PLANNING AND ENGINEERING GUIDELINES & STANDARDS (PEGS)
SUPPLEMENT NUMBER: PEGS-20-002

DECEMBER 1, 2020

BUILDING INFORMATION MODELING (BIM) STANDARDS

A. Volume 1, Section 1.3.3, BIM Standards
B. Appendix 1F – Building Information Modeling (BIM) Standards
C. Appendix 1G – Standard Specifications: 010012X, Building Information Modeling (BIM) Use During Construction
D. Volume 8, Section 2.6 BIM Standards Requirements for Tenants

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Effective immediately, the following modification shall be made to the MDOT MAA 2020 PEGS Manual:

A. Volume 1, AIRPortal – Chapter 1, AIRPortal
Insert New Section 1.3 AIRPortal Data Standards, ***1.3.3 BIM Standards***

1.3.3 BIM Standards

Refer to Volume 1, Appendix 1F – *Building Information Modeling (BIM) Standards*

Refer to Volume 1, Appendix 1F-1 – *Building Information Modeling (BIM) Execution Plan (BxP) Template, Version 1.0*

Refer to Volume 1, Appendix 1F-2 – *Building Information Modeling (BIM) Revit Template, Version 1.0*

Refer to Volume 1, Appendix 1F-3 – *Building Information Modeling (BIM) COBie Spreadsheet Template, Version 1.0*

Refer to Volume 1, Appendix 1F-4 – *Building Information Modeling (BIM) Submission Review Checklist*

Refer to Volume 1, Appendix 1G – *Standard Specifications Section 010012X, Building Information Modeling (BIM) Use During Construction*

Please note Appendixes 1F-1 to 1F-4, noted above, are hyperlinked for download on the PEGS website and are not included with this memo due to the complexity of the associated files.

B. Volume 1, AIRPortal – Appendix 1F (NEW)
Insert New Appendix – *Building Information Modeling (BIM) Standards*

PEGS Supplement: PEGS-20-002

A. Volume 1, Section 1.3.3 BIM Standards,
B. Appendix 1F – Building Information Modeling (BIM) Standards,
C. Appendix 1G – Standard Specifications: 010012X Building Information Modeling (BIM) Use During Construction
D. Volume 8, Section 2.6 BIM Requirements for Tenants

C. Volume 1, AIRPortal – Appendix 1G (NEW)

Insert New Technical Specification Section *010012X - Building Information Modeling (BIM) Use During Construction*

D. Volume 8, Tenant Standards and Guidelines

Insert New Section: *2.6 - BIM Standard Requirements for Tenant Projects*

> *2.6 BIM Standard Requirements for Tenant Projects*
> Tenants/Tenant Consultants shall confirm with the MDOT MAA Permit Committee during the building permit process whether MDOT MAA's BIM Standards and Technical Specifications is applicable to their project.

The MDOT MAA BIM Standards can be found on the landing page of AIRPortal website https://www.airportal.maa.maryland.gov. The BIM Standards identify anticipated outcomes for BIM-based design, to achieve consistency and quality in design and construction documentation for Baltimore/Washington International Thurgood Marshall (BWI Marshall) and Martin State (MTN) Airports projects.

Consultants listed herein are required to distribute this PEGS standard supplement to their respective staff and subconsultants.

If you believe this standard supplement conflicts with any other codes or regulations or if you should have any questions regarding this matter, please contact the Manager, GIS & Engineering Technology Section at (410) 859-7768.

PEGS Supplement: PEGS-20-002

A. Volume 1, Section 1.3.3 BIM Standards,
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DISTRIBUTION

Attachments:

- Building Information Modeling (BIM) Standards
- Standard Specification 010012X, Building Information Modeling (BIM) Use During Construction

PEGS Supplement: PEGS-20-002

A. Volume 1, Section 1.3.3 BIM Standards,
B. Appendix 1F – Building Information Modeling (BIM) Standards,
C. Appendix 1G – Standard Specifications: 010012X Building Information Modeling (BIM) Use During Construction
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1.0 General

The MDOT MAA Building Information Modeling (BIM) Standards identify BIM-based modeling requirements for Baltimore/Washington International Thurgood Marshall (BWI Marshall) and Martin State (MTN) Airports projects. The model deliverable provides an "As Constructed" deliverable to MAA for configuration management, operations, and maintenance. The MDOT MAA recognizes the National BIM Standards definition for BIM:

"BIM is a digital representation of the physical and functional characteristics of a facility. BIM is a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its lifecycle, and defined as existing from earliest conception to demolition." -National Institute of Building Sciences

This document is for design and construction service providers. MDOT MAA project consultants shall understand how the requirements affect their roles, project delivery, and deliverables. MDOT MAA assumes the reader has skills and knowledge of CAD and BIM project workflows, modeling methods, derived construction documentation, and the standard industry terms used in this document.

This standard, combined with the Planning and Engineering Guidelines & Standards (PEGS), provides the basis for CAD, GIS, and BIM for MDOT MAA projects. Section 1.6 of this document contains other referenced standards.

TABLE 1: ACRONYMS IN DOCUMENT	
3D	Geometry in BIM representing building elements or assemblies
4D	Time sequencing of construction
ASCE	**A**merican **S**ociety of **C**ivil **E**ngineers
ADM	**A**IRPortal **D**ocument **M**anager
A/E	The terms A/E (architect-engineer) designer and consultant are interchangeable.
BAS	**B**uilding **A**utomation **S**ystems
BIM	**B**uilding **I**nformation **M**odel, Modeling, Management
BIM USES	How the project team use the model during the project
BxP	**B**IM E**x**ecution **P**lan
CAD	**C**omputer-**A**ided **D**esign
CDE	**C**ommon **D**ata **E**nvironment
CIM	**C**ivil **I**nformation **M**odeling
CMAR	**C**onstruction **M**anager at **R**isk
CM	**C**onfiguration **M**anagement being MAA's activity to use the Record model of a facility or portion of for the Common Data Environment. May be provided by MAA to support the scope of work controlled by MAA
CMMS	**C**omputer **M**aintenance **M**anagement **S**ystem – Maximo at MDOT MAA
CO	**C**hange **O**rders
COBie	**C**onstruction **O**perations **B**uilding **i**nformation **e**xchange
CSI	**C**onstruction **S**pecifications **I**nstitute
Cx	**C**ommissioning
DBB	**D**esign **B**id **B**uild
DD	**D**esign **D**evelopment
EDI	**E**lectronic **D**ata **I**nterchange
E-TRANSMIT	Electronic exchange process tool
FAA	**F**ederal **A**viation **A**dministration
FIELD	Mobile access to documentation
FFE	**F**urniture, **F**ixtures, **E**quipment
GC	**G**eneral **C**ontractor
GIS	**G**eographic **I**nformation **S**ystem – ESRI at MDOT MAA
IFC	**I**ndustry **F**oundation **C**lasses
LOD	**L**evel **o**f **D**evelopment – the geometric and data accuracy of the model elements
NCS	**N**ational **C**AD **S**tandard

NORA	**N**otice **o**f **R**ecommended **A**ward
NTP	**N**otice **to P**roceed
NSF	**N**et **S**quare **F**ootage
MAA	**M**aryland **A**viation **A**dministration
MDOT	**M**aryland **D**epartment **of T**ransportation
MEPFT	Mechanical, Electrical, Plumbing, Fire Protection & Telecom (The National CAD Standard “T” discipline includes security)
PEGS	MDOT MAA **P**lanning and **E**ngineering **G**uidelines & **S**tandards
RFI	**R**equest **for I**nformation
SOW	**S**cope **of W**ork
XREF	e**X**ternally **REF**erenced file inserted in a current drawing using the AutoCAD “ATTACH” command.

1.1 MDOT MAA INFORMATION MANAGEMENT STRATEGY

BIM adoption is part of the MDOT MAA multi-year strategy to develop a Common Data Environment (CDE) integrating planning, design, construction, operations, and facilities management information. The CDE will integrate BIM project data and geometry as “ground truth” into other applications (CMMS and GIS technologies) used as part of its operational workflows.

Figure 1. MDOT MAA’s Common Data Environment (CDE)

- BIM - Building Information Modeling
- CIM - Civil Information Modeling
- GIS - Geographic Information Systems
- CMMS - Computer Maintenance & Management System
- BAS - Building Automation Systems (sensors)
- FIELD - Mobile access to documentation

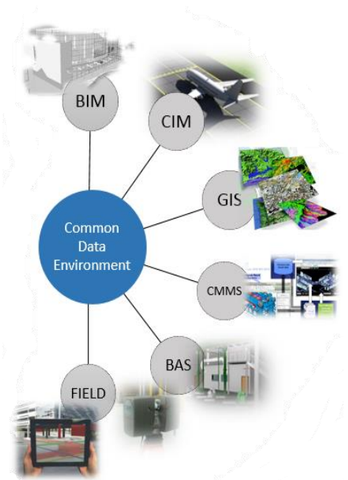


Figure 1- Common Data Environment

1.2 BIM Benefits and Goals

BIM is a process requiring standards, modeling strategy, and planning to maximize the benefits throughout the project lifecycle. It is necessary to *"Begin with the End in Mind."* Benefits accrue throughout the project lifecycle into asset management and operations. MDOT MAA's goal is to work with teams that maximize BIM benefits (see Figure 2) on projects and manage the demands of airport construction.

