall model its contribution to the design options and final design. These individual models are Work in Progress (WIP) models. These are reviewed, and then federated with other models for ongoing clash coordination (weekly or a pre-determined schedule). Upon completion, all models are federated into the architectural model to create the Design Intent model of the final design solution.

2.1 Architectural Model – LOD 200 – 300



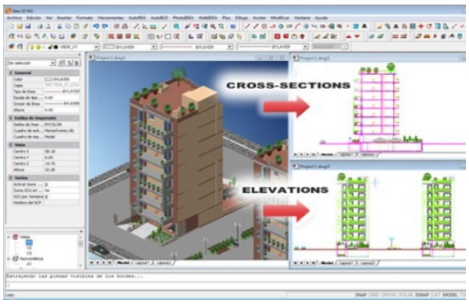
Description: This model is used to explore design options, and serves as a base model for the federated design intent model, design analysis and other BIM Uses. It contains the BIM elements assigned to the architectural authoring team. The elements, LOD, and model progression should be defined in the BIMxP. This base model is used for discipline integration, and must support "clash avoidance" and model checking.

Responsibility: Architectural design team has responsibility for this. The BIM Manager will use it as a basis of model integration with other disciplines. Defined coordinates for all disciplines are in this model, as specified in BIMxP.

LOD: Progressive from LOD 200 (spaces) to Construction Documentation for contractor handover.

BIM Architectural Elements: Design Development

- OmniClass *Spaces by Function (Table 13)* are used in conjunction with Massport Room Numbering, functional designations, secure spaces designations
- Partitions and Walls – Dimensionally accurate interior partitions and exterior walls. This LOD includes assemblies supporting other BIM Uses, budgetary estimates, estimates, visualization, space validation conformance, and other discipline models. Massport wall naming conventions must be followed. This LOD includes doors, windows, and openings. Finishes are to be included within wall types.
- Interior, Exterior Soffits, overhangs, sun control elements, parapets, screening elements
- Architectural precast
- Floor, Ceiling, and Roof systems, dimensionally accurate (slopes as needed) with floor to floor dimensions, and used as a basis for coordination with Structural and other discipline models. Assembly data supporting construction documentation, 3D detailing, QTO and estimating, and analysis.
- Soffits and openings shall be modeled along with louvers, diffusers, and other building elements required for visualization, QTO, Schedules.
- Vertical shafts, elevators, stairs, ramps (railing systems) and other horizontal and vertical conveyence systems
- Model mechanical, electric fixtures, and plumbing fixtures and equipment requiring architectural space. **Examples:** LOD - 300 Toilets and stalls, sinks, outlets



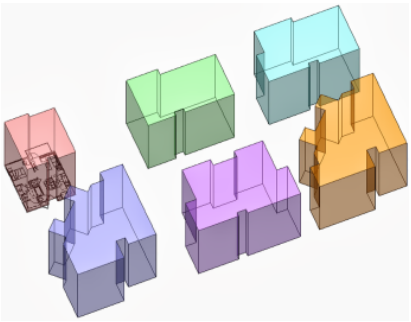
- Consideration must be given to Mechanical Equipment Clearance Zones for access, service space requirements, meter reading, clear space required by relevant code authorities, and operational elements needing service space. Zones may be modeled as transparent or translucent solids, named, and classified and on separate model layers. This equipment, these fixtures, and devices must be coordinated with MEP domain specialists.
- Interiors including casework, shelving, interior built-in elements, furnishings (furniture systems, fixed and loose furniture), fixtures and equipment (FFE) if not supplied by others, must be included in the architectural model.
- Specialty Equipment, including food service and medical equipment if not supplied by others, will be included in the architectural model.

Deliverables: Revit Model, federated model for handover, used as basis for Record (As-Built) model.

Software: Sketch-Up during options and programming (converted to Revit) Revit Architecture for architecture model.

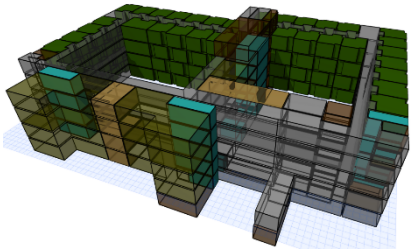
2.2 Space & Circulation Requirements Modeling

Description: MPA requires the design team to model space and circulation areas using consistent modeling methods and MPA space and data standards. When modeled correctly, spaces can be validated against the project program, functional space needs, and circulation rules using a model-checking tool.



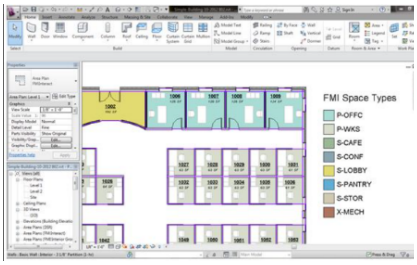
Definition of BIM Space Modeling and Circulation

- **Spaces:** are bounded areas or volumes created using the BIM authoring application's space definition tool with a room tag to contain its designation and the required space classification information.
- **Spaces** are automatically generated to the face of the wall in areas enclosed by walls such as rooms, or may be modeled as stipulated spaces that are operational or organizational in nature rather than being defined by physical wall elements. **Examples:** a reception space, a department, a mezzanine, an elevator lobby space.
- **Circulation:** defines the accessibility allowed for various spaces within Massport buildings. These conditions also determine the ease of egress from different spaces in the building in case of emergencies, transit, security, as well as access to specific spaces in a building for special populations, such as travelers and access for people with disabilities.
- Public circulation is understood as all those areas for the use of general public inside the building
- Restricted circulation has a controlled interior entry; the use of these zones is limited to screened passengers and other designations in the project program
- Secure circulation includes all areas intended for the circulation of employees only. It is under the control of the TSA or airport security authorities.
- Spaces are color coded and a legend or schedule of spaces created**.**



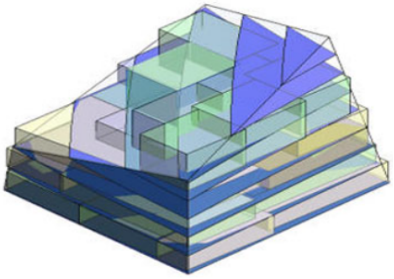
Model Elements:

- All spaces/areas greater than 9 square feet (> 9 SF) in plan area, relevant to the project, existing, changed, or new, shall be modeled.
    - The BIMxP will specify the exact figure below which a space need not be modeled, and therefore will not be tracked by MPA. For post-911 security reasons, MPA may set a lower figure for accessible space.



Additional BIM elements and data shall include:

- Space Name and Space ID Number per Massport requirements
- OmniClass Table 13 - Spaces by Function
- Space security classification – Minimum secure and non-secure space identification
- Elevator, containing space name, space ID number, security level
- Stair, containing space name, space ID number, security level
- Ramps, ramp slope, ramp designation
- Wall LOD 200, for space boundary, no specific wall attributes required for space validation
- Space Door(s), LOD 200, door number assigned to space on "secure" side or door number or name derived from space on secure side of door; no specific door attributes required
- **Color Code:** MPA uses a color code for certain space types. Yellow- public



Red- Non-Public

- Colors may be modified (lighter, or less intense as needed)

Space Calculations:

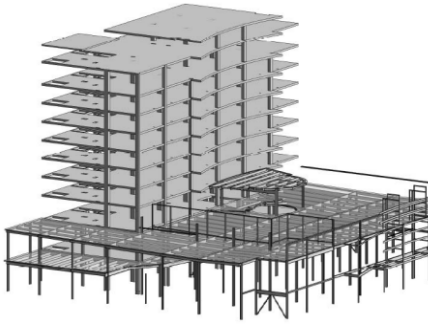
- **Gross Area:** the footprint of the building or floor to the outside face of wall
- **Usable Area:** the spaces to the face of wall (**Example:** room). It does not count the space under columns in the room.
  Program requirements describes square footage based on Usable Area, which is the actual occupiable area of a floor or building used solely by the client. This figure represents an accurate reflection of the project space needs so the size of the proposed space should vary as little as possible from the Usable Area listed in the RFP.
  Usable Area is determined by measuring the entire floor area of the premises (or such other space) bounded by a line established by the predominant inside finish of the permanent outside building walls which abuts the floor (not from the inside face of windows) and by the interior surface of corridor walls or other demising walls. No deductions shall be made for columns or other projections necessary to the building structure or systems or for partitions subdividing the premises. Under no circumstances shall the Usable Area include elevator shafts, vestibules, stair enclosures, elevator machine rooms or other building equipment areas, janitorial, electrical or mechanical closets, loading platforms, or restrooms (unless they are included in the Agency Specifications and in addition to the restrooms required to meet code), irrespective of whether the Agency occupies the entire floor or the entire building.
- **Rentable:** Formula supplied to Tenant

Codes: Americans with Disabilities Act (ADA) and the Architectural Barriers Act (ABA).

Deliverables: Additional model tools may be used during early design. See the list of space planning tools in the MPA BIM Guide. Space views and space reports are required for design meetings and communication during design development. Final design model shall be in Revit.

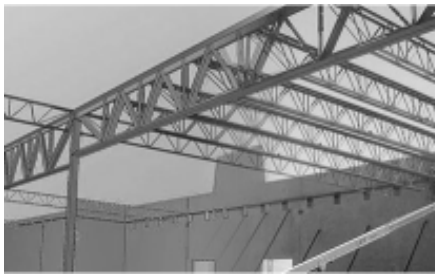
For Model Validation: A single file containing the BIM exported to IFC 2x3 format or most current approved IFC version. See BIMxP for the project has approved software versions.

2.3 Structural Model



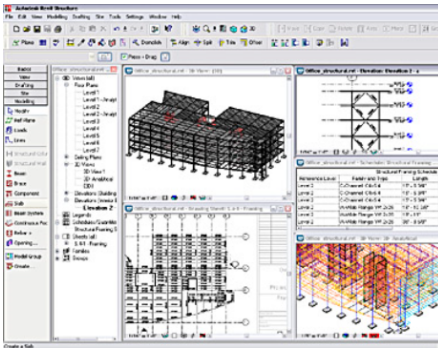
Description: A discipline model of the structural system of an existing or proposed design. The system, detailing responsibilities and modeling LOD shall be documented in the BIMxP.

Responsibility: Structural Engineer has final responsibility for structural systems in the model. The design team may begin design in the architectural model and share modeling during design options. The modeling responsibility shall be documented in the BIMxP.



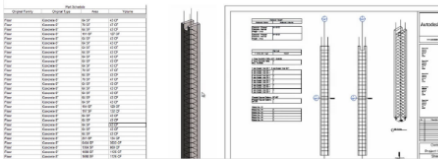
Modeling Includes, the (proposed and/or existing) specified structural system, ready for handover and construction detailing

- Foundations – Any foundation type, Structural Foundation Walls
- Framing, steel columns (correct shape & size), steel joists (C-joists, open web, joist girders, steel beams (correct section shape and size)
- Precast Concrete elements – Hollow Core Plank at LOD 100 - 200 may be modeled as slab; at LOD 300 - 350 if coordination with mechanical is required.
- Cast-in-Place Elements
- Floors, including openings
- Wood posts, columns
- All other joists and wood trusses
- Solid wood and Laminated Beams
- Fireproofing, if required, using a 2” clearance for clash avoidance, detection.
- Load Bearing Walls and openings – masonry, concrete, cold-formed steel and wood (model overall wall thickness)
- Design Team Optional Modeling may include steel reinforcement, embeds in concrete, additional steel elements, angles for openings, channels for mechanical units, metal decks, elements required for coordination, QTO, and clash avoidance or clash detection.



Data Requirements: OmniClass, UniFormat, and COBie data

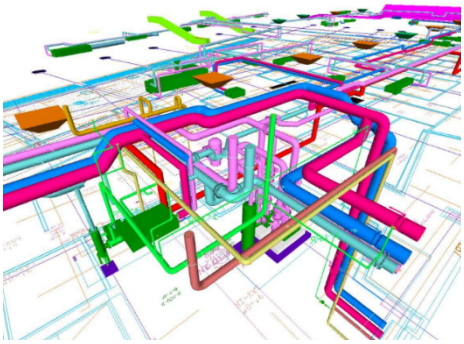
Deliverables: Structural discipline model, shop drawings model integrated into structural model, record (As-Built) model



Software: Revit Architectural, Revit Structural, Tekla. Other software documented in the BIMxP

2.4 HVAC Mechanical Systems

Description: A separate discipline model – Modeling of system for decision support, analysis, made ready for detailing and fabrication.

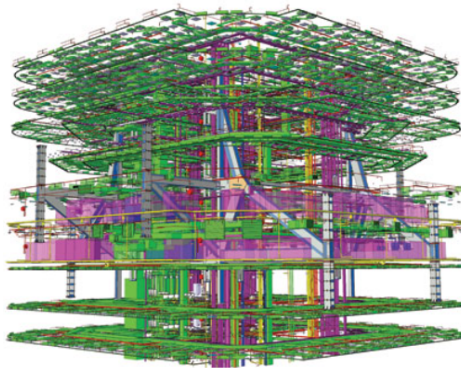


Responsibility: Multiple team members. How the system is modeled across phases and handover for detailing and pre-fabrication is to be diagramed and defined in the BIMxP.

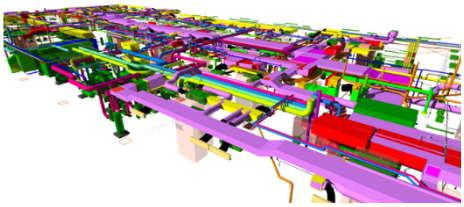
The various HVAC and fuel systems modeling shall follow the LOD designation provided in the AGC LOD Manual.

Model Elements:

- Equipment, fans, VAV's (Variable Air Volume) compressors, chillers, cooling towers, air handlers, and other equipment required for construction documentation, QTO, and handover for pre-fabrication
- LOD 200 – Generic elements, approximate size, shape, location. Shaft requirements in model. Maintenance space requirements
- LOD 300 – Detailed elements, Contractor submitted actual elements including dimensionally accurate elements, air supply location, connections, piping, valves, insulation. Actual wall and floor penetrations.
- Allowance for hangers, supports, vibration
- LOD 400 – Manufacturer and contractor modeling elements for field installation. Finalized data requirements in Commissioning. As-Built (Record) Model



Data – Performance and manufacturer required data for analysis, Record Model and FM, OmniClass and Massport facility handover



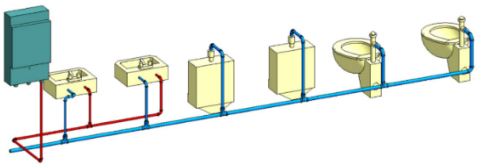
Deliverables: Structural discipline model, clash avoidance between Architectural, Structural, and HVAC; equipment lists, COBie data

Software: Revit MEP, other software documented in the BIMxP, Navisworks, Solibri Model Checker

2.5 Plumbing & Fire Protection

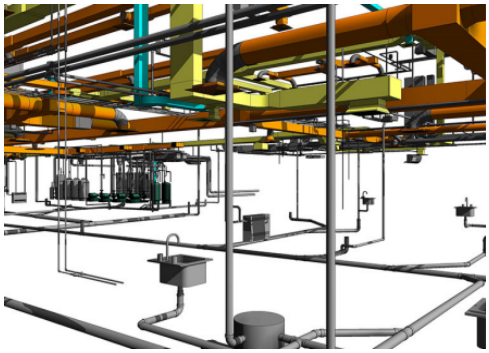
Description: Separate discipline models - Minimal modeling of system sufficient for shop modeling and fabrication.

Responsibility: Architect, Mechanical Engineer responsibility defined by phases in BIMxP



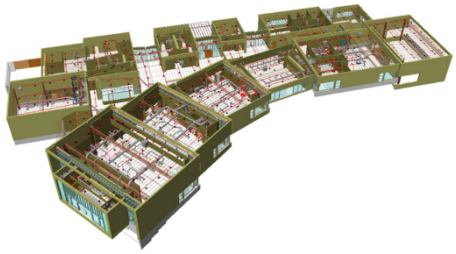
Modeling Requirements:
The plumbing and fire protection systems modeling shall follow the LOD designation provided in the AGC LOD Manual.

- Waste and Vent: piping at or over ¾" inside diameter (i.d.). Model insulation unless noted and approved in the BIMxP.
- Supply: piping at or over ¾" i.d. Model insulation unless noted and approved in the BIMxP. Domestic Booster Pumps
- Fixtures: sinks, toilet fixtures, urinals, water tanks, floor sinks, and other fixtures. LOD 200 – 500 for As-Built (Record) Model. Include performance data for analysis.
- Fire Protection: Sprinkler lines, sprinkler heads, fire protection pumps, stand pipes, wall hydrants, fire department connections, risers and valve clearances. Sprinkler heads with virtual label, performance, and installation date.
-



Data Requirements: COBie data and schedules for construction documentation and commissioning data per project requirements.

Deliverables: Discipline model, COBie data and commissioning information, construction drawings to A/E

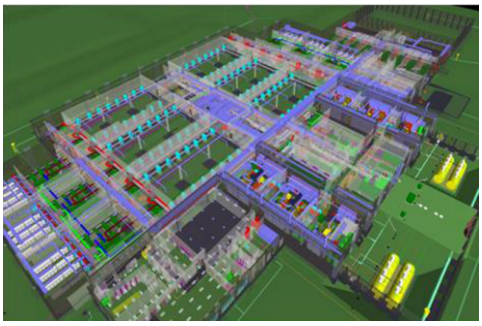


Software: Revit Architecture, Revit MEP, other applications with add-ons and plug-ins as documented in the BIMxP

2.6 Electrical, Alarm Systems

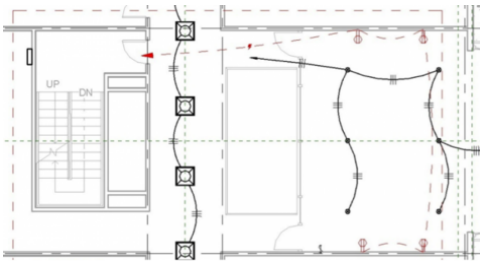
Description: As separate discipline models**,** model the primary components of the electrical, lighting, alarm systems and building automation systems (BAS) controls.

Responsibility: Electrical Engineer, Architect, Interior Designer. Modeling responsibility by phases will be documented in the BIMxP.



Information Requirements:

- List of major equipment consuming electricity:
- Chillers, Boilers, Compressors, Condensers, Unitary Equipment, Air Handlers, Transport Elements (e.g., people movers): Electrical phases, Load, Voltage, System Type
- List of equipment (if any) for generating electricity:
- Generators, solar panels, wind turbines, output voltage, system type, generating capacity
- List of equipment for storing electricity:
- Uninterruptible power supplies (UPS), connected load, uptime
- Emergency lighting battery units, exit signage
- General-purpose electric demand in/for building:
- Space: power density for lighting, appliances, equipment, outlet requirements



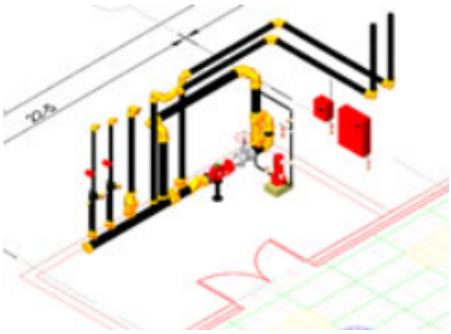
Modeling Elements:

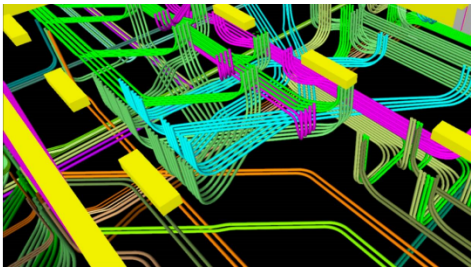
- Data, power, and telecommunications: Interior and exterior transformers, emergency generators, main and distribution panels, switchgear including access clearances. Main IDF's, outlets, switches, junction boxes. Include BAS devices and controls, and electric building products for QTO.
- Lighting: Permanently mounted light fixtures, lighting controls, switches, junction boxes. Moveable plug-in fixtures are not modeled unless required for visualization, or plug load calculations, or QTO, or estimating. Requirements decision shall be documented in the BIMxP.

  LOD 200 with generic lighting and performance data for analysis.

  LOD 300 actual fixtures with correct performance and load data and location.

  LOD 500 – As-Built (Record) Model
- Fire Alarm and Security Systems: input devices, notification devices and associated equipment and access clearances, emergency lighting and permanently mounted fixtures, electrical power-off buttons





Data Requirements: COBie and commissioning data, classified according to OmniClass and UniFormat.

Deliverables: Discipline model, panel schedules and other equipment schedules, COBie data, commissioning data in model; QTO for estimating, Electrical drawings showing physical size and location of all elements in the

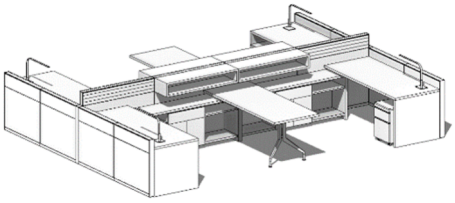
electrical system, including final electrical specifications will be part of the deliverables.

Software: Revit Architecture, Revit MEP, Navisworks, Solibri Model Checker.

2.7 Interiors

Description: Modeling of interior design options, materials and finishes, details, furniture, fixtures, casework, equipment (FFE) furniture systems, signage and way finding, support for lighting power locations, LEED and Daylighting.

Responsibility: Architect, Interior Designer, Lighting Consultant, Furniture Contractor, Coordination with electrical engineer for lighting outlet placement, telecommunications and surveyors. Tenant representatives may be involved per scope of work.



Model Elements: interior partitions, soffits, ceiling grids, moldings, base, architectural details, lighting, FFE, ramps, raised floors signage. Materials and finish schedules. Elements modeled to support QTO and estimates, LEED, lifecycle costing

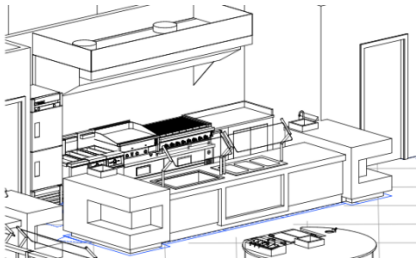
Survey Points: Survey control points identified during pre-construction should be esthetically integrated into the final floor design finishes as brass, steel or other permanent material markers for future facilities work.

FFE: BIM will be used for QTO, estimating, procurement and pre-fabrication.

Deliverables: Renderings, model views as requested for design review. Model elements to be integrated with Architectural model for construction documentation, FFE schedules, Material and Finishes Schedules

Software: Revit Architectural, Navisworks, rendering visualization software provided in BIMxP

2.8 Tenant Build Out



Description: Tenant projects are all sizes, from simple kiosks to new hotels. The tenant will work with MPA to determine the space, scope, and requirements for tenant documentation, including BIM.
MPA will utilize its BIM Decision Matrix to determine if BIM is to be used.

Responsibility: Tenant designer is required to inform Massport concerning tenant BIM and CAD standards that conflict with Massport standards. The tenant will provide models and data per Massport-provided requirements. Massport will supply any existing information available for the space and applicable code requirements.

Modeling Elements: All disciplines

- All new building elements in the space, equipment, MEP, and specialty items will be modeled at LOD 300 for review by Massport Tenant Coordinator.
- Food Service will conform to all applicable codes. Clash Detection and resolution will be performed on design prior to construction documentation completion.

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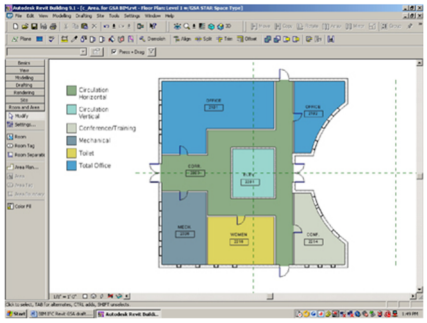
3 Analysis and Reporting

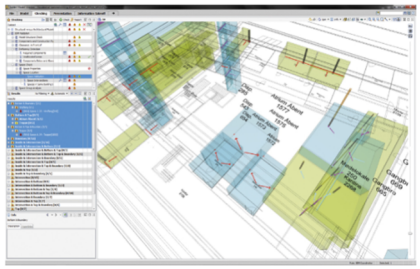
A major benefit of BIM is the ability to analyze the model for performance, design conformance, and to run reports of critical design information as the model changes.

3.1 Area and Space Program Validation (SPV)



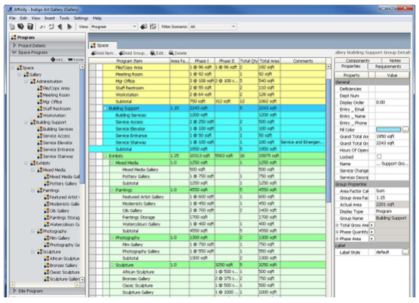
Description: The BIM file, specifically spaces and bounding elements, including floors and stories, is analyzed using model checking software. Attention is given to the file format required by the checking software, and its applied rules. A report of deviations to be reviewed and addressed by the design team is generated.

Responsibilities: Design Team, Massport Review
Spatial Program Validation (SPV) is done by the design team, reviewed and approved by the Massport team. SPV assesses the degree to which the modeled design meets all of the Massport defined space requirements. Such assessments are ongoing during design development, and used in design review meetings.