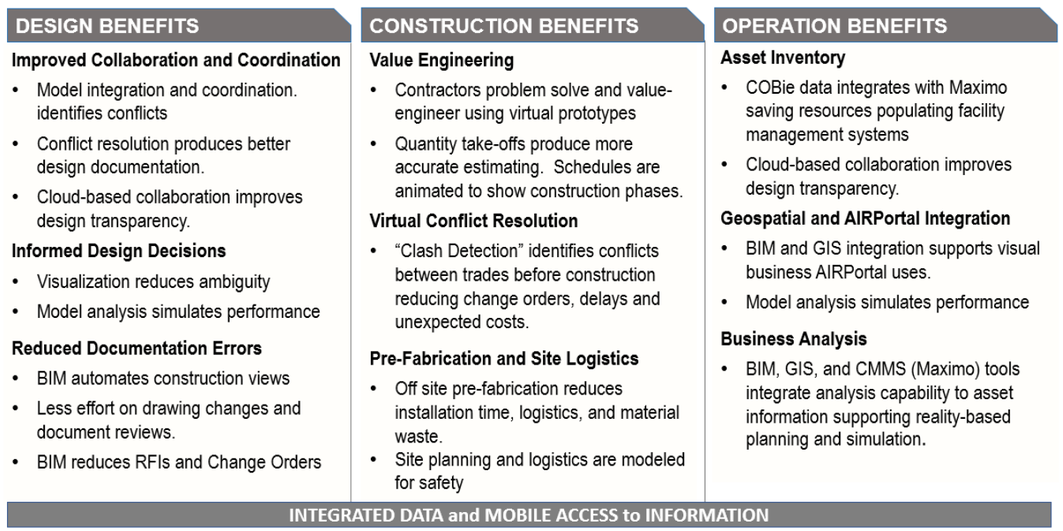


Figure 2- BIM Benefits

1.3 When to Use BIM on MDOT MAA Projects

Not all design and construction projects will require BIM. However, all interiors and facility projects, regardless of size, shall use BIM, and the model shall be a deliverable.

Table 2 is used by MDOT MAA to determine when a project requires BIM, which depends upon the project type, complexity, size, and cost. The use of BIM on a project will be outlined within the project scope of work, RFP, and reflected in the project deliverables. If a design team chooses to use BIM as their preferred design process, then follow the MDOT MAA BIM Standard which specifies Revit as the BIM authoring tool

TABLE 2: MDOT MAA BIM PROJECT MATRIX

PROJECT TYPES	BIM USE	REQUIREMENTS			BIM DELIVERABLES
		DESCRIPTION	BxP	CLASH	
MDOT MAA Studies	Optional at discretion of MDOT MAA	Schematic model, design options, reports, visualization.	No	No	TBD by MDOT MAA based upon SOW. Any model developed becomes a deliverable
Architectural Design to 30%	Required	Some projects are ended at 15%-30%. If preliminary modeling is required follow the BIM Standards. LOD 200 – 300 and BIM Uses	Yes	Yes	BxP, 30% model, 30% documents
Small Projects - <500,000	Optional at discretion of MDOT MAA	Small area,single or few disciplines - BIM if specified in SOW process	Yes, if BIM	Yes, if BIM	60-100% model, documents, As-Built documents. Record model, DWGs
Projects > $500,000 construction cost	Required	BIM per MDOT MAA Standards	Yes, if BIM	Yes, if BIM	60-100% model deliverables, As-Built documents, Record model.

New Construction	Required modeling and BIM Uses per SOW	Major discipline models, construction documents, reports	Yes	Yes	30-60-100% Model and Documents (PDF) during Design Conformed models after BID Project close-out As-Built documents, Revit Record model LOD 300 - 450 Navisworks model including Shop models DWG Floor Plans for GIS MAA Asset Spreadsheet (COBie based)
Building Renovation					
Building Systems Replacement or Renovation		Primary equipment in building system, Architecture, MEP			
Building Permit Tenant Projects	As required by MAA	Per SOW	Yes	Recommended	

1.4 Model Terminology and Definitions

MDOT MAA uses the following modeling terms and modeling relationships throughout project execution (Figure 3).

1.4.1 Study Model – BIM Optional

MDOT MAA may require BIM (Revit) use for study reports. It may be necessary to analyze the design, document options, or illustrate study findings.

1.4.2 Existing Conditions Model – Revit

Not all projects have existing facility information. At the beginning of a project, MDOT MAA may provide a model as part of existing documentation. If not, then the consultant shall produce a model to support the project scope of work.

1.4.2.1 Creating a Model of Existing Conditions

The consultant will use the MDOT MAA Revit template for model creation. Define the Level of Development (LOD) of model elements in the BIM Execution Plan (BxP). Laser scanning may be used as a basis for the model.

1.4.2.2 Receiving an Existing Condition Model from MDOT MAA

MDOT MAA may provide a model of the project area. The model LOD and accuracy will be confirmed at the MDOT MAA BIM/GIS Kick-off meeting. Document further model development in the BxP.

1.4.3 Design Intent Model – Revit

The Design Intent model is developed throughout the design phases. It is the basis for project collaboration, coordination, analysis, stakeholder reviews, and decisions. Most elements are LOD 300, others LOD 350 - 400 based on project requirements. The LOD matrix, part of the BxP, identifies an item LOD. Teams resolve discipline model conflicts periodically, as stated in the BxP. MDOT MAA reviews all model submissions for standards compliance. The 100% Design Intent model and derived construction documentation shall be coordinated and free of significant element conflicts and errors.

MDOT MAA will review and provide written comments on the various model submissions (documented in the BxP) for standards compliance. Comments requiring model changes will be updated for the following model submission and be compliant for the Bid process. Models and construction documentation are project deliverables per Chapter 4, Table 9.

1.4.4 Bid Model – Revit

The Bid model, provided by MDOT MAA to bidders, is the revised 100% Design Intent model. Responses to Bidder's questions/comments submitted to MDOT MAA and design modifications or clarifications are issued as Addenda during the Bid process.
Bid models are created and submitted for DBB projects only. CMAR projects do not have a Bid phase.

1.4.5 Conformed Model – Revit

The Conformed model is the Bid model with all addenda incorporated by the design consultant. The winning contractor will receive the model after the initial NTP at a model handover meeting.

Conformed models are created and submitted for DBB projects. CMAR projects have an "Issued For Construction" model which is the final/100% Design Intent model with all addenda incorporated.

1.4.6 Construction Model – Revit and Navisworks

The Conformed model is a basis for additional construction modeling. This work provides detail and information for construction through shop modeling, constructability reviews, and product data. Construction BIM Uses will be documented in the BxP.

Navisworks is an approved tool for construction and shop model integration, constructability reviews, and clash detection. The Navisworks model is a final deliverable.

1.4.6.1 Construction Model – Revit

The contractor will use the Revit Conformed model as a basis for construction modeling.

1.4.6.2 Construction Model – Navisworks

The contractor will use Navisworks to integrate Revit modeling with shop models for clash detection and coordination. The Navisworks reports are provided to MDOT MAA, showing clash issues and resolution. The Navisworks model is updated with as-built information and is a deliverable as per Chapter 4, Table 9.

1.4.7 As-Built Drawings - Navisworks Model and.DWG Drawings

The contractor regularly provides as-built information to the design consultant to produce the Record model (Revit). Contractor supplied .dwg drawings may be required per the SOW. Dwg files shall conform to the MDOT MAA CAD Standards Layers within the MDOT MAA Revit template. Other layers may be added based upon project content. These layers shall be identified in the BxP. The Navisworks model deliverable contains the approved shop models, as-built data, and additional LOD detail.

1.4.8 Record Model – Revit and COBie Spreadsheet

The Record model is the Conformed model updated with as-built information supplied by the contractor. The Record model is LOD 300 or higher per element. Joint reviews of as-built conditions will facilitate knowledge transfer.
The COBie spreadsheet, per project SOW, is a model export providing asset data (building systems and equipment data) required by the MDOT MAA.