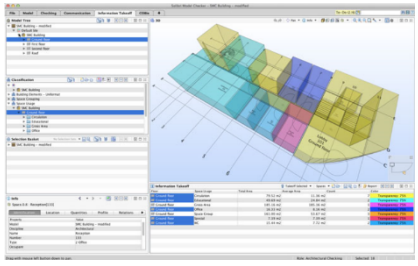
SPV during concept design focuses on the following things:

- A pre-check of the model for valid model structure and for completeness, relative to what is required for space in the Massport BIM Guide and the project program
- Measurement of space areas, by space type and occupant, or by space type and function, and required attributes
- Assessing and documenting differences between space areas provided in the design and what is required in the space program for the project, organized by space type and occupant or space type and function
- Assessing and documenting differences between the design and requirements in other areas (e.g. space proximity, adjacencies, floor location, etc.)
- The Massport review is a crosscheck of the design option conformance. Design issues will be communicated back to the project design team for resolution before the design is accepted by Massport.



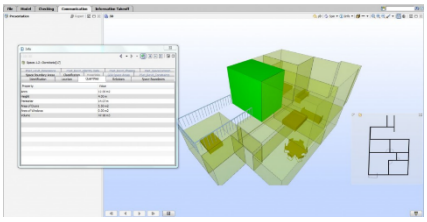
Space/Area Modeling:

- Assignable Areas and Non-Assignable areas modeled to face of wall and designated boundaries
- Gross area measured to the outside face of wall
- Space modeled as volumes, calculated as area in square feet and cubic feet
- Model plenum spaces, interstitial spaces as specified separate volumes



Minimum Space Attributes:

- OmniClass Table 13 – Spaces by Function
- Existing numbering structure in existing construction or renovation
- Categorize as public, private, secure space designation
- Generic assignment of MEP elements per square feet. **Example:** Number of light fixtures per area



Software:

- Authoring tools, Revit Architectural, Trelligence, Solibri Model Checker

3.2 Design Options

Description: The design team will develop design options in BIM supporting the project program requirements. The options will be modeled to support model analysis and BIM based reviews. Set-based design may be used for this process.

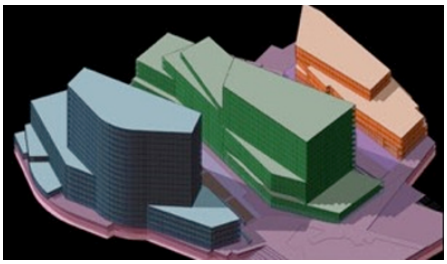
Responsibility: The design team will work with other disciplines to determine modeling level of effort for the design options. **Example:** If energy modeling is required for design options then team will provide a model that supports data for energy analysis. The BIMxP will document design option uses.

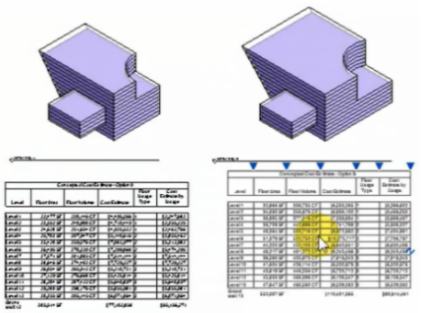
Model Requirements:

- **LOD 100** – Generic massings, approximate size, shape, location
- **LOD 200** – Modeled with floors, generic building envelop for analysis and calculations
- **LOD 300** – Generic but identifiable building elements, envelop, spaces, zoning for preliminary HVAC. Model integrated with site model for siting, sun-shadow (heliodon) analysis, square foot (m^2) calculations for costing

Deliverables: Structural discipline model, Clash avoidance between Architectural, Structural, and HVAC, Equipment lists, COBie data

Software: Revit MEP, Navisworks, Solibri, and other software, add-ons, and plug-ins as documented in the BIMxP





3.3 Model Checking Program Compliance (Checking)

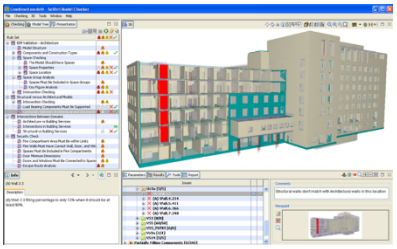
Description: Model Checking is a rules-based activity that automates model review for design program, modeling quality, data, and some code conformance. Ability to modify and write rules expands usefulness. **Examples:** Accessibility code conformance, egress path length, corridor width. **QA/QC** – Check for model quality. **Examples:** check door sizes, swing direction, door width; check that walls meet floors and ceilings; check that walls heal at corners; check that space entities defined in the BIM are properly bounded (i.e., do not "leak")

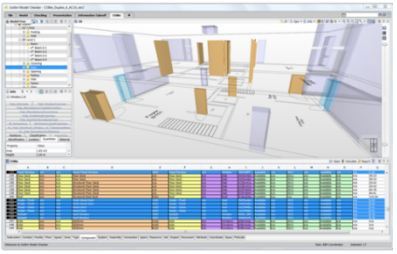
Responsibility: BIM Manager with design team input. Same process as clash avoidance. Select and configure rules to be run against the model.

Modeling: Integrated discipline models required to review for code compliance or design requirements.

Recommendation: Use model checking to determine that required data has been added to model elements. **Example:** Check that assignable spaces have a space number and/or name.

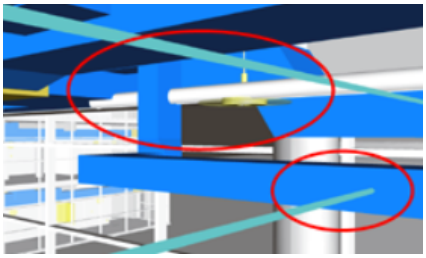
Software: Solibri Model Checker

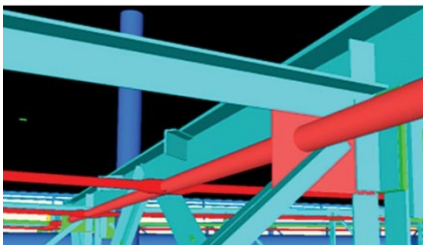




3.4 Clash Avoidance and Detection

Description: This is a required BIM Use. Note: The graphics in this section are available full size for download with the ***Clash Matrix Graph (2).wmv. The project PM will provide the materials or location on the MPA website.***
Clash Avoidance is a primary method to minimize interferences between building elements using "clash detection" software. Starting in design and continuing into construction, teams will regularly federate current models to identify any conflicts in geometry and provide a design resolution.



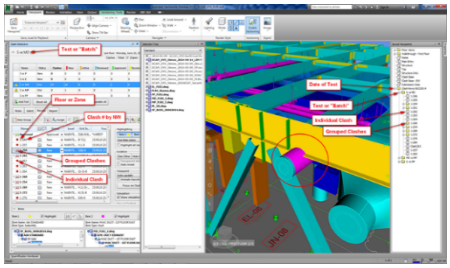


Responsibility: The Design Team BIM Manager will integrate the discipline models and check for interferences during design and prior to construction documentation. Clash detection software, visual walk thrus of the model, section and perspective captures, support review and conflict resolution. The BIM Manager will update the MPA Clash Detection Template and submit it to the project manager for review.

Deliverable: These conflicts will be cooperatively resolved in review meetings. What the conflicts are and how they are resolved is reported to MPA and the team using the ***MPA Clash Matrix Report template.*** The views

Software: Navisworks and Solibri Model Checker

The MPA Template
Clash Matrix Graph(2).wmv
The clash matrix template is an excel spreadsheet designed to standardize clash reporting to MPA.
The Clash Matrix has identified batches, colors, and reporting requirements.



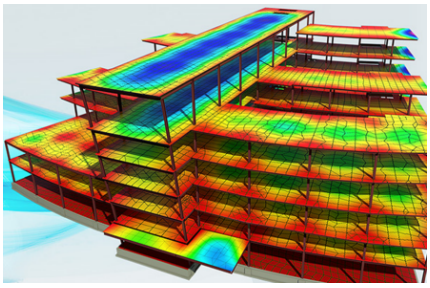
Example Batches

Arch vs PL	Struc vs PL
Arch vs EL	Struc vs EL
Arch vs MD	Struc vs MD
Arch vs MP	Struc vs MP
Arch vs FP	Struc vs FP
PL vs EL	Struc vs TD

The batches will be documented in the Clash Report Template.
Clash saved views will be provided in the following folder structure to MPA:
Date
→Discipline
→Floor
→Elements

3.5 Structural Analysis

Description: Model based analysis of structural design to determine fitness for use. Required structural analysis is to be documented in the BIMxP. BIMxP will document the software use and the projected outcome for the activity.



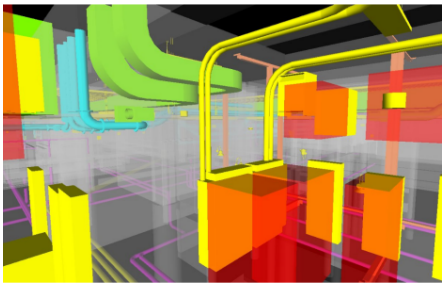
Responsibility: Structural Engineer, Structural model coordinator, Design team BIM Manager.

Deliverable: Structural analysis report and graphics for design reviews.

Software: Revit Structural, Web Add-in, plug-ins and other analysis software to be documented in the BIMxP.

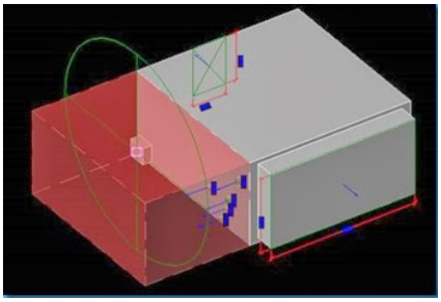
3.6 Equipment Maintenance Clearance Space Modeling

Description: Required for MEPF, this modeling covers major equipment and elements requiring defined access or maintenance space. Consideration should be given to typical maintenance cycles and continuity of operations so that adjacent equipment can be serviced at the same time. Consideration must be given to replacement paths and accessibility of large equipment.



A level of detail for equipment showing not only fit in spaces provided and shown in the design intent BIMs, but how it can be maneuvered into the designated spaces during building construction.

Responsibility: BIM discipline coordinators are responsible for elements in their models. The BIM Manager will review as part of clash avoidance. The visualizations and views of the model showing the maintenance space will be reviewed by the facilities team.



Note: These views may be saved to support the BIM use – Model for Maintenance Training.

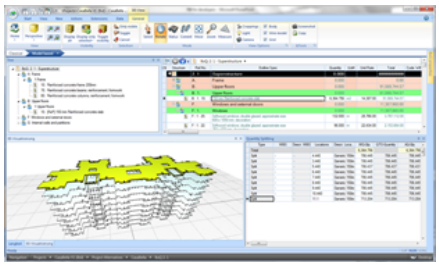
Modeled Elements: Model the access space as a transparent or translucent shape. **Example:** red cube in illustration. The color and applicable naming convention of the clearance space is to be documented in the BIMxP. The volume is not counted as a building element in QTO.

Deliverable: BIM based review with Massport Facility Management team for approval.

Software: Revit Suite, Navisworks.

3.7 Budgetary Costing Model (LOD-200)

Description: Budgetary Cost uses BIM spaces, major building elements with historic square foot costing data, project type, region, and construction type, to calculate budgetary estimates. Used as a decision basis in design options review and selection. Define milestones and LOD in BIMxP.



Responsibility: AE team, CM during pre-construction services with FM input.

Model Elements: Floors, walls, spaces, structure, roof, curtain wall and/or windows (building envelop), with specifications for parametric costing of partitions, lighting, ceiling grids, etc.

Data: Classify according to OmniClass and UniFormat systems. Define or identify historic cost data in BIMxP.

Deliverables: Periodic costing reports for design options.

Software: Revit Architecture, Microsoft Excel, VICO Office, online costing data, and other software documented in BIMxP.

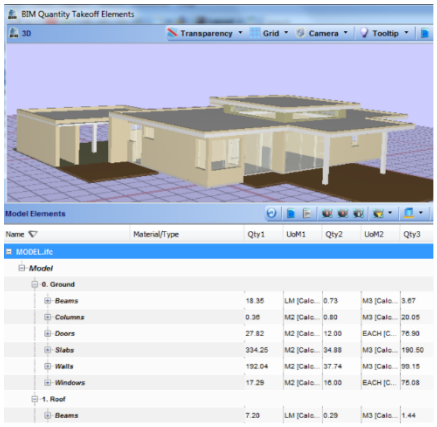


Image: VICO

3.8 Quantity Take Off (QTO) LOD 300

Description: As the model develops, a progressively more complete and detailed quantity take off can be reported from the model. Quantities are classified by building systems, OmniClass or UniFormat. Depending upon the BIM authoring software, classifying quantities by building system may require a custom parameter and appropriate values to be added to the BIM's entities, objects and/or elements.

QTO serves as the basis for estimating providing professional estimators with quantities used, rather than quantities purchased. Quantities must be derived from building objects, elements and symbols in the model. (The item count portion of QTO may also support MPA's commissioning effort. IFC quantity parameters and appropriate property set parameters may be supplied where model exchange uses IFC among different BIM authoring tools. Third party plug-ins that facilitate bi-directional IFC data exchange with *Revit MEP*, *Revit Architecture* and *Revit Structure* may be appropriate.

Responsibility: BIM Manager, Constructor, GC Estimator
Provide in "scheduled" format (grid or spreadsheet) quantity listings for windows, doors, fixtures, and finishes tied to corresponding spaces, categorized according to owner-preferred space categories. These additional OmniClass tables shall serve as a standardized QTO classification basis: Elements (Table 21), Products (Table 23)

For early design, estimators may have approximate or historical costs by *space function*. OmniClass Tables 13 and 14 should be used:

- Spaces by Form (Table 14), Spaces by Function (Table 13)

Software: Revit Suite, VICO Office, Innovaya, BuildingExplorer, Navisworks

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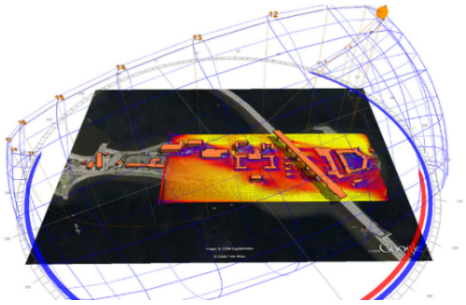
4 Sustainability, Energy, LEED Design and Analysis

MPA requires BIM analysis to help achieve sustainable, resilience, and energy efficient designs on its projects.

4.1 Energy Modeling, Daylight and Sun Studies



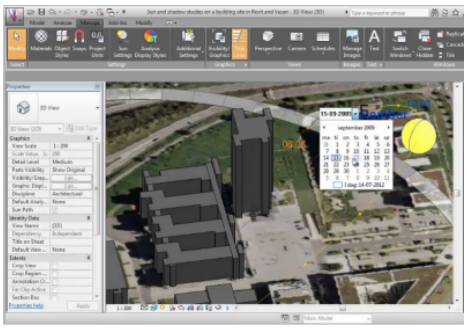
Description: In this Use Case, the BIM is analyzed to improve day lighting in design, to understand sun shading needs and the balance between daylight and artificial lights to support space usefulness. Energy simulation, solar load analysis, daylight feasibility, sun and shadow studies, and thermal break representations are based on materials and other BIM data including geometry. In early design, these studies may be done simultaneously to support design options for interior visual comfort and task needs, window placement, direct sun and passive solar analysis in building placement, sun-shading features, and on site shadow studies for site impact. The BIM is also used to quantify daylight luminance levels to support the documentation of the LEED *IEQc8.1: Daylight and Views – Daylight*.

Space Airflow Schedule

Number	Name	Calculated Supply Airflow	Actual Supply Airflow	Airflow Delta
System Type	Type	Mark	Flow	
115	Instruction	1457 CFM	1470 CFM	13 CFM
Supply Air	24x24 - 8 Neck	SD 1-12-109	360 CFM	
Supply Air	24x24 - 8 Neck	SD 1-12-110	450 CFM	
Supply Air	24x24 - 8 Neck	SD 1-12-111	330 CFM	
Supply Air	24x24 - 8 Neck	SD 1-12-112	330 CFM	
116	Conference	580 CFM	0 CFM	-580 CFM
117	Instruction	523 CFM	0 CFM	-523 CFM
118	Electrical	45 CFM	0 CFM	-45 CFM
119	Sprinkler Main	57 CFM	0 CFM	-57 CFM

The BIMxP will specify whether AHRAE 140-2007 and/or ASHRAE 90.1-2007 (LEED Energy) standards are to be met.

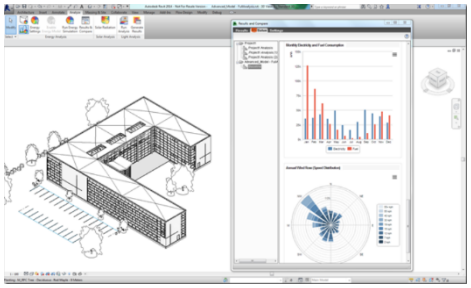
If BIM is not used, then the rationale, process and software used shall be documented in the BIMxP.



Responsibility: Architecture team, mechanical engineer

Modeling Elements: (see reference documents)
The models shall be created to an LOD and quality required to perform an energy analysis for the phase and decision requirements of the project, per the BIM authoring software requirements and recommendations.

Design Teams shall utilize energy modeling and sustainable design software that extracts BIM data to the appropriate file format for the analysis tool.

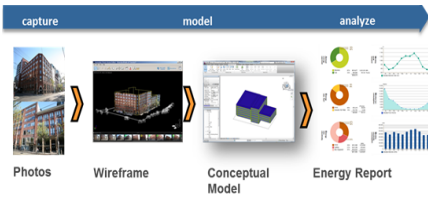


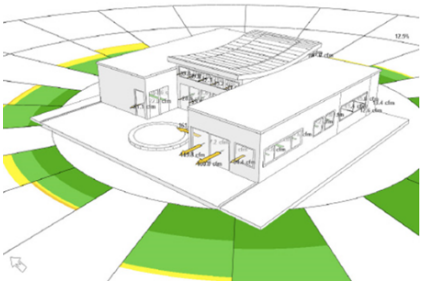
Deliverable: Calculations, data and visualization of study analysis to be used in BIM based reviews, and design option activities.

Software: Concept design – Green Building Studio Energy Analysis, Ecotect, and Vasari, EcoDesigner STAR, and energy analysis tools based upon Energy Plus-DOE 2, IES.

References:
http://sustainabilityworkshop.autodesk.com/buildings/daylight-analysis bim#sthash.ALTF0xfQ.dpuf
Daylighting 3 http://energy.gov/building3design
EcoDesigner STAR
http://www.graphisoft.com/archicad/archicad_17/energy_evaluation
http://www.graphisoft.com/archicad/ecodesigner_star/

4.2 Existing Buildings - Rapid Energy Modeling





Description: Rapid Energy Modeling (REM) is a streamlined process for simplified simulation that quickly and with minimal data from existing building conditions develops an energy analysis. Additional process information required will include location, orientation, building geometry, and internal systems. Material assignments and space representations must be executed in accordance with BIM authoring software requirements and recommendations. Optimizing a building's performance requires incorporating all those variables into design and operations along with weather data and building science. BIM authoring software that support rapid energy modeling will indicate approximations and "slack" as is appropriate to early design and lower levels of model development while still permitting energy modeling results useful to Massport.

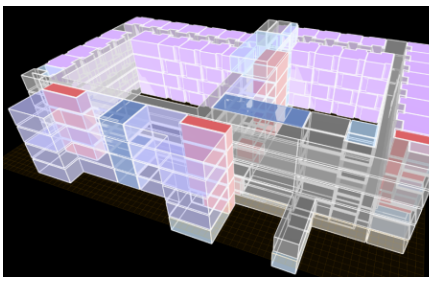
Software: Sketch-up Energy Modeler – Sefaira, Autodesk Revit, IES

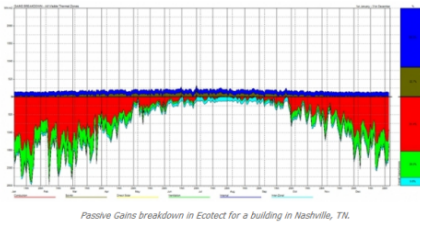
References:
http://images.autodesk.com/adsk/files/rem_white_paper_2011.pdf
http://www.graphisoft.com/archicad/archicad_17/energy_evaluation
http://www.graphisoft.com/archicad/ecodesigner_star/

4.3 Mechanical Analysis

Space Airflow Schedule

Number	Name	Calculated Supply Airflow	Actual Supply Airflow	Airflow Det
System Type	Type	Mark	Flow	
115	Instruction	1457 CFM	1470 CFM	13 CFM
Supply Air	24x24 - 8 Neck	SD 1-12-109	360 CFM	
Supply Air	24x24 - 8 Neck	SD 1-12-110	450 CFM	
Supply Air	24x24 - 8 Neck	SD 1-12-111	330 CFM	
Supply Air	24x24 - 8 Neck	SD 1-12-112	330 CFM	
116	Conference	580 CFM	0 CFM	-580 CFM
117	Instruction	523 CFM	0 CFM	-523 CFM
118	Electrical	45 CFM	0 CFM	-45 CFM
119	Sprinkler Main	57 CFM	0 CFM	-57 CFM





Passive Gains breakdown in Ecotect for a building in Nashville, TN.

Description: Virtual testing and balancing of the design model to support sustainable building systems design and analysis, calculate native heating and cooling analysis that is built into the MEP software or exported using gbXML to an external analysis application such as eQuest, Trane/Trace, or DOE or EnergyPlus based analysis programs.

Responsibility: Mechanical Engineer

Model Elements: Room data can be read from the linked architectural model to create mechanical spaces (each space is the same as the room in the architectural model). Multiple spaces are joined to create zones. This data can be used to calculate native heating and cooling analysis that is built into the MEP software or exported using gbXML to an external analysis application such as eQuest, Trane/Trace, or DOE based analysis programs.
All airflows can be checked for load balance to the terminal box and back to the air-handling units. When internal spaces are defined, they shall be modeled with internal environment parameters for early MEP design.

Software: The software (eQuest, Trane/Trace, or DOE based analysis programs) used for this activity shall be identified in the BIMxP, IES.

References: Teams should check with MEP modeling software developers for additional information.

4.4 LEED Credit Certification Reporting

Description: This Use Case relies on specs and BIM to identify, quantify, and cross-reference materials supporting LEED credits. LEED credits for design will be identified in the BIMxP.

Responsibility: Architecture team, LEED specifier, and others, based upon LEED credits

Model Elements: Determine based upon LEED category and credits.

- Recycled percentage of materials for building elements (MR Credit 4.1)
- Calculations for roof pitch and rainfall
- Material location

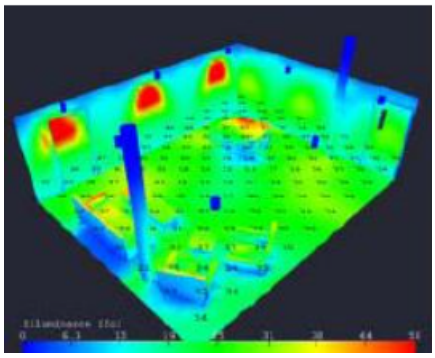
Leadership in Energy and Environmental Design (LEED) evaluates green building criteria in five major categories: site design, indoor environmental quality, and the efficient use of energy, materials, and water.

Deliverables: Deliverables will include images, documentation, and reports as evidence of conformance for LEED certification

Software: Revit Architecture, Energy software – EcoDesigner STAR, E-Specs, Ecotect, GBStudio, IES

http://bimcurriculum.autodesk.com/unit/unit-6-%E2%80%93-leed-and-sustainable-practices

4.5 Lighting Analysis



Description: This Use Case has two objectives: LEED compliance and energy performance and comfort. It relies on specs and BIM to identify and cross-reference materials and performance supporting LEED credits. LEED credits for design will be identified in the BIMxP.

Analysis also supports review for lighting comfort levels and usefulness.

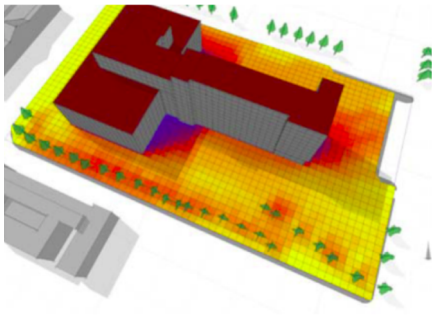
Responsibility: Architecture team, specifier, and others, based upon LEED credits

Model Elements: Determined, based upon analysis use and LEED credits.

Deliverables: Deliverables will include images, documentation, and reports as evidence of conformance for LEED certification

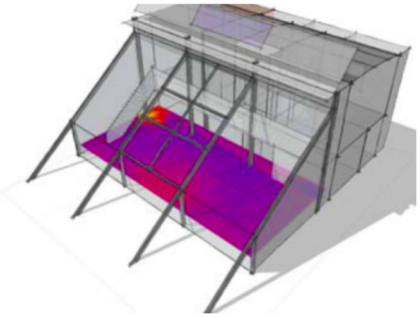
Software: Revit Architecture, Energy software such as EcoDesigner STAR, E-specs, Ecotect, GBStudio, IES Data requirements are software analysis specific.

4.6 Systems Analysis (Retrofitting)



Description: BIM is used to capture the building geometry and characteristics needed to conduct aspects of energy performance analysis and support contracting processes. Use BIM to assess building performance, prioritize investments, and evaluate proposals to help reduce operational costs, conserve energy, reduce water consumption, and improve building air quality. The goal is to increase building performance and minimize energy consumption, water and wastewater infrastructure demands, improve air quality, and create a smaller overall carbon footprint.