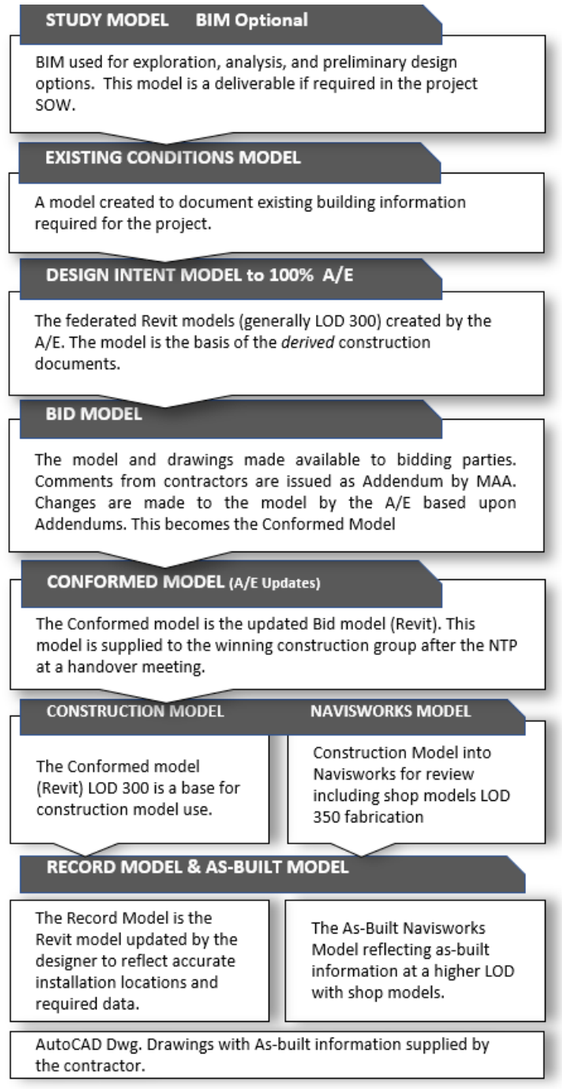


Figure 3 - MDOT MAA BIM Models

1.5 Model Progression by Contract Method

MDOT MAA uses Construction Manager at Risk (CMAR) and Design, Bid, Build (DBB) contracts on projects. These contracting methods must be determined at project inception as they alter model progression and handoff between parties.

1.5.1 Construction Manager at Risk (CMAR) BIM Model Progression

CMARs provide preconstruction services, collaboratively work with the design consultant, and maximize BIM, project cost, and schedule. A joint BxP created by the consultant and CMAR documents the services to be provided. The consultant updates model submissions with the CMAR and MDOT MAA comments during the project. These projects do not have a Bid model. The final/100% Design Intent model is developed collaboratively by the team with Addenda issued as necessary to support efficient construction procurement and delivery. The resulting documents are the Issued For Construction set and model.

Once construction begins, the CMAR serves as the project's general contractor, constructing the project with company crews or subcontracted trades. The CMAR retains the responsibility for monitoring design—coordinating any design changes, advising the owner on any design modifications, and coordinating approval of shop drawings with the consultant. During construction, the CMAR provides as-built updates and equipment data for Record model creation. The as-built Navisworks (350-400) model and .dwg drawings per SOW are deliverables. The design consultant creates the Record model using the submitted as-builts.

1.5.2 Design, Bid, Build (DBB) BIM Model Progression

The Design BIM Manager shall submit the Design Intent model for MDOT MAA review at each design phase. The reviewed and updated 100% Design Intent model becomes the Bid model set. Bid models and the derived construction documents are part of the DBB project Bid package. The bidding contractors are provided the Bid models during the Bid process. Comments and model issues are submitted to MDOT MAA. MDOT MAA will address comments via addenda. This updated model becomes the Conformed model, which is provided to the winning contractor (GC) after NTP at a model handover meeting.

The contractor shall supply as-built information to the consultant to update the Record model (Revit). The As-Built model (Navisworks LOD 350 - 400) and CADD (.dwg) files reflecting as-built information are deliverables. The CAD drawings (.dwg) shall conform to the MDOT MAA CAD standards, reflecting as-built conditions.

1.6 Referenced MDOT MAA Documents and National Standards

The MDOT MAA Planning and Engineering Guidelines & Standards (PEGS) contain the current design, CAD, and GIS guidelines for projects. This BIM document references these standards to decrease redundancy and conflicts. Introducing BIM on projects does not negate the requirements identified in these standards. Additional referenced standards include:

TABLE 3: ADDITIONAL REFERENCED STANDARDS
MDOT MAA GIS Data Standards Utilities Supplement
MDOT MAA Data Quality Standards
MDOT MAA Data Security Standards
MDOT MAA Building & Space Naming, Identification, Addressing, and Measurement Standard
MDOT MAA Planning and Engineering Guidelines & Standards (PEGS)
MDOT MAA Asset Management Standard
BIM RELATED STANDARDS
MDOT MAA Revit template
National BIM Standards – National Institute of Building Sciences (NIBS)
COBie (Construction Owner Building Information Exchange) - NIBS
OmniClass - Construction Specification Institute (CSI)
BIMForum Level of Development (LOD) - Associated General Contractors (AGC)

1.7 Access to Documentation and Templates

The MDOT MAA provides consultants access to content through AIRPortal. https://www.airportal.maa.maryland.gov. Relevant content is available on the landing page and does not require a login. MAA MDOT will provide the information if it is not currently on AIRPortal.

TABLE 4: CONTENT AVAILABLE THROUGH AIRPortal
Current MDOT MAA CAD Standards
Linetypes
Symbols
Logos
MDOT MAA Additional Topographic Symbols
Layer Template – X000-Geom.dwg
MDOT MAA Planning and Engineering Guidelines & Standards
MDOT MAA Signage Symbols
Plot Styles (ctb)
Standards Borders
Standards Title Block, Index Sheets
BIM Execution Plan Template
MDOT MAA Revit Template
MDOT MAA BIM Standard
MDOT MAA Asset Management System Data Delivery Standards

1.8 Approved BIM Software

TABLE 5: SOFTWARE USE	APPROVED APPLICATION NAME
BIM Authoring Tool	Autodesk Revit (Architecture, MEP, Structure)
CIM Authoring Tool	Autodesk Civil 3D
Model Checking Tool	Navisworks, Autodesk Model Checkers, Solibri, Revizto
Drawing Submissions	e-Transmit
Document Review	Bluebeam and Autodesk Design Review
Collaboration Tools	BIM 360 Design, Docs, Build

MDOT MAA uses Autodesk™ Revit software as its primary BIM authoring application. Other BIM authoring tools require MDOT MAA approval. Secondary tools for Revit, such as library management (UNIFY or others) or BIM 360 Design for collaboration, are part of the service providers' BIM environment documented in the project BIM Execution Plan (BxP).

1.9 BIM and Data Ownership

MDOT MAA shall have unlimited rights to all information and materials developed under a contract and furnished to the MDOT MAA, including all reports and listings, and all other items about the work and services according to its agreements, including any copyright. Unlimited rights under its contracts are rights to use, duplicate, or disclose data and information, in whole or part in any manner and for any purpose whatsoever without compensation to or approval from Contractor. The MDOT MAA will at all reasonable times have the right to inspect the work and will have access to and the right to make copies of the items mentioned above. All digital files and data, and other products generated under MDOT MAA contracts shall become the property of the MDOT MAA.

1.10 Waiver of BIM Standards Requirements

If a modification to a BIM requirement is in the best interest of the project, then a written waiver identifying the change, purpose, and alternative shall be submitted via email to the MDOT MAA for approval. Include the MDOT MAA PM on the email. After approval, document the changes in the BxP. E-mail address maapegsstandards@bwiairport.com.

1.11 Quality Assurance

The efficiency of the BIM process and the value of the construction documents depends upon model structure, level of development (LOD) accuracy, periodic model review and clash detection resolution, and quality control procedures. Plans, sections, elevations, essential details, schedules are ***derived*** from the model and have minimal 2D drafting. The consultant is responsible for seeing that all electronic files are compliant with all applicable MDOT MAA Standards and Guidelines.

The MDOT MAA Revit template is the base file for design. The Design BIM Manager shall periodically review the federated discipline models for conflicts using Navisworks, Autodesk Model Checker, or Solibri model checking tools. The clash/conflict reports are project deliverables. These reports will include the conflict type, number of specific conflicts, and the schedule for resolution by the design team.

Construction documentation is derived from conflict checked and resolved models with a minimum of 2D drafting on details. Schedules are reported from the model. The MDOT MAA BIM Manager will review model submissions for standards adherence, conflicts, and errors. The 100% model shall be free of reported errors and clashes before accepting the 100% model.

2.0 General

Several BIM management standards are part of the National BIM Standard. MDOT MAA uses several included in the MDOT MAA Revit Template.

2.1 Model Level of Development (LOD)

LOD defines the visual complexity and data reliability of a BIM object. Object LOD assignments are documented in the BIM Execution Plan (BxP). Objects carry the LOD, not the model; however, based upon most objects' LOD, a model is said to have general LOD. The Associated General Contractors (AGC) BIMForum and National Institute of Building Sciences (NBS) have jointly developed the Level of Development (LOD) Specification for BIM. A copy of the AGC LOD Specification is available on the AGC webpage http://bimforum.org/lod/.