Responsibility: The design and engineering team will continually monitor the progress from performance specification to design alternatives, identification of final solution and procurement to assure that the system installed meets the performance specifications and desired solution.



Model Elements:

- Building shell with energy data used in analysis and options modeling

Deliverables: A series of analysis reports identifying the options and the optimum solution for energy reduction. BIM model to be used as a basis of project execution and documentation.

Software: Revit Architecture, Green Building Studio, EnergyPlus, Ecotect, IES,EcoDesigner

Resource: bim_retrofit_and_building_analysis.pdf

5 Design, Constructability Reviews and Coordination

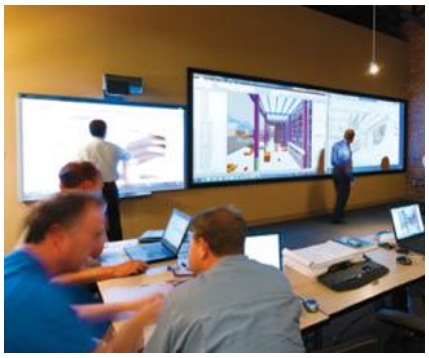
BIM efficiencies can be maintained or lost during construction handover. MPA requires the design and construction teams to work in a Lean manner to maximize BIM use, communication, and coordination. The following BIM Uses support this project phase.

5.1 BIM Based Reviews "Big Room"– Project Lifecycle

Description: The purpose of these reviews is to minimize misinformation between team members, to reduce paper-based communication, and to focus attention on design decisions at hand. The design or constructor team will utilize live model manipulation, saved views, and other electronic graphics to support problem solving and decision support.

Model Manipulation and Visualization: There should be a "designated driver" available for meetings. This person should be familiar with BIM presentations, and is responsible for setting up the model and saved views prior to the meeting.

Photorealistic and texture mapped model views are not required unless necessary for specific reviews. A working level of flat shade and shadow from BIM authoring tools is typically used.

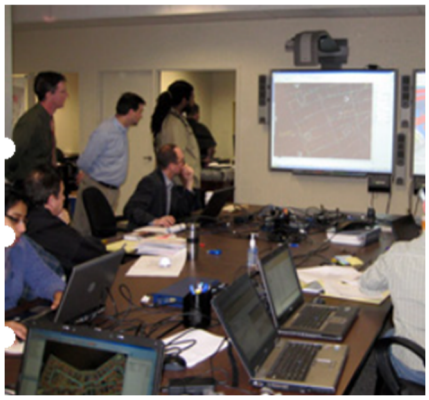


BIG-Room –The current prime on a project is responsible for BIG Room set-up. The BIG-Room location(s) and responsibility during the phases will be identified in the BIMxP. Massport will make available a conference room and single projection capability on an agreed upon schedule. MPA may provide a space near the construction site for these meetings on a project-by-project basis. The constructor will be responsible for equipment and space for BIM in field use.

- **Tablets** supporting model use and review for field inspections and walkthroughs will be provided by the contractor.
- **Web Meetings, software, and procedures** will be organized and tested by the BIM Managers as part of project set-up.

Access to BIM Server

- Instructions, security access, and training for Massport PM and other stakeholders needing access to the model will be provided by the BIM Manager team.



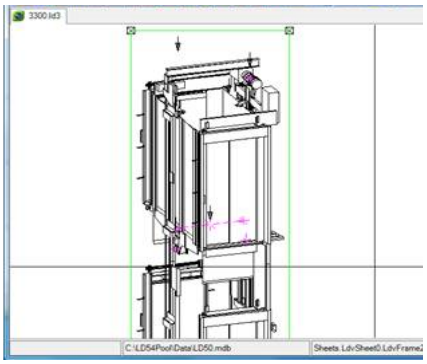
Responsibility: AE, CM/GC, and sub-trades – BIM Managers and Coordinators

Deliverables: Design Coordination Reviews, Constructability Reviews, Shop Drawings, Construction Documents, Energy and Performance Reviews, Change Management Reports, Cost Estimates, Value Analysis Reports, and others as defined in BIMxP.

Software: Navisworks, VEO, Vico Office, Tekla, BIMsite, BIM360 or others as specified in the BIMxP

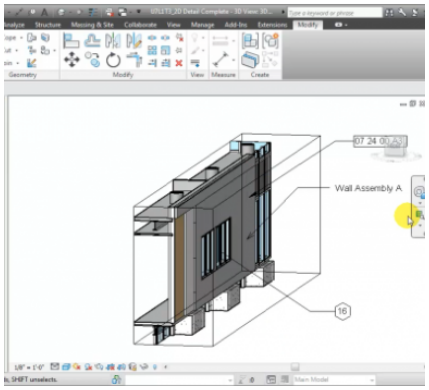
5.2 Digital Detail & Mock-Ups

Description: It is cost effective for the project, and improves the discussion and understanding of construction for the design team to create digital mock-ups of elements in the project that are unique, require complete stakeholder understanding, or team consideration, for constructability meetings and value engineering. Massport supports the inclusion of 3D views and details in construction documents to support field understanding of the project.



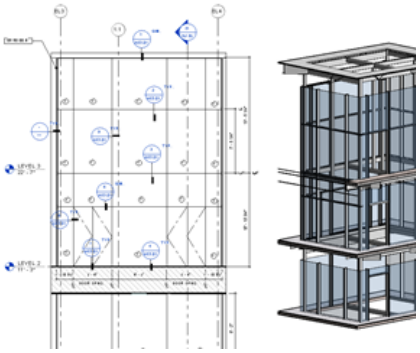
Responsibility: The design team with Massport and the CM will determine when digital mock-ups are in the interest of the project. These will be documented in the BIMxP. It may be appropriate for trade sub-contractors to work with the CM, Constructor, and A/E to create the digital mock-ups as part of the shop drawing process. This will be documented in the BIMxP.

The BIM Manager will be responsible for the integration of any digital mock-ups into the integrated models for construction drawings



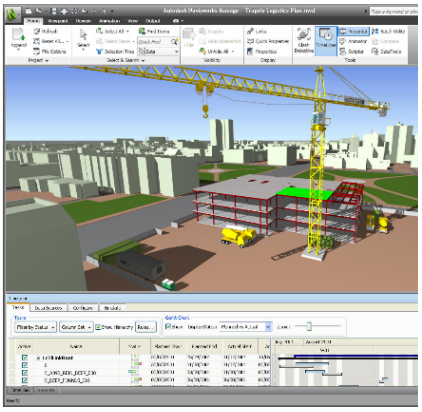
Model Elements: Some specific design elements that benefit from digital mock-ups are facades including curtain wall assemblies, parapets, shading, solar devices, mechanical spaces, shafts and elevators, material and building element interfaces and connections, way finding signage, and blind spot identification.

Deliverables: Images, views, sub-models, integrated model sections, per the mock-up creation and views to be integrated into construction drawings as appropriate will constitute deliverables for this Use Case. CAD details are to be incorporated into the permitted construction set, and models are to include sufficient details as they relate to trade coordination and model-based shop drawings.



Software: Revit, MEP software, AutoCAD, Revit, Tekla, other applications identified in the BIMxP

5.3 Scheduling - 4D BIM for Project Schedule, Phasing



Description: Construction coordination model supporting Look-Ahead, construction phasing, construction material movement, labor sequencing, site planning for material delivery, loading/unloading, staging, and storage. Supports team communication, conflict resolution, training, and schedule compliance.

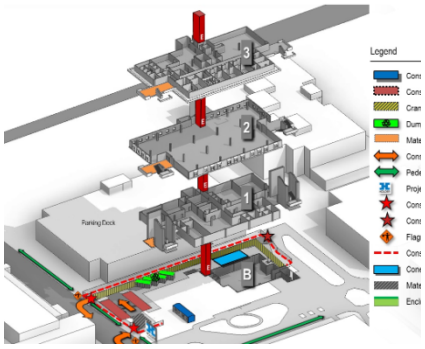
Responsibility: CM/GC, Scheduler, Construction BIM Manager

Recommended Elements for 3D Details: All project models as they relate to the trade planned scope of work. Site area required for material staging. Equipment as needed to show sequencing. (See list provided in BIM Use 5.4)

Deliverables: Updated 4D models as the project progresses, with updating, reporting, and delivery as set in BIMxP

Software: Synchro, Navisworks, Timeliner, Vico Control, VEO

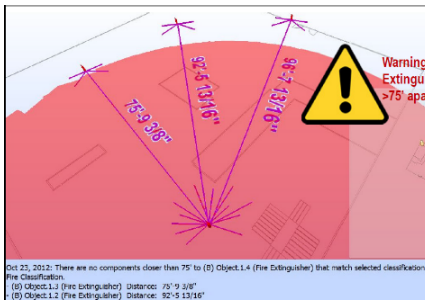
5.4 Site Safety Review



Description: Integrating the project site logistics, materials and equipment use, vehicles, with load and delivery planning schedule data with BIM provides a means to see, prevent, and resolve conflicts. This information is easier to communicate In BIM. The model can be used for approvals, reviews, and safety training.

Responsibility: CM/GC, Scheduler, Construction BIM Manager

Recommended Elements for Model: Modeled elements for this Use Case include the site, temporary access roads, adjacent roads, building shell(s), cranes, trucks, materials storage areas, staging areas, necessary clearances/access, vehicular traffic and pedestrian flows, protected/off limit areas, protection measures, and adjacency restrictions.

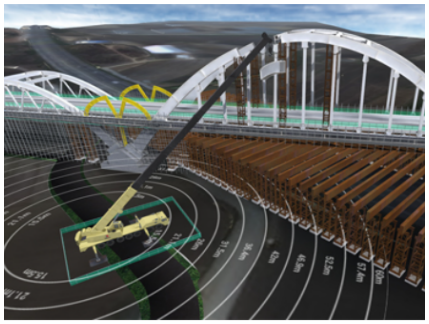


- Landmarks including Fence, Sheds/ scaffolds, Hoist, Crane, Foundation/ Excavation, Transit, etc.
- Site in question, Lot lines / site boundary lines & Adjacent Building within 20 feet of the lot line.
- Adjoining building exits to the street and any common yards within 20 feet of the building under construction
- Cross street – if applicable
- Sidewalks - provide widths of all roadways and number of lanes, sidewalks
- Lot dimensions / metes and bounds
- Vehicular traffic flow on and off the site
- Guard booth /watch person calculations
- Temporary walkways
- Show the site enclosed with a construction fence if one is required
- Truck and personnel gates
- Fire department access
- True North indicated
- Submittal elevations based on building's ground floor, not sea level
- Hole coverage/protection
- Location of ramp with means of egress for the works

- All structures on the site
- Show protection of pedestrians, egress a n d adjoining property
- Storage of Materials
- Temp electrical and water, sanitary facilities
- Chutes
- Watch person & Flag persons types of barriers & controlled access
- Crane location and maximum / minimum radius of the boom & the radius of the counter weight. If a tower crane is used, provide weathervane radius.
- Standpipe
- Containers
- Sidewalk shed if required
- Show all existing services (i.e. waste, gas, electric, sewer, signs, HYD, lights, Muni-meters) Fire hydrant and cutouts at construction fence
- Signs, signage for the gate scaffolding and sidewalk sheds
- Siamese and manual release value with details

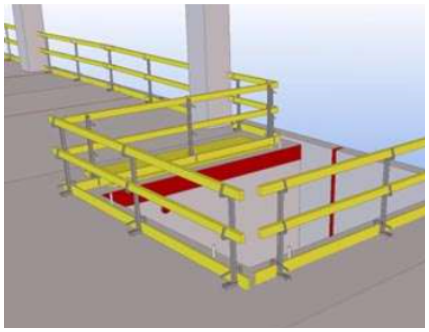
Construction:

- Height of building and setbacks, if any, for adjoining buildings and their setbacks, if any, within 20 feet of the lot line, in feet and stories.
- Adjoining Property Protection
- Extent, sequence and means of demolition.
- All Bracing and Shoring necessary
- Horizontal safety on floors
- Vertical Safety on floors
- Types of roof protection
- Typical Adjacent Window Protection
- Show protection at all foundation exposures with railings and fences
- Show pads for cranes, elevator pits, and hoists



Excavation / Foundation

- All excavation must have ramps with a ratio of 1:4 to be used as egress: show second means of egress for workers
- Show protection of utility poles, trees, etc.
- Show gates with flagmen at each side and project signage.
- Show protection at all excavations, including railing and fencing



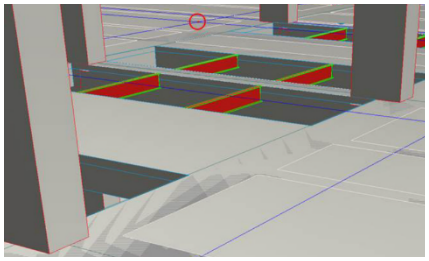
Deliverables: Site views, animations, sequences, PDF logistics plans as the project progresses, 4D site logistics model, delivery schedules, schedule updates

Software: Synchro, Navisworks Timeliner, Vico Control or other as specified in BIMxP.

5.5 In Field Construction Lay-Out

Description: BIM is used as a basis for laser guided field layout of walls and building elements. BIM supports better construction layout. As components are *fabricated to the model*, it is imperative that the *layout be per the model* to avoid field construction issues. Survey or layout points are taken from the model and loaded into robotic total stations for layout.
Conversely, survey/layout points are captured in the field during construction and round-tripped back to the model for proactive validation/quality control. When this workflow is closely followed, the BIM is self-documenting and constitutes a sound basis for the As-built (Record) BIM.

***NOTE:** to enable correct layout/verification, the team must keep the federated BIM accurate, complete, and up to date. Dimensions must remain associated.*



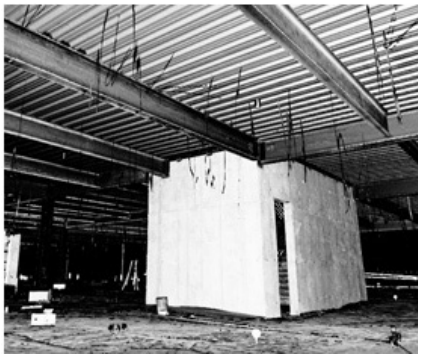
Responsibility: CM, Constructor and sub-trades. The BIM Manager must keep the model federated while the GC BIM Manager provides model updates. It is the responsibility of the architecture and structural team to model to tolerances supporting BIM based field layout.

Recommended Elements: Project features that must be modeled to support this Use Case include excavation and grading, foundations and vertical concrete (formwork, anchor bolts, penetrations), structural, embeds, MEP system distribution anchorage, wall layout, penetrations, stairs, exterior envelope, equipment anchorage, flatwork, site utilities.

Deliverables: XYZ survey/layout point files for exchange

Software: AutoCAD, AutoCAD Civil 3D, Tekla, specified in BIMxP.

5.6 Laser Scanning – Construction Phase



Description: 3D laser scanning performed during construction captures as-built work. This aids the team in change management, captures newly built conditions prior to being covered and closed to view, and later will aid facilities operations in reliably locating systems components with high degree of accuracy. Laser scans may also provide detailed information for subsequent renovations.
Coordination for Survey Points: Coordination between the MPA Survey department, the laser scanning team, and the BIM Manager is necessary to determine the use of existing or the positioning of new survey points per MPA requirements.

Responsibility: Responsibility may be shared by the CM, Constructor, or the MPA survey team, and may be performed under subcontract to a third party specialist.

Recommended Elements: Prior to closing walls and ceilings, in-wall and interstitial spaces can be captured along with major MEP equipment locations and paths. **Site:** exposed existing utilities, new hook-ups and new utilities.

Deliverables: Registered/rotated/elevated 3D point clouds conforming to the defined coordinate system as determined in the BIMxP. Organization of point clouds will be determined based on overall aggregated file size and capability of team to handle such files, similar to how BIM content is aggregated or broken up for use by the project team and owner during the facility lifecycle.

Software: Faro Scene, Leica Cyclone, Trimble Realworks

5.7 Pre-Fabrication of Building Components

Description: This BIM Use Case includes modeling the proposed building components with a focus on visualizing and simulating the logistics of their placement in a *new* or *existing* building, as well as the logistics of maintenance, repair and eventual replacement *in situ.* This Use Case goes beyond fabrication and shop drawing coordination.

The building industry is trending toward prefabrication of ever larger and more complex building components in order to exercise rigorous quality control over the finished product, to eliminate weather related delays, to make use of semi-stationary fabrication equipment that cannot be brought to a building site, and to reduce costs. This Use Case includes simulations of onsite placement and maneuverability, and visualizations to support decisions as to how best to modularize and maximize pre-fabricated building components.

Responsibility: Constructor, CM, sub-contractors, manufacturers.

Deliverables: Schematics and animation sequences of prefabricated building components being transported, placed onsite, and installed.

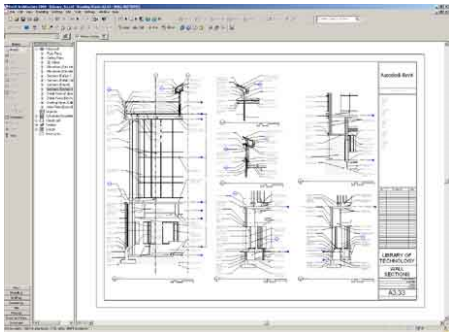
Software: Revit Software Suite and other specialty software as required per BIMxP.

6 Documentation, Drawings, and Specs

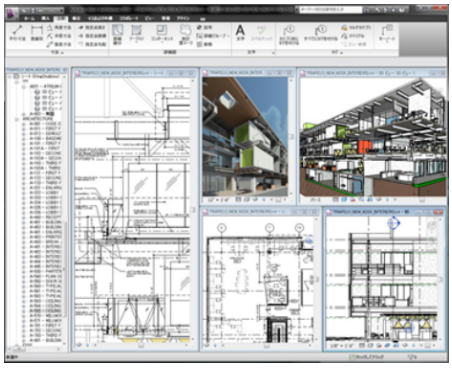
It is an MPA requirement that drawings and construction sets are derived from the model. The following BIM Uses support BIM use for more coordinated documentation during design and for record models at project turnover.

6.1 Construction Drawing Production

Description: 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 of construction document views. The documents so generated include plans, exterior elevations, interior elevations, sections, and reflected ceiling plans. Schedules and legends generated from the model will be as sound as the inputted data. 3D detailing and color-coding are enhancements that improve communication.



2D Details: Details derived from the model are better coordinated than generic 2D details created in the traditional way by documenting a mental visualization effort. Whenever possible, the details shall use the model as a basis for detail drawings. 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 alone, in particular, the relationships among sections and elevations.



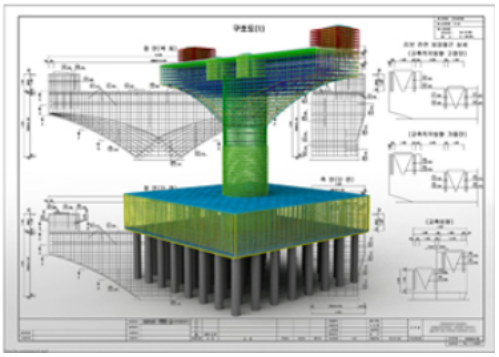
CD Generation: Construction Documents (CDs) are not the driver of the BIM process, but rather a required output at the end of the design process. The final CD set should be developed from a model that has gone through the various review processes and quality control checks. These include visual checking by the modelers, clash detection by the design team and CM, and model checking for quality in a model-checking program.

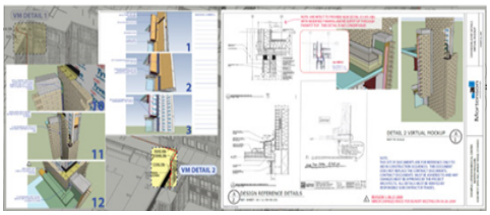
Responsibility: A/E, Discipline Model Coordinators, sub-trades for shop drawings, specifier, and other model authors.

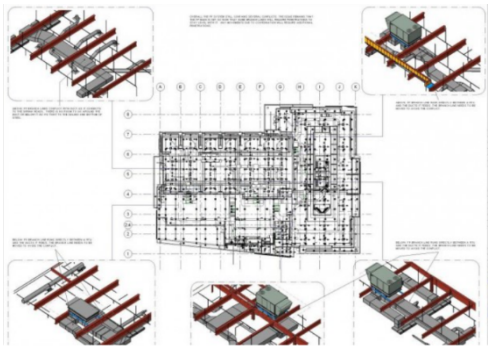
Deliverables: Deliverables per MPA Drawing and Publishing requirements in the BIM Guidelines

Software: BIM Authoring and discipline tools, Revit Suite, and other tools identified in the BIMxP

6.2 Shop Drawing Coordination







Description: Detailed shop drawings for fabrication and construction are derived from the discipline specific design intent model. Coordination among the federated models produced by the A/E, constructor, and the job shop fabricator is required. Shop drawing coordination is at a fine level of detail. Moreover, shop drawings are governed and guided by equipment and tooling that is available to fabricate the items represented in the BIM, its shop models, and their derived drawings. These shop drawings must be consistent with one another (fully coordinated) and frequently carry or imply sequencing, forming, folding, and attachment, fit and finish information. 3D views should be incorporated into the shop drawings for better communication.

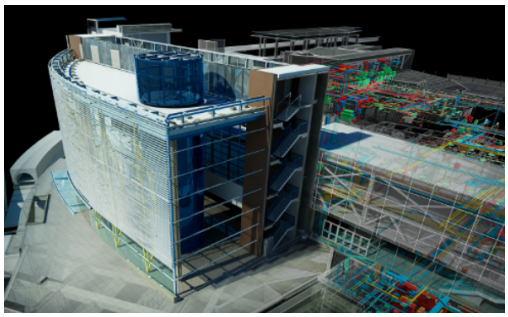
Responsibility: Constructor BIM Manager and sub-contracted shop fabricators.

Deliverables: Shop drawings may be supplanted by a "shop model," from which G-code can be generated to control machines that cut, place, fold, bend, weld, and otherwise create building elements, components, and parts according to the design intent model. On projects where this level of workflow automation is, not employed, standard shop drawings must still flow from a shop model that is derived from the BIM and supplemented by 3D views.

Software: Suitable software for transforming design intent models into appropriately detailed shop models is required.

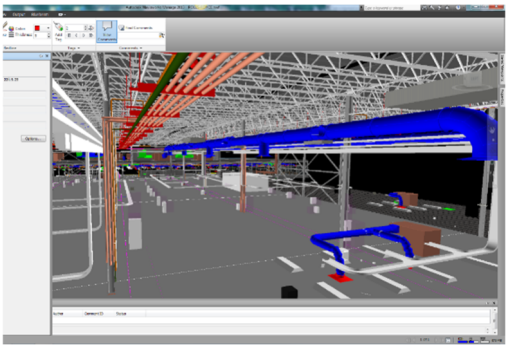
6.3 As-Built Models

Description for As-Built Model: This Navisworks file incorporating shop models and drawings and as-built conditions is more detailed than the record (.rvt) model. Ex. The as built would show hanger locations, the record model may not. This model may be used during construction in the field using mobile BIM software.



Responsibility: The Constructor's BIM Manager, Design BIM Manager, Commissioning Agent, and the DTIG BIM Manager

Deliverables: Deliverables include the Navisworks file; data is represented in the BIM, and systems and equipment test specifications and test results. Some of these test specifications and/or test results may be linked to graphic BIM elements, while others may be in the form of standard Commissioning documents external to the BIM. The BIMxP (Section 5. Model Element Worksheet) in coordination with the commissioning agent's contract will specify which information is found where.

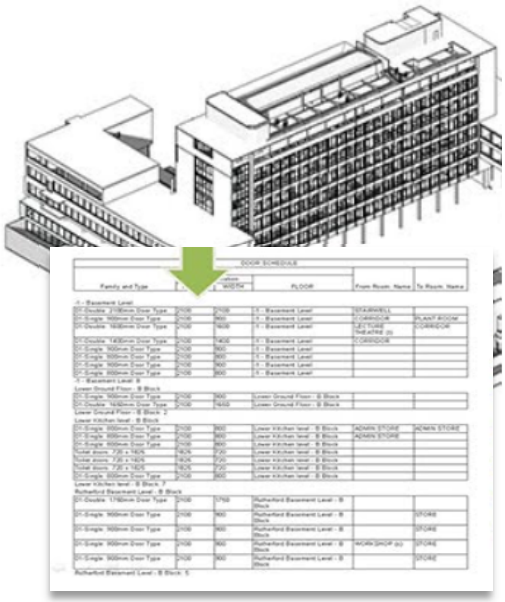


Commissioning of the BIM itself may be required according to specifications found in the BIMxP. If so, then documents listing all software and associated add-ons, add-ins, plug-ins, stock and custom object libraries, and other application-supporting modules that have been used in producing the BIM, shall be provided with specific version and software "build" numbers. Furthermore, if the BIM itself is to be commissioned, then the report produced by a final model-checking run at the point of handover shall be submitted. The BIMxP in coordination with the commissioning agent's contract will specify the aspects of the BIM to be checked in terms of rules and rule sets so the results are fact-based, repeatable, verifiable, and documented.

Software: BIM authoring software, external but linked databases, Navisworks. EcoDomus and Solibri Model Checker may be used to support review prior to handover.

6.4 Data Normalization

Description: The BIM Managers, the MPA BIM Manager and the commissioning agent will supervise the creation and review of MPA required information.