2.1.1 Graphic Accuracy

MDOT MAA requires the design team to accurately model object size and location so that the contractor can use the model with a confident understanding of accuracy. Door offsets, outlet heights, walls on slabs, cut-throughs, and proper height, ceiling tiles with referenced lighting fixtures from Mechanical, Electrical, Plumbing (MEP) models are all part of LOD accuracy. These conditions should be reviewed by the design team as part of QA/QC and submit models with LOD accurate objects. The accuracy of placement can be more important than a highly detailed object.

2.1.2 Data Reliability

LOD also supports the reliability of data. At 100% documentation, elements should be at LOD 300 in terms of graphic accuracy and data reliability. The Record model is a minimum LOD 300 graphically with as-built and as-installed product data at LOD 350 – 400. Use the LOD matrix and the MDOT MAA Asset Management Requirements to determine the level of effort for data.

2.2 Level of Development Definitions

LOD 100 – Schematic representations of elements, not accurately placed or identified, or volumes for space reservation.
LOD 200 – Elements are generic but recognizable placeholders in approximate locations. Data is approximate.

LOD 300 – Elements are accurate. The type, quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modeled information such as notes or dimension callouts. All parts are accurately located to the project origin, nearby, and attached elements. Building systems components are connected. Data is accurate for design intent and performance.
LOD 350 – Shop model and fabrication installation accuracy.

LOD 400 – Represents modeling at a shop drawing level and data of the As-built condition. LOD 400 is ***graphically*** higher than is necessary for MDOT MAA Record models. LOD 300 graphics with accurate as-built location and data for MDOT MAA Maintenance and Operations. MDOT MAA requires the NavisWorks model as a deliverable that includes Shop model and as-installed components supporting MDOT MAA maintenance repairs or remodeling.

LOD 500 – Facilities management – MDOT-MAA does not use this designation for projects.

Examples of various LODs are shown in Figures 6, 7, and 8.

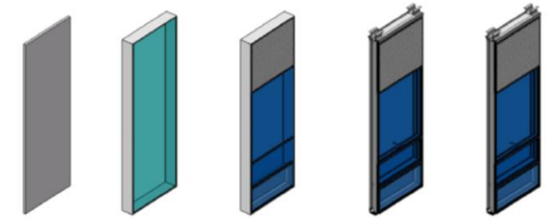


Figure 6 – LOD of Wall Assemblies

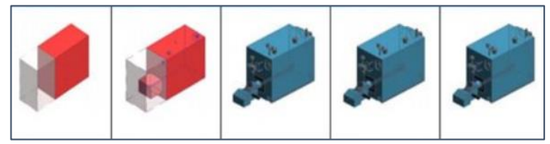


Figure 7 – HVAC LOD

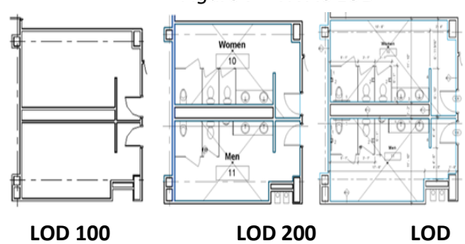


Figure 8 – LOD of Plan Graphics

2.3 Data Management

MDOT MAA building, space, and equipment data are strategic assets that must be maintained to preserve value. Teams working on MDOT MAA projects must ensure that data standards, terminology, OmniClass, and COBie are maintained during project phases, submissions, and the transfer between software applications. MDOT MAA uses the following data standards:

1. MDOT MAA will use the National Institute of Building Sciences (NIBS) COBie template to transfer information from BIM to Maximo (MDOT MAA's asset management system)
2. Level of Development (LOD) – Associated General Contractors (AGC) and National Institute of Building Sciences (NIBS) standard for graphic detail and data reliability. Use the current version distributed by AGC. http://bimforum.org/lod/
3. BIM to GIS Handover
4. MDOT MAA Planning and Engineering Guidelines & Standards (PEGS) – Vol 1, Appendix 1E - MDOT MAA GIS Standards
5. The National CAD Standard (NCS), current version. Layers used in the MDOT MAA Revit template are listed in Appendix 1D of MDOT MAA PEGS. Using new layers, not in the Revit template, requires written permission from the MDOT MAA BIM Manager.

2.3.1 OmniClass Building Classification Tables

Assign OmniClass to all spaces, building systems, and products. Spatial areas must maintain MDOT MAA naming, abbreviations, and codes. OmniClass is used to name model worksets to define the workset content.

TABLE 6: OMNICLASS TABLES	PURPOSE in BIM
Tables 13 and 14	Combined for project spaces
Table 23	Equipment
Table 21	Building systems
Table 22	Assets and products

2.4 BIM Objects

BIM object refers to an individual building product or assembly in a model. All BIM objects must have an OmniClass product descriptors found in OmniClass Tables 21 and 22.

2.4.1 BIM Object Authoring

All new objects must use the provided tool, family, and type within the software. For example, a BIM software's *wall* tool must be used to create a wall. A drafted wall is not permitted.

2.4.2 New Object Criteria

Objects are named, typed, and classified for the real-world element it represents. All objects must accurately report from the software, rather than be unassigned, graphic primitives. Proper naming allows associated information to be correctly updated, published, and available for export. Generic, miscellaneous, or unspecified categories are not allowed.

Global Properties increase modeling value and performance. Attributes of any given object will reference global properties for its respective category. For example, a "Width" property for one piece of equipment must use the same global property for Width universally within the same category. Additional properties, meaning the same characteristic, are not allowed. (i.e., width1, Object Width, etc.)

BIM authoring software object libraries will be used when creating objects, whether they are actual 3D objects or 2D representations. Models must be populated with the software's objects for building products. Geometric lines, arcs, and vertices are not allowed. Objects are necessary to enable classification and reference keynoting (such as the Unified Facilities Guide Specification (UFGS) or MASTER SPEC numbering.)

2.5 GUID – Globally Unique Identifier

The Globally Unique Identifier (GUID) is a universally unique number assigned by the software to every element within the model. The GUID must be preserved during export in exchange formats such as IFC and COBie (Construction Operations Building Information Exchange).

2.6 Properties and Annotations

Object properties will be populated. The model(s) and objects must contain the appropriate non-graphical data to accurately support the automatic population of annotation tags and schedules from the BIM software.

All general annotations must comply with the MDOT MAA CAD Standards graphics. Where the MDOT MAA Standard does not explicitly define an annotation standard, the latest version of the National CAD Standard applies.

The models must use the appropriate tool within the BIM software designed for that purpose.

1. All references, including but not limited to, elevations, sections, plan, and detail callouts or marks, must be created using the appropriate tools/commands and remain dynamically connected throughout the project. Do not use manual overrides.
2. The Title block identification values (e.g., sheet number and sheet name) must be associated and automatically populated and remain current throughout the project.
3. Annotation symbols such as tags are to read from and display information contained within the model properties.

3.0 General

The BIM teams shall maximize BIM capability to meet project goals. BIM managers will attend project kick-off meetings to understand MDOT MAA project goals and the scope of work. BIM Managers will then interpret these into BIM requirements and uses for the project to define the necessary members of the project BIM team. The BIM team will manage model development, submissions of the models, and documentation throughout the project phases. The Design BIM Manager has the responsibility for the design BIM Execution Plan (BxP).

3.1 BIM Roles, Responsibilities, and Expertise

The consultant and contractor shall designate a BIM Manager responsible for BIM execution per the project scope of work (SOW). Team member roles are shown visually in Figure 9 and described in Table 7. Additional team members shall be assigned accordingly per the SOW, BIM Uses, and project complexity.

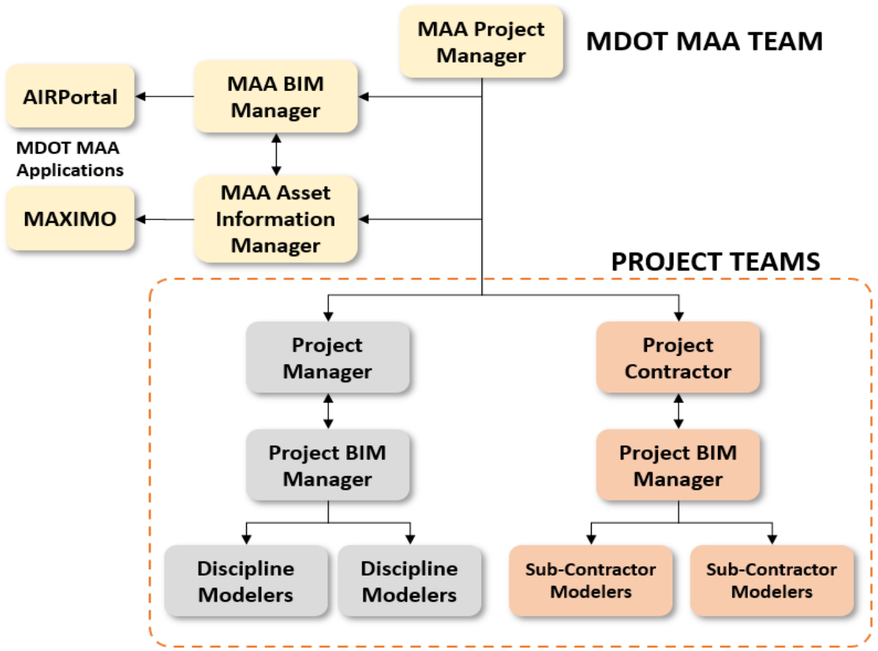


Figure 9 – BIM Teams

TABLE 7: BIM ROLES and RESPONSIBILITIES	
MDOT MAA PM	**MDOT MAA PROJECT MANAGER** – is the MDOT MAA representative with project management and oversight responsibilities on behalf of the MDOT MAA. The PM manages all aspects of the project to achieve the project goals. The PM works closely with the MDOT MAA BIM Manager on BIM schedule, deliverables, and data handovers.
MDOT MAA CMi	**CONSTRUCTION MANAGER/INSPECTION** – is the MDOT MAA representative during construction. This group will have oversight and review authority on BIM deliverables and the BxP per the SOW.
MDOT MAA BIM Manager	**MDOT MAA BIM MANAGER** – The MDOT MAA BIM Manager reviews and provides oversight on BIM requirements and deliverables.
MDOT MAA Cx	**COMMISSIONING TEAM** – A Commissioning team, if used, may request the model or model data for the commissioning process.