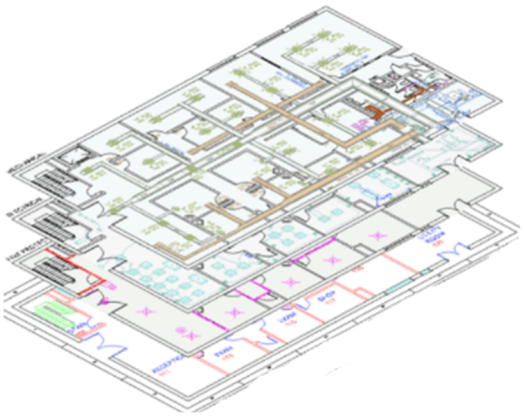
The basic data standards include:
OmniClass Table 13, UniFormat, MasterFormat, and the MPA data fields required in commissioning. COBie data may also be required.
If COBie data is delivered, the model must be developed to support COBie spreadsheet export.

Responsibility: Design BIM Manager, Constructor's BIM Manager, Commissioning agent, MPA project manager.

Deliverables: BIM Record model with normalized data following the MPA standards.

6.5 As-Built CAD Drawings – Floor Plans

Description: MPA may require As-Built CAD drawings of all floor plans from the Record Model. These drawings will be used by MPA to be integrated with the CMMS and leasing applications used by MPA. MPA BIM Manager will provide the AutoCAD version for saving the files.



Responsibility: The constructor BIM Manager is responsible with the design team for developing the As-Built information. The saved CAD files from the model is the responsibility of this documentation team. It is to be documented in the BIMxP.

Model Elements:
The CAD files will show traditional building elements for floor plans.

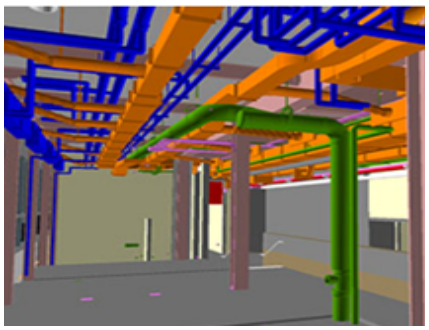
- Wall, doors, and window elements, stairs, core, elevators
- Major equipment and data
- Areas and room spaces with identifying data
    - Room name and number
    - OmniClass functional use
        - Public and secure spaces
        - Leased and tenant spaces
    - Measurement

Deliverables: All updated floor plans with data for each space and major equipment. Verified column grid and survey points.

7 Commissioning and Handover

7.1 Virtual Handover (Record Model)

Description: This is the design intent (.rvt) model, updated with as-built locations for building elements within the model. This updated model is submitted to MPA and reviewed for product data requirements, model versioning, and integration into the MPA environment. Upon substantial completion, the design team should finalize this record model for handoff to MPA as part of the commissioning process.

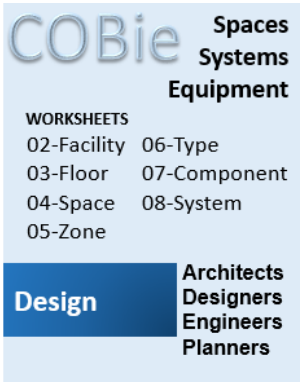


Commissioning of the BIM itself may be required according to specifications found in the BIMxP. If so, then documents listing all software and associated add-ons, add-ins, plug-ins, stock and custom object libraries, and other application-supporting modules that have been used in producing the BIM, shall be provided with specific version and software "build" numbers. Furthermore, if the BIM itself is to be commissioned, then the report produced by a final model-checking run at the point of handover shall be submitted. The BIMxP in coordination with the commissioning agent's contract will specify the aspects of the BIM to be checked in terms of rules and rule sets so the results are fact-based, repeatable, verifiable, and documented.

Responsibility: The design and constructor BIM Managers will work together to assure that the record model contains the necessary building element updates, product, space, and FM data. The model links should be unbroken.

7.2 COBie Data Set

Note: If COBie is not required on the project, the team should use the MPA Equipment Naming Conventions spreadsheet (See Commissioning BIM Use).



Description: COBie (Construction Operations Building Information Exchange) is a vendor-neutral flexible data specification that indicates how to format design and construction data so it can be consumed by other facility software. COBie data includes information necessary to building operation. Much can be integrated into BIM. COBie provides an extensible framework that describes both the process of collecting and validating data, and the dataset that contains required data. Commissioning procedures use some of the same data as COBie, as input to or the basis of performance and compliance testing. The spreadsheet is only one *view* of COBie data. The spreadsheet view of COBie data can flexibly be expanded or streamlined as necessary to meet Massport's requirements.

Available files:

- The Massport Revit template file may be used to support the COBie BIM Use by directly extracting COBie data from the Revit file.
- Third party software may extract COBie data from an IFC BIM exported from Revit.

Responsibility:

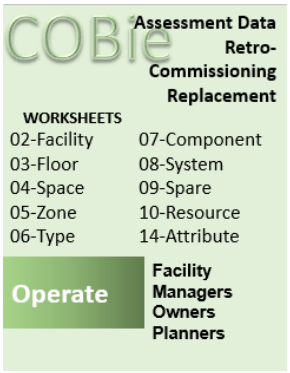
Project Set-Up: The COBie implementation process should begin before an experienced AE team starts project modeling. As part of the project set-up, Massport, the team, and the BIM Manager need to determine a clear set of requirements for the modelers in

order to reduce the amount of downstream rework (waste) in the project lifecycle. Beginning with the end in mind, the BIM will be structured to carry the required data.

- The Massport team shall review the project scope of work to determine the COBie data to be collected. This will be based upon Massport's need for data to operate the facility, not primarily on modeling convenience.
- The A/E BIM Manager will work with the Massport DTIG BIM Manager to update the Revit template for the project
- The required data will be found in the BIMxP.

Data requirements:

- **Object Attributes** (metadata) for Type, Component, System, Space, Facility, Floor
- **OmniClass Use:** Massport is transitioning to OmniClass. OmniClass will be used in BIM: *Table 13 – Spaces by Function* (locations) and UniFormat.



- **Naming Conventions:** MPAClassifications_for_Maximo_Assets2014.xlsb
- **Documentation Categories** for Type, Component, System, Space, Facility, Floor the COBie framework requires that delivered documents are attached (linked) to asset types, components, systems, etc. The documents required for a specific equipment category can be defined by using OmniClass. **Example:** the documents required for a chiller (23-33 21 00) are Product Datasheet, Photograph, Test Report, Warranty Information, O&M Manual, EHS Information, Spare Parts and Supply List (and possibly others). **Example:** A lighting fixture (23-35 47 00) only needs Product Datasheet, Photograph, Spare Parts and Supply List. In both examples, COBie is flexible enough to allow additional or fewer document types to be associated to a specific asset type according to Massport's needs. It is recommended to keep the defaults.
- Most of current online project management systems allow collecting documentation and linking it to equipment records. Owners can also use specialized software applications to verify the availability of the documents provided by the project team.
- **Data Collection Rules:** As part of project scheduling look-ahead, the team will identify milestones and the requirements for each milestone

Design Phase:

1. Facility and Floors are defined
2. Spaces should be classified using OmniClass and Net Area is provided (Gross Area is generated by the BIM authoring application)
3. Zones should have Categories assigned
4. Types should have Name, Category (OmniClass), Description, AssetType
5. Components should have Name, Description, Type and Space
6. Systems should have Name, Category (OmniClass), Components

Construction Phase:

1. Type information is updated by providing Manufacturer, Model Number, Warranty information (Parts and Labor and Duration), Replacement Cost
2. Component information is updated by providing Serial Number, Installation Date, Warranty Start Date, and optionally Tag Number or Barcode. Installation Date for major equipment will be the Finish Date of the corresponding schedule activity.

3. Spare parts are provided for Types
4. Attributes are provided for Types and Components

Commissioning Phase & Handover:

1. Test reports and other documents are assigned (uploaded) to corresponding BIM objects (Types, Components, Spaces, Facility)
2. Attribute values are corrected based on real measurements

There are off-the-shelf software tools that allow verifying that data is provided correctly at the specific milestone.

System Nomenclature

Use a combination of the industry standard nomenclature OmniClass *Table 21 – Elements*, the U.S. National CAD Standards (NCS) 3.1 Module 5, NBIMS, and other standards to name systems as illustrated below.

Example: Supply Air System for Air Handling Unit (AHU) D-1 = OmniClass *Table 21* 21-04 30 60 10 Air Supply + Discipline (Mechanical) + AHU + Description "D1" = AHU-DI = System Name (Mechanical Supply Air AHU-D1)

For systems that are not directly connected to a piece of equipment, follow this convention: **Example: Return Air RG-1 2nd Floor 214A Office**
Industry Discipline – OmniClass *Table 21* + Equipment Operation Description (as above) + Floor and Massport Room Name and Numbering Convention (OmniClass *Table 13* + Room Numbering Protocol in Referenced Standards)

Zone Nomenclature
Use a combination of various standards to name zones as illustrated below:
Example- HVAC Zone associated with VAV Box D01 serving offices 100-101-102

NCS 3.1 Module 5 – Abbreviation for Air Handling Unit- VAV – Description denoting size/type easily identified "D01", + Massport Room Names and Numbers contained in the zone 99, 100, 101 = **ZONE NAME** – VAV-D01 Offices 99, 100, 101

Available files:

- Excel file for basic required attributes
- Another source of information for object attributes is the COBie Guide: http://www.nibs.org/

Deliverables: Based upon the agreed upon assets to be defined in COBie, the team will populate the COBie worksheets per the schedule defined in the BIMxP.

Software: Model Authoring- Revit Suite, Navisworks, EcoDomus, Solibri can check COBie Data

NAMING CONVENTIONS

Family Name
OmniClass Table 23 Products
Use exact wording of equipment description.

+

May add additional description

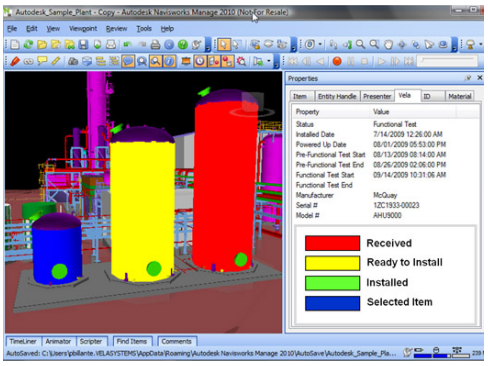
NAMING CONVENTIONS

Type Name
US CAD Standards (NCS) 3.1 Module 5: Terms & Abbreviations

+

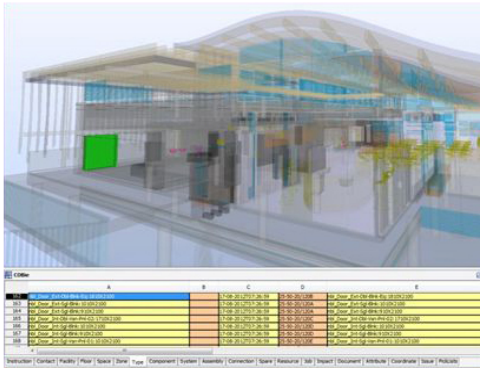
Equipment Operation

7.3 Commissioning



Commissioning is an important opportunity to develop a facility BIM. Early coordination meetings will help update data requirements and determine whether a mobile BIM version will be used to collect data or data will be entered into the BIM during As-Built updates.

Description: Commissioning is a systematic process of verifying that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved by actual verification of performance. Commissioning starts in the design phase and extends through the post occupancy phase of the project.

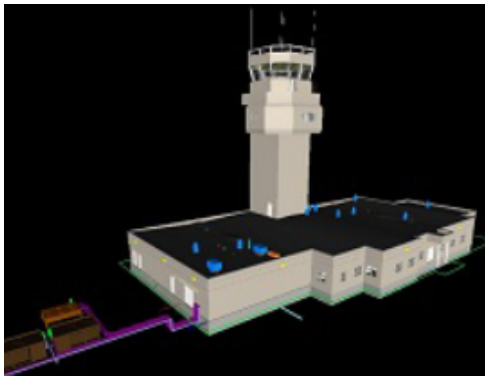


Purpose: The objective of commissioning is to provide documented confirmation that the facility will fulfill the required functional and performance requirements.

Responsible Parties: Responsibility: The Commissioning Agent is involved throughout the project from the design through post occupancy phase. The agent will work with the BIM Managers to identify the objects and attributes supporting equipment commissioning. A report supplied by MPA or COBie spreadsheet will be created to support the commissioning process.

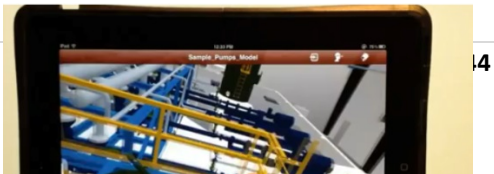
The Commissioning agent will meet with the PM, facility manager, IT and communications, and major building systems subs to determine any updates to the data requirements.