A/E - DESIGN BIM TEAM		GC - CONSTRUCTION BIM TEAM	
Design BIM Manager		**Construction BIM Manager**	
Manages the use of the MDOT MAA Revit Template; provides oversight of model structure, development, and integration of discipline models; determines model/s information; maintains construction documentation, quality, submissions, and team collaboration		Overall execution and use of BIM and construction documentation for the development of Shop models, constructability reviews, quantity take-off, and the As-Built information.	
Discipline Modelers	Major disciplines modeling teams with the expertise to develop these models and provide analysis as needed per the project SOW	**Fabrication Modelers**	Sub-contractors' BIM modelers managed by the Construction BIM Manager. Use the Design Intent model or other approved tools for fabrication.
BIM Use Modelers Rendering, Animation, Public Presentations Separate team members may be assigned as a visualization task coordinator, estimator, LEED analyst per the SOW. Reports to the Design BIM Managers		**BIM Use Modelers** Different teams may supply schedule (4D), estimating, (5D), and construction logistics visualizations tasks per the SOW. Teams report to Construction BIM Manager	
QA-QC – Model Management A separate team member may be designated as QA/QC task coordinator for model and data checking, model integration, and other multi-disciplinary activities. Reports to the Design BIM Manager.		**QA-QC – Model Management** A separate team member may be designated as QA/QC task coordinator supporting the As-built model, data checking, model integration, and other multi-disciplinary activities. Reports to the Construction BIM Manager.	

3.1.1 BIM Manager (Consultant or Contractor) Expertise and Responsibilities

The BIM Manager shall have an in-depth technical knowledge of Revit modeling and structure, project delivery, and BIM processes. They can manage teams and convey instructions to designers and other modelers. BIM Managers shall have experience interpreting what BIM uses to meet project goals for the BxP creation and updates for the project. BIM Managers:

1. Ensure compliance with MDOT MAA BIM standards and manage QC program
2. Develop, maintain, update, and provide clarifications to the BxP
3. Manage model creation and review across discipline teams or trades during construction
4. Participate in project meetings for BIM review.
5. Lead and facilitate BIM meetings
6. Manage and coordinate team modelers
7. Verify geo-references in all associated discipline models
8. Schedule periodic design coordination and construction coordination reviews
9. Manage submissions
10. Manage 2D Drawing, and BIM derived information production
11. Develop submission packages for design or construction handover to MDOT MAA and other parties

3.1.2 Discipline, BIM Users, and Fabrication Modelers

BIM teams require multiple areas of expertise. Discipline modelers are trained professionals in the discipline combined with BIM expertise. BIM Use modelers have additional software expertise that makes use of the Revit model.

1. Have professional expertise in the discipline to be modeled
2. Ability to review multiple discipline models for coordination and review
3. Object creation and best practice expertise for project use
4. Ability to derive and create documentation views and details from the model
5. Understand and adhere to standards
6. Fabrication modelers can utilize design intent models for fabrication through Revit or other fabrication software
7. BIM Use modelers use the model for analysis, rendering, animation, or other required uses beyond Revit capabilities

3.2 Project Kick-Off Meeting – BIM Participation

The MDOT MAA BIM Manager will work with the design team to define project BIM Uses and the model development strategy based upon MDOT MAA standards to achieve project goals. The BIM team must be aware of the downstream contractor, and MDOT MAA BIM uses to develop their model/s accordingly.

1. The MDOT MAA BIM Manager shall attend regular project review meetings and facilitate model uses to support MDOT MAA decision processes.
2. Regular BIM team meetings will be held to maintain the modeling schedule, model coordination, and quality control.

3.3 BIM Execution Plan (BxP) Development

Projects have different characteristics based upon scope, contract type, project type, assets, and type of construction, which illustrates why a common BIM package for all MDOT MAA projects is not possible. The BxP identifies and documents the model uses on the project, its structure, and responsible parties. It details the schedule for BIM development, LOD progression, model coordination activities, model structure, and required asset data. The BxP is a deliverable per Chapter 4, Table 9. The BxP provides the following information:

1. Project information
2. BIM goals & uses
3. Each project member's role, staffing, and competency, contact information
4. BIM process and strategy
5. BIM exchange protocol and submittal format
6. BIM data requirements including additions to the MDOT MAA data naming conventions for new instances
7. Collaboration and discipline model referencing procedures for shared models
8. Quality control plan
9. Technology infrastructure & software used

3.3.1 BIM Execution Plan (BxP) Templates

There are two templates available to use for the MDOT MAA BxP:

1. MDOT MAA BxP_Template 1 – can be used for all size projects; composed of 2 separate files as follows:
    a. MDOT_MAABxP_Template 1.docx
    b. MDOT_MAABxP_Part2 LODMatrix_Attributes Parameters.xlsx
2. MDOT MAA BxP_Template 2 – typically used for smaller, simple projects
    a. MDOT MAA BxP_Template 2.xlsx

Consultants shall confirm with the MDOT MAA BIM Manager, which template to use based on the complexity of the project.

3.3.2 BIM Execution Plan (BxP) Phases

The BxP documents the technical coordination of the model across teams. BxP development has two stages: the Design BxP and the Construction Phase BxP. Consultants and contractors must submit a BxP for their phase of the project for approval. The Design BxP is a contract deliverable as per Chapter 4, Table 9. As a contract deliverable, it provides documentation about the project BIM use and is a tool supporting post-project model use.

On DBB projects, the Design BxP is provided to the contractor. The contractor builds upon the Design BxP by adding additional information for the construction phase, which becomes the Construction Phase BxP.
On CMAR projects, the consultant and CM team jointly prepare the BxP. This combined plan is also called a Project Execution Plan (PxP).

3.4 BIM Uses

BIM Uses identify modeling tasks for the project, responsible parties, LOD, referenced standards, and the desired outcomes. BIM Uses are defined in the BxP for the design and construction phases. Below is a table of MDOT MAA recognized BIM Uses. Others may be added to the BxP.

TABLE 8: BIM USES for MDOT MAA			PARTICIPANTS				
No.	**BIM USES**	**GENERAL DESCRIPTION**	**A/E**	**GC CMAR**	**CMi**	**Cx**	**MAA**
BIM Uses 1-17 by MDOT MAA		**Document all BIM Uses in the project BxP**					
1	**Existing Conditions Modeling**	The model developed from field measurements, existing docs, and laser scanning to produce an accurate existing conditions model. The A/E and the contractor (GC or CMAR) are individually responsible for implementing any process or technology required to field-verify existing conditions needed to perform their contractual obligations.	**X**	**X**			**X**
2	**A/E - Model Authoring**	Various discipline models developed for project design, analysis, and construction documentation	**X**		**X**		**X**
3	**Visualization Animations**	3D model views developed to more realism supporting stakeholder understanding, public reviews, and decision-making processes	**X**	**X**			
4	**Space Program Validation**	Quantify space in the model for variations from project space requirements and codes	**X**				**X**
5	**Fire Safety Review**	Model review of fire suppression system and alarm with the architectural model for interactive FM and Fire System reviews.	**X**		**X**		**X**
6	**Design Analysis**	Analysis of design per scope of work, required egress plan, vertical circulation coordination, energy, and others as required in the SOW	**X**		**X**		
7	**Coordination Reviews**	In-depth reviews of design for coordination. Use Navisworks, Revizto, or Solibri Model Checker for “Clash Detection” and data requirements	**X**	**X**			**X**
8	**Quantity Take-Off Reports**	Reporting on areas, volumes, square footages, objects, and material quantities supporting analysis, validation, procurement, estimating, and building system analysis	**X**	**X**			
9	**Phasing-Modeling (4D)**	Use model phasing tools to show design phases for design planning and scheduling		**X**			
10	**Logistics Modeling**	Modeling and representative views or animations supporting site planning, material and equipment handling, traffic patterns, etc.		**X**			
11	**Construction Sequencing**	4D or views showing construction phases and project development over time		**X**			
12	**3D Trade Coordination**	Use of model checking and “clash - conflict resolution” to verify model/s coordination – A Clash Resolution report is a deliverable		**X**			
13	**Facilities Data Turnover**	As-Built model LOD 300 with accurate data for FM. GC/CMAR will update the LOD 300 model with as-installed data	**X**	**X**	**X**		**X**
14	**Digital Layout**	Use of laser layout equipment for field layout of walls and other elements in the construction		**X**			
15	**Laser Scanning**	Use of laser scanning as a base to develop highly accurate existing models or to capture as-built conditions during construction		**X**			
16	**Digital Cx**	Commissioning (Cx) of the model for data integrity – Use of model in the field during commissioning to verify data	**X**	**X**	**X**	**X**	**X**
17	**Analysis Reporting**	All types of analysis including energy, daylighting, sun studies, LEED, as needed to meet project scope	**X**	**X**			
A/E= Architectural Engineer, GC – General Contractor or CMAR, CMi = Construction Manager inspection Cx= Commissioning Team							

4.0 BIM Project Deliverables

Table 9 shows the BIM project deliverables. Exact deliverables shall be discussed with the MDOT MAA BIM Manager. Deliverables must comply with Section 4.2 Electronic Submission and AIRPortal Document Manager. Additional project deliverable requirements are mentioned in Planning and Engineering Guidelines & Standards (PEGS) V2, Chapter 3 Deliverables.

TABLE 9: MDOT MAA BIM SUBMISSIONS and DELIVERABLES

	DELIVERABLE	FORMAT	DELIVERY METHOD	RESPONSIBLE PARTIES		TIMEFRAME
1	BIM Project Execution Plan (BxP)	Excel or Docx template	As agreed upon in BxP	A/E	GC	20 days after NTP (A/E); 30 days after NORA (GC)
2	Site Survey Information and Utility Locations	Native, IFC formats, Digital 2D PDF	As agreed upon in BxP	A/E		Before design starts
3	Laser Scans	Native Files	As agreed upon in BxP	A/E	GC	30 days after scan
4	Blocking & Stacking, Phasing Sequencing (Phasing project dependent)	AVI, MPEG, MOV	As agreed upon in BxP	A/E	GC	Concept design submittal (A/E); construction phasing submittal (GC)
5	Design Coordination and Construction Coordination Reports	Navis and EXCEL	As agreed upon in BxP	A/E	GC	Each design submittal (A/E); after each Construction Coordination meeting (GC)
6	Design-Intent 2D Drawings (Building and Site)	DWG, Digital 2D PDF	As agreed upon in BxP	A/E		Each design submittal
7	Design-Intent Model(s) (Building and Site)	Native Format, NWD (or Equal)	As agreed upon in BxP	A/E		Each design submittal
8	Final Design-Intent Model(s) (Building & Site)	Native Format, IFC, NWD, 3D PDF	As agreed upon in BxP	A/E		100% Design
9	Bid Model (DBB projects only)	Native Format	As agreed upon in BxP	A/E		Bid submission
10	Conformed Model (DBB) or Issued for Construction (CMAR)	Native Format	As agreed upon in BxP	A/E		Conformed submission (DBB) or Issued for Construction submission (CMAR)
11	Construction Models, including Fire Protection	Native Formats, NWD (or Equal)	As agreed upon in BxP		GC	As agreed, upon in BxP
12	Record (FM) Model(s) (Building and Site)	Native Format, IFC, NWD or Equal, 3D PDF	As agreed upon in BxP	A/E		Within 60 calendar days after receiving as-builts
13	As-Built Model(s) and Drawings (Building and Site)	Native Format, DWG, Digital 2D PDF	As agreed upon in BxP		GC	Within 60 days after final acceptance
14	FM Data	EXCEL/COBie	As agreed upon in BxP	A/E	GC	After Concepts, at each design submittal (A/E)
15	BIM Submission Review Checklist	PDF	As agreed upon in BxP	A/E		Each design submittal
16	COBie Spreadsheet	EXCEL	As agreed upon in BxP	A/E		With Record submittal (60 calendar days after receiving as-builts)

All models shall be submitted in native (.rvt) format for the project and in 2D and 3D PDF format as required. The submittals shall be compatible and editable within Revit or with markup capability in PDF or DWG in BlueBeam.

TABLE 10: SUBMISSION FILE TYPES	
Construction drawings new and existing	DWG and PDF
Installation permit drawings	PDF
Building permit drawings	DWG and PDF
Space Allocation drawings	DWG and PDF
Model files	.rvt model and associated files
Design, planning, and record drawings	DWG and PDF
Data files	COBie compliant excel spreadsheet

4.1 Folder Structure from Consultant Team to MDOT MAA

Models shall be e-Transmitted per Section 4.2 Electronic Submission and AIRPortal Document Manager (ADM) with the folder structure below. E-Transmitted versions are snapshots of the model at each submission level. Maintaining consistent file naming and use is critical for referenced (linked) files to function correctly across project teams and for MDOT MAA to retrieve data once the project is complete.
Folders should be supplied for each submission for Civil Drawings as required by the BxP.

FOLDER STRUCTURE for CONSULTANT SUBMISSIONS for BIM	
489 BWI	Campus BWI or Martin
XXX-XXX-XX	Project Folder (Project Number and name)
Concourse A	Building Number/ Name/Level (as required)
Presentations and Images	
2018-01-02 Renderings	Year/Month/Day Name
2018-02-02 Walk-thru - Animations	
2018-03-01 Slideshows	
Photographs	
Scanning	
Study	
Reports	
Model	
CADD	
Phase One – 30% Submission	
BIM	BIM review models during design (Navisworks)
BIM Submission	30% BIM Submission Model
Data Reports	
Phase Two 60% Submission	
BIM	BIM review models during design (Navisworks)
BIM Submission	60% BIM Submission Model
Data Reports	
Phase Three 100% CD	
BIM	BIM review models during design (Navisworks)
BIM Submission	100% BIM Submission Model

CADD	Collection of CAD Drawings Exported from Revit as well as produced in the CAD environment
Submission Documentation	
List of Drawings	
Specifications	
Cost Estimate	
Drawings	PDF Format
Full Size Set	Composite PDF with hyperlinks and bookmarks
Half Size Set	Composite PDF with hyperlinks and bookmarks
Individual Sheets	Individual PDFs 1:1 ratio corresponding to each sheet in the set
Geotech Information	
Design Report	
Conformed Model Submission	Updated Model based upon Bid Process reviews and discrepancies
Project Management	
BIM Execution Plan	Dated files for additional Submissions
Action Item Checklists	
Bid Documents	
Environmental Permitting	
Sustainability	LEED or other sustainability documentation
OFM Issues and Meetings	
Construction Phase (Four)	
Construction Schedule	
BIM	
Shop Models	
Coordination Model	
As-Built Model	
As-Built Drawings	
Commissioning	
FM Data (COBie)	

4.2 Electronic Submission and AIRPortal Document Management (ADM)

The electronic submissions process is outlined in PEGS Vol 2, Chapter 3.2, Deliverables by Design Phase. The prime consultant must upload all the submissions using ADM with hard copy submissions delivered to MDOT MAA for distribution and review.

4.2.1 e-Transmit for Revit Models

Revit model submissions shall use the e-Transmit for Autodesk Revit add-in. There is currently a 2GB limit on file size for ADM uploads. In the event a file is too large for upload, it will be delivered to MDOT MAA's GIS and Engineering Technology Section (GETS) via DVD or thumb drive to then be loaded into AIRPortal by the ADM Administrator.

The submitter shall provide a narrative on *delivered files connection*, and in what order the files shall be opened to reduce errors. Test the e-Transmit file and remove errors before submission.

Unacceptable Revit Errors:

1. “Error (must be addressed to continue)”
2. “Can’t obtain permission to edit the element. The Central model is inaccessible.
3. “Unresolved References. Revit could not find or read *n* references. What do you want to do?”
4. “Open Manage Links to correct the problem” does not allow the recipient to point to a file included in the *e-Transmit* package
5. “New shared parameters: id nnnn”
6. “The File could not be found.”