Designer Responsibilities: The project design team is responsible for two aspects of asset management that are included in the BIM documents: identification of geolocation codes (room numbers) in the models and identification of asset tag numbers in the Record Model and on as-built plans. Massport's room numbers for all projects is supplied by the EAM Project Manager in the Capital Programs and Environmental Affairs Department as will the asset numbers generated through the EAM system, Maximo.



Asset Management Data Collection: Massport uses Maximo as its Enterprise Asset Management (EAM) system. The Commissioning agent will verify the Maximo version at Commissioning commencement. Collection of data for assets is required for all equipment and systems as defined in the EAM on-boarding documentation available from the EAM Project Manager in the Capital Programs and Environmental Affairs Department. The Standard Operating Procedures include spreadsheets for all Massport asset classifications, attribute information required per asset type, and tagging requirements for assets included in the EAM system. The following is a list of minimum information that must be provided for asset data:

- Name plate data
- O & M manuals
- Preventative maintenance requirements including frequency and time to complete
- Parts list and parts list per job plan (PM requirements)



- Asset attributes -MPA Classifications_for_Maximo_Assets2014.xlsb
- Naming Conventions: MPAClassifications_for_Maximo_Assets2014.xlsb

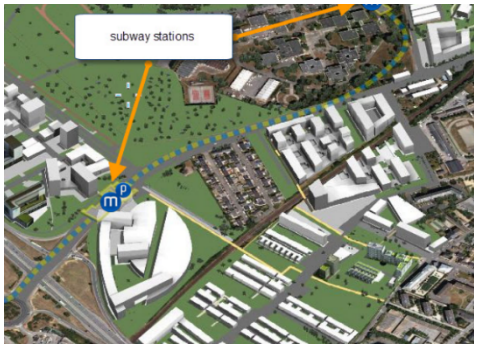
While the Massport classifications are based on OmniClass standards, they are not identical. Therefore, it is important that the MPA standards be followed when reporting asset data. Asset tagging, which is performed by the Commissioning Agent, will be done using Massport supplied tags.

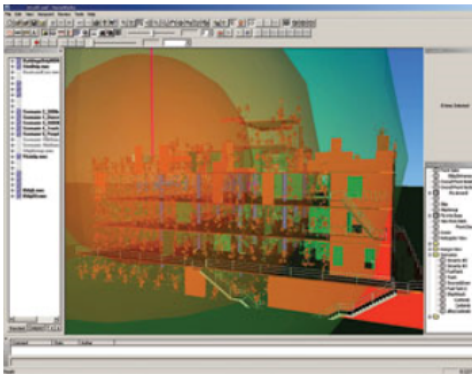
Deliverables: Record Model updated with MPA data requirements on major assets and spaces and project construction documentation supporting the commissioning process

Software: Revit Suite and COBie Spreadsheet, EcoDomus, mobile BIM software, third party products supporting BIM data collection

7.4 Model Data Supporting Disaster Planning

Description: MPA may require BIM use and GIS data for Master Planning studies that include considerations for disaster planning. The A/E will consider options in BIM for disaster planning per MPA project requirements. Ex. line of site, escape routes, security zones, blast areas, and setbacks. Crime Prevention Through Environmental Design (**CPTED**) options may be modeled in BIM.





BIM Data: Owners of public facilities need to provide first responders accurate facility information. BIM in combination with other organization and situation data can be used to support disaster response situations. This information is made available for disasters in multiple formats including computer, cloud, and paper, and multiple locations, and access points.

Responsibility: Design BIM Manager, Constructor BIM Manager, Security or CPTED consultant.

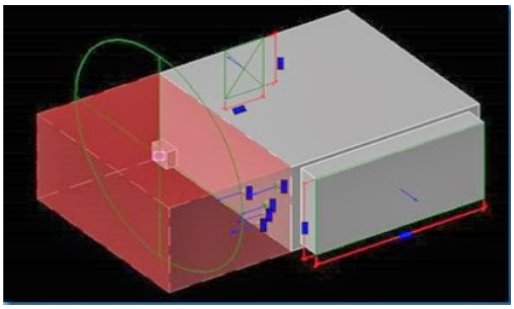
Model Elements: Site and Building elements effected by the disaster options in consideration. These elements are to be documented in the BIMxP. Custom objects for security setbacks, blasts, etc. Some objects will require LOD 300-350 data to support simulations. Example: Wall assembly, window glass type, and applied films are required for blast simulations.

Deliverables: Simulations, model views supporting design options during design and master planning.

Software: Revit suite, GIS, Navisworks, simulation software, custom objects

7.5 Model for Maintenance and Maintenance Training

Description: The model is used during commissioning, pre-occupation, and post occupation to train staff on asset location, maintenance access, and maintenance procedures. This information can be developed into a mobile accessible package.



Responsibility: This is a joint responsibility between the commissioning agent, the facility manager, and constructor BIM manager. Additional sub-contractors may be required to integrate BIM, O&M, and facility data for facility management training. The training packages can be simulations, animations, and accessible mobile models and data.

Model Elements: As required for training on major assets maintenance.

Deliverables: TBD. Third party software may be used to develop the training packages.

Software: Revit Suite, EcoDomus, BIM360, BIManywhere

8 Facilities

The integration of BIM into the entire facility lifecycle is in the early stages. MPA is committed to maximizing BIM capability for more efficient facilities management. Mobile computing, access to real time data and analysis will be based upon data developed through BIM projects. Service providers are encouraged to expand their BIM capability into FM.

8.1 Assessment Models

Description: BIM may be used in the field for efficient data collection. Mobile software supporting BIM shall be considered by the assessment team. The team will work with the MPA FM and DTIG BIM Manager to determine the BIM data requirements per the assessment scope of work and the in-field tools to be used.

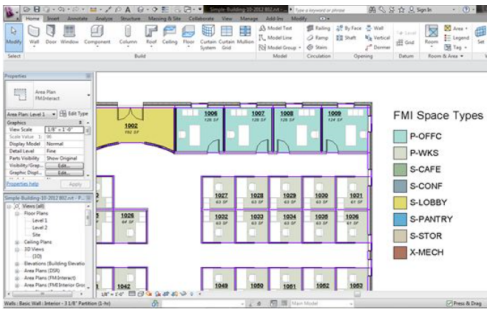
Responsibility: BIM capable assessment team, MPA FM and DTIG BIM Manager

Model Elements: Elements to be assessed will be defined by MPA. The team will utilize the element standards (UniFormat)

Deliverables: Data deliverable may be the updated BIM, assessment report and database for integration with Maximo.

Software: Existing BIM model, EcoDomus, BIM360, Maximo integration tool

8.2 Space Planning – Move Management



Description: The design and space planning team will utilize BIM and intelligent objects to manage space, occupancy and use.

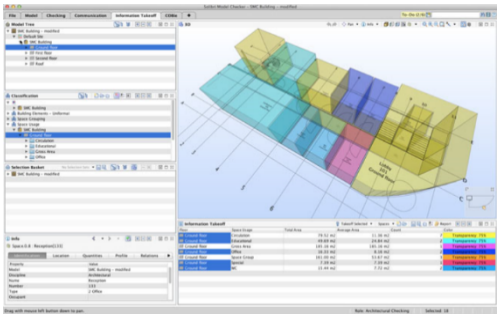
Responsibility: Architecture BIM Manager and discipline team. MPA may be required to provide operational and space requirements, and existing plans and data.

Model Elements: Space planning team will utilize BIM to develop intelligent floor plans with functional space data, room numbering, and layouts to support move management.

Deliverables: Rvt. Model utilizing MPA BIM standards

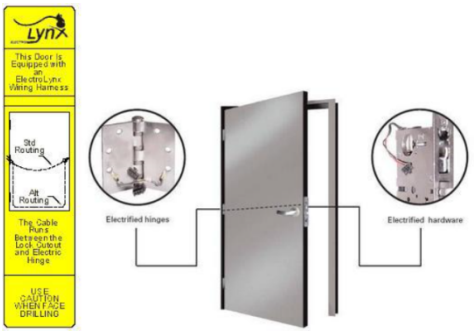
Software: Revit Architecture, Trelligence Affinity and other BIM space planning tools

8.3 Security



Description: MPA may require BIM use security studies. The A/E will consider security options and simulation in BIM per MPA project requirements. Ex. line of site, escape routes, security zones, blast areas, and setbacks if any. Crime Prevention Through Environmental Design (**CPTED**) options may be modeled in BIM.

BIM Data: BIM spaces in combination with operational and situation data can be used to support security simulation and review for public buildings. Manufacturer objects for doors and security. This information and design options are made available for review by security groups.



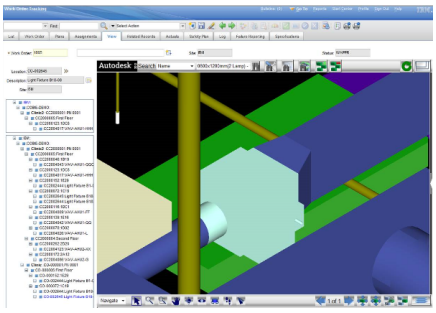
Responsibility: Design BIM Manager, Constructor BIM Manager, Security or CPTED consultant.

Model Elements: Spaces with OmniClass functional space classifications, Objects utilizing UniFormat. Camera views for line-of-site for security stations, cameras. Some materials defining sound, glass strength, secure doors.

Deliverables: Model views, animations, simulations supporting security review. Solibri model checker may also be used to verify space.

Software: Revit Suite, Navisworks, Solibri Model Checker, simulation, animation software

8.4 CMMS and CAFM Integration



Description: MPA uses Maximo for facilities management. MPA may require additional integration of Record model graphics and commissioning data with Maximo. MPA will provide the version and data requirements for Maximo integration.

Responsibility: BIM Manager or third party software integrator.

Model Elements: Floor plan elements, spaces and MPA room numbering, equipment data per MPA facility management requirements. Unique identifiers provided from Maximo.

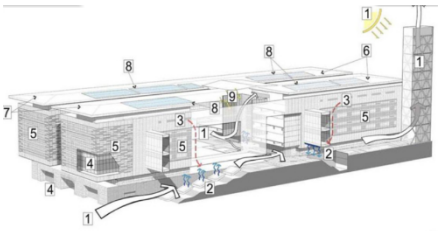
Deliverables: The deliverables may be the integration of BIM graphics and data into the MPA Maximo facilities environment.

Software: Revit Architecture, Maximo

8.5 Resiliency Modeling

MPA Resiliency Definition: Resiliency is the ability of a system to withstand a major disruption within acceptable degradation parameters, recover within an acceptable time, and balance composite costs and risks.

Description: Many MPA assets and properties are located in areas subject to environmental change. The mission of the assets are impacted by data sets typically held in GIS. These include population, transportation, weather and rainfall, storm surge, and others. Use of these datasets in a design mash-up and simulation greatly informs Master Planning and design options.



By utilizing BIM with this Cost-Benefit-Analysis (CBA) information, design options in BIM can help visualize these complex informational relationships supporting better design for sustainable and resilient assets.

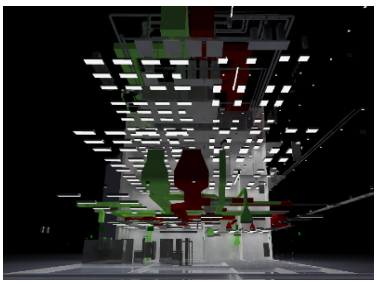
From this macro perspective, BIM can be used for building materials, and construction techniques that help make design more resilient. These innovations can be modeled to determine the CBA and reduce the risk of innovation. Visualization and simulation can be used to support land use policies and help analyze first responder data and access prior to determining a final strategy.

Responsibility: The design team may choose to work with GIS professionals, state and local GIS data, and Master Planning information from MPA to gain a design-in-place perspective for design options.

Model Elements: GIS data layers supporting CBA. Asset elements with identified sustainable materials (attributes)

Deliverables: Animations and simulations including BIM and GIS. Third party products including Autodesk Infraworks, ESRI modules for simulation

8.6 Building Automation Systems BAS Integration



Description: Integration of mobile BIM graphics (2D & 3D) with building automation systems is in its early phases. BIM provides spatial location points for building systems and components. It integrates sensor data for real time displays of system activities. This integration provides better management of systems and work orders. Integrated lifecycle BIM also enables the use of visual work orders by mechanical engineers and others.
Responsibility: MPA facility managers, the DTIG BIM Manager will work with the building system consultants to integrate project BIM data with building systems.

Model Elements: Building systems and components from model. MPA equipment naming conventions and room numbering.

Deliverables: Model integrated into the Building Automation system. Mobile tablet download.

Software: Revit Suite, EcoDomus, software managing building systems, mobile tablet system