4.2.2 e-Transmit Revit files Best Practices

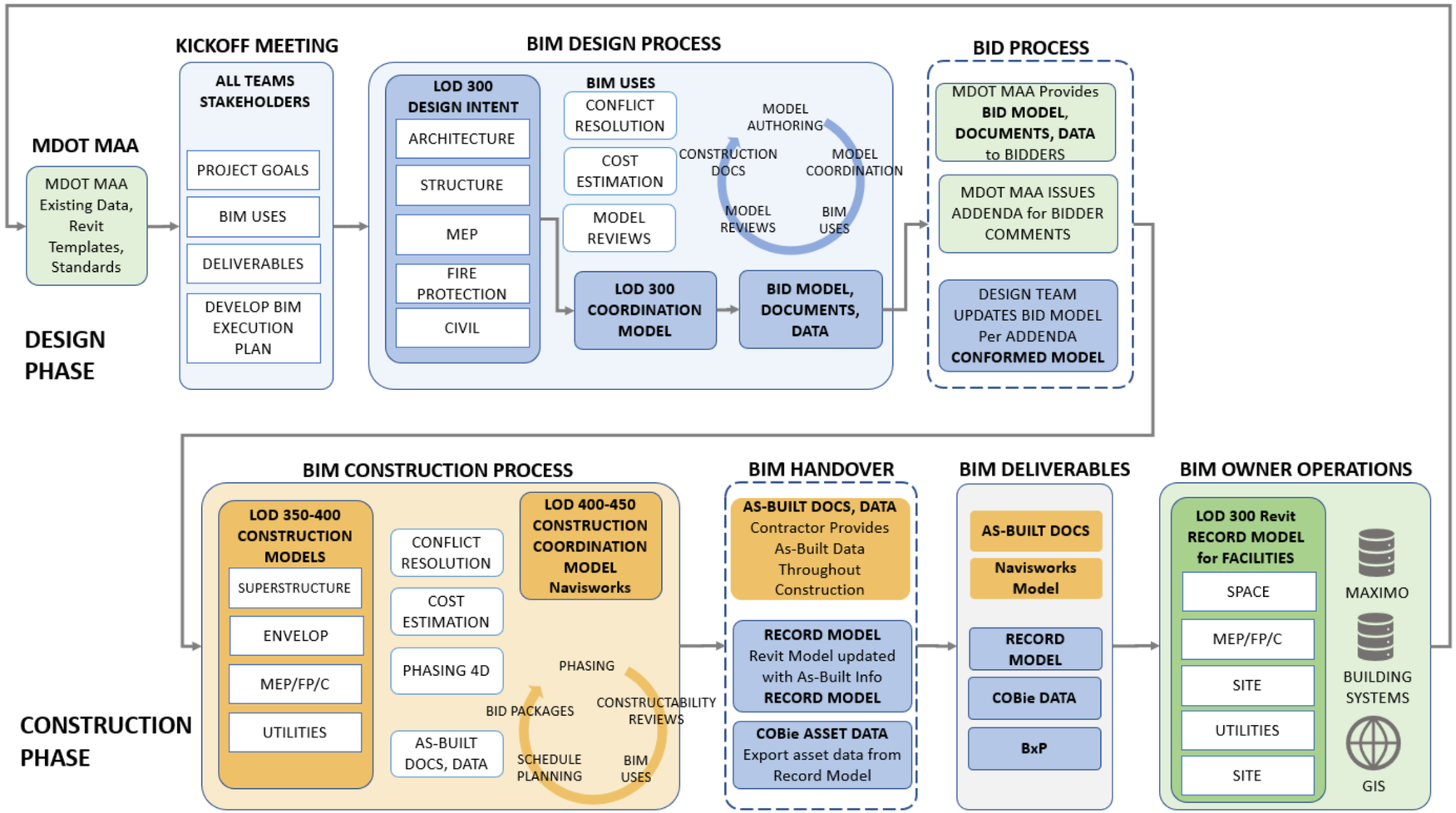
1. Include related dependent files such as linked models and DWF markups. Include supporting data such as documents or spreadsheets.
1. Disable Worksets
2. Remove unused families, materials, and other objects from the Revit models to reduce file size.
3. Delete unnecessary sheets and specific view types so that the models do not contain redundant data.
4. Include only the views placed on sheets.
5. Include dependent files. In some cases, not including these files can make the model unusable by the recipient.
6. Dependent files can be included automatically in the transmittal folder, reducing the possibility of error. Convert fully specified (absolute) paths of dependent files to relative paths or "no path" to ensure that the model can locate the dependent files.
7. Ensure model closure.

File types not automatically included in the transmittal folder during the e-Transmit process can be manually added to the transmittal directory after the e-Transmit process is complete.

1. Point clouds
2. Shared parameter file
3. Lookup tables
4. Material rendering images
5. XRefs linked to CAD models
6. External font files

5.0 General

Overall project organization and modeling conventions support the development of model and documentation deliverables in a BIM process. The required MDOT MAA Revit template supports this structure.



5.1 Revit Central File

All MDOT MAA projects shall use BIM work-sharing methodologies. A Revit Central file is created for each designated discipline team.

1. Worksets should be organized as described in Section 5.10 Workset Organization of this document.
2. Models should be opened **only** by going into "file -> Open" and selecting the "Create New Local" checkbox.

5.1.1 Central Model File Naming Convention

The model file naming convention includes the building or area name as designated by MDOT MAA. The GIS and Engineering Technology Section (GETS) is responsible for the administration of the Building Number Management Program. It will determine and assign all building identification numbers at BWI Marshall and Martin State Airports. The central model file naming convention includes:

Project Number	Space	**Software Version**	Space	**Discipline Designation**	Space	**Building Name /Code Description**	**.rvt**

Example: MDOT MAA-4604_R17_A.rvt

5.2 Discipline Designations, Codes

A/E design models must be subdivided by discipline and by non-building equipment as required in the MDOT MAA BIM Standards. All discipline model divisions are to be documented in the BIM Execution Plan (BxP). In general, each discipline model must contain the objects that relate to their discipline's design.

TABLE 11: DISCIPLINE DESIGNATIONS DISCIPLINE CODE	DISCIPLINE
A	Architectural
B	Geotechnical
C	Civil
D	Demolition
E	Electrical
F	Fire Protection
G	General
H	Hazardous Materials
I	Interiors
L	Landscaping
M	Mechanical
P	Plumbing
Q	Equipment-Baggage
R	Real Estate/Lease
S	Structural
T	Telecommunication
V	Surveying/Mapping
Z	Contractor/Shop Drawing

5.3 Plot Sheets, Drawing Sheets, and Sets

Plot and sheet sets shall follow the MDOT MAA CAD Standards. The document types are named using the MDOT MAA CAD Standards naming convention. Refer to MDOT MAA Planning and Engineering Guidelines & Standards (PEGS) Vol 1, Appendix 1D, Table 1D-5, Construction Drawings Set. Drawings from BIM shall conform to these requirements.

5.4 Model and CAD Referencing

All discipline models must be referenced to each other with the process described in the BIM Execution Plan (BxP) to ensure proper coordination between disciplines (lighting to ceiling, utility hookups, structural support, etc.).

All CAD files referenced into Revit models should be Linked (not inserted) with Current View Option only as 2D elements. There should not be any CAD files directly inserted into Revit. No CAD files should be visible in any 3D view. The only CAD files temporarily added as 3D geometry are topography files on link CAD worksets.

5.5 Multiple Building Projects

There is only one building per file. Multiple buildings require a Composite model file. Duplicate the file structure for each building. The Composite model integrates individual building models into a Site/civil model for submission.

5.6 Modeling Tolerances and Dimensioning

Building objects are modeled in a location within industry standards tolerance of not more than 1/2". All elements in the model use real-world dimensions (not nominal). The A/E and GC are responsible for designating stricter tolerances if needed for specific BIM Uses, fabrication, laser layout, or installation as outlined in the BxP.

If laser-guided layouts (such as Total Station), pre-fabrication, or modular assembly techniques are used, then the modeling teams, preferably with the GC, will review the tolerances required in those areas and for that building system component. Results, and any adjustments affecting current and future modeling, are documented in the BxP. MDOT MAA BIM Manager must approve exceptions.

Dimensions must comply with MDOT MAA CAD Standards, be automated, associated, have an object reference, and not overridden. Dimensional values (i.e., the text appearing in dimension strings) will be in Imperial units (e.g., 10'-0").

5.7 Model Navigation

Because MDOT MAA will receive numerous models from different A/E and construction teams, a standard view structure is critical for MDOT MAA to review and use federated models.

1. MDOT MAA is enforcing strict project browser organization mandatory for all Revit Files it receives from consultants.
2. The project browser organization shall meet the design, construction, and facility management requirements.

5.7.1 Project Browser

Others use BIM models after the design is complete. To facilitate this, MDOT MAA requires a uniform project browser organization for consistency between projects and files. Proper project browser organization streamlines model review and verification by the client.

1. The Default Project Browser organization for Views, Sheets, and Schedules are based on two Project Parameters: Category and Subcategory.
2. All View organization should sort the views by Associate Levels.
3. All Views, Schedules, and Sheets in the Revit file shall be categorized according to their purpose (function): Administration, Coordination, Documentation, Design Review, Design Authoring, Exports.
4. Additional Views, Schedules, and Sheets categories may be added if approved by MDOT MAA BIM Manager and documented in the BxP.
5. All Views, Schedules, and Sheets should use the naming conventions.

5.7.2 View Organization Requirements

Any Revit file should contain at least three mandatory categories of views in the Project Browser:

1. Administration
2. Coordination
3. Documentation

Additional categories for views must follow standards and best practices.

The category of Administration views should contain at least three main Subcategories for Levels, Worksets, and Categories.

The category of Coordination views shall contain building working floor plans, elevations, sections, and should be divided into the corresponding subcategories.

The category of Documentation views should be divided into Subcategories that represent the sheet index number of the corresponding construction documents: A01, A02, S01, etc.

When working with Phases in a project, a new mandatory project browser organization should be created: Phase / Category / Subcategory, sorting the views by their phase.

If several design disciplines are present in one model file, a new mandatory project browser organization shall be used: Discipline / Category / Subcategory, based on the discipline view parameter.

Each Revit File should contain mandatory views that help with model management, verification, and audit. Each model should include the following views:

1. Category Views: Views that include specific isolated individual Revit Categories (one per category.) There are a limited number defined by the owner.
2. Level Views: One view per level. Directly connected with corresponding levels and shared names.
3. System View: Views with isolated Mechanical, Electrical, Plumbing System types
4. Workset Views: Views that contain separate individual user-defined worksets (one per workset per view.)

5.7.2.1 Sheet Organization Requirements

There are two mandatory sheet categories in the Project Browser: Administrative and Documentation. The subcategories of the sheets under Documentation Category shall be divided based on the Construction Document Sheet Index: A01, A102, S01, etc.

5.7.3 Views

Revit projects consist of a variety of views: Floor Plans, Reflected Ceiling Plans, Sections, Elevations, Isometrics, Perspectives, Details. The number of views in the project does not affect the size of the Revit file. Each view contains only the specific set of Visibility and Graphic settings necessary to display the correct model components.

Annotation components: Lines, Dimensions, Text, Tags are in View Worksets and will contribute to the overall size of the model. If views with 2D elements are replicated, the file size will increase. Use the “duplicate with details” option as little as possible.

5.8 Geo-Reference Requirements

MDOT MAA requires all models to contain geospatial information referenced between a permanent, physical, USGS Survey Markers geographic survey point available in the Maryland State Plane Coordinate system, and the coordinate system within the project itself. The survey points are available in the MDOT MAA Survey Control Manual. It is necessary to tie the model to an actual, physical point in space, appropriately referenced during construction, and for other purposes. All models must be correctly geo-referenced and fulfill the following requirements.

5.8.1 Project and Shared Coordinates

All Revit files in the Design model shall have project and shared coordinate systems.

Project Coordinate System Requirements:

1. For each building, a Project Coordinate System should be established by placing Major Grid Line Intersection at Hardcoded Revit Origin.
2. Each building in the project should be located orthogonality relative to Project North, independent of True North orientation. The example shown in Figure 11 below.

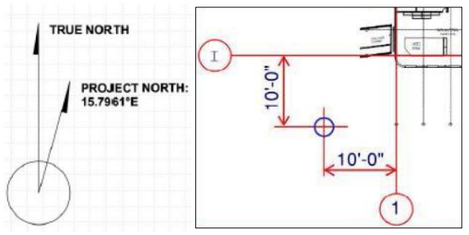


Figure 11 – Exterior Building Marker

3. One of the building Levels should be aligned with Hardcoded Revit Origin and have Elevation equal to “0” relative to Project Base Point.
4. All Revit Files related to the same building should be linked “Auto - Origin to Origin” only to share Project Coordinate System.
5. The Revit template file should be used with the MDOT MAA supplied coordinates.

5.8.1.1 Shared Coordinate System Requirements

1. Each project should contain the Revit Site Context model with an established shared coordinates system aligned with the Civil 3D files. This file should accurately position buildings in space relative to other buildings and structures located on-site.
2. Shared coordinates are established within the Site Context model in a way that all model elements or linked files are located within a 2-mile radius from the hardcoded Revit origin in the Site Context model.
3. Major Civil gridline intersections should align with hardcoded Revit origin, and site project base point coordinates should be populated based on the Civil grid line values.
4. Architecture Revit files establish the shared coordinate system by placing the Revit file into the Site Context model, aligning it to the proper position in space (True North Orientation, Building Elevation) and Publishing Shared Coordinates System back to the file.
5. All discipline Revit files should acquire the shared coordinate system from the linked Architecture model.

5.9 Model Levels

Each project should have a clearly defined list of Levels in the BIM Execution Plan (BxP). The MDOT MAA BIM Manager confirms these. All project Revit files should have the same number of levels and names. The naming conventions come from the MDOT MAA space allocation drawings and building floor plans.

If it is necessary to add additional levels, then the name of the levels and associated elevations (both project and shared) should be documented in BxP and approved by the MDOT MAA BIM Manager.

5.10 Workset Organization

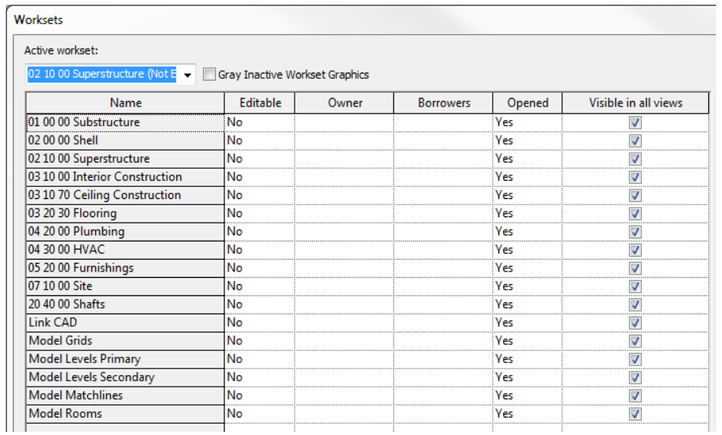
Worksets are a primary method for model organization and collaboration. There are three Workset types defined in Table 12.

TABLE 12: WORKSET TYPES		
Worksets that contain building elements:	01 00 00 Substructure	Organization carried out by OmniClass (OmniClass Table 21)
Worksets that contain External Links:	Link CAD Link [name of the connection file]	Used for linking DWG documents. Linking the .rvt file for each connection file separately.
Workspaces that contain elements related to the model:	Model Rooms Model Levels and Grids Model Levels Primary (Model Levels Secondary) Model Grids Primary (Model Grids Secondary) Scope Boxes	Including the room space, the line of room separation, and other connected features. Including levels and axis. Worksets used in many levels. Worksets used in many axes.

5.10.1 Workset Naming Conventions

Workset naming conventions and content definition use OmniClass. Worksets will increase according to model progression and complexity. New Workset types include documentation. Worksets that are “workspaces” will be deleted before final submission. Worksets used for linking 3D DWG documents shall conform to the naming conventions.

Figure 12 is a preliminary Workset list for project launch. If a model is used for a study and not carried forward, then a reduced workset may be used; however, if there is a potential of the model moving forward, then OmniClass building worksets with more granularity should be applied.



Name	Editable	Owner	Borrowers	Opened	Visible in all views
01 00 00 Substructure	No			Yes	☑
02 00 00 Shell	No			Yes	☑
02 10 00 Superstructure	No			Yes	☑
03 10 00 Interior Construction	No			Yes	☑
03 10 70 Ceiling Construction	No			Yes	☑
03 20 30 Flooring	No			Yes	☑
04 20 00 Plumbing	No			Yes	☑
04 30 00 HVAC	No			Yes	☑
05 20 00 Furnishings	No			Yes	☑
07 10 00 Site	No			Yes	☑
20 40 00 Shafts	No			Yes	☑
Link CAD	No			Yes	☑
Model Grids	No			Yes	☑
Model Levels Primary	No			Yes	☑
Model Levels Secondary	No			Yes	☑
Model Matchlines	No			Yes	☑
Model Rooms	No			Yes	☑

Figure 12 - Worksets

5.11 Model Phases in Revit

All renovation, additions, and fit-out projects should utilize at least two phases: Existing and New Construction.

There is no Demolition phase in the Revit file as demolished objects are marked as such using Phase filters in the New Construction Phase. If multiple phases are present in the project, they must be documented in BxP and approved by MDOT MAA. Only phase filters appearing in the template file are used in all project Revit files.

5.12 Schedules and Details Development

All schedules are exported from the properties of the model object, except for calculations (e.g., calculations for low voltage, structural, electrical, etc.). Schedules should not contain unconnected data.

Exceptions are calculations done outside of BIM. These are noted in the QA/QC reports identifying the technical reason for this exception. Designers and contractors submit reports per the BxP.

Both details and schedules are reported from the model with as little 2D drawing as possible. All construction details must be “Model Details” linked to the 3D view. No “Drafting Details” created in 2D software and added as 2D Drawings will be accepted unless they are approved MDOT MAA details for existing equipment installs.

5.13 Legends and Symbols

Legends and symbols in the 2D drawings may be 2D representations connected to an actual referenced BIM object. (i.e., any change to the BIM object will result in an immediate updated 2D image). BIM Objects must be 3D with attached or associated data and metadata as defined in the MDOT MAA BIM Standards.

6.1 Annotations

The model and objects shall have appropriate non-graphical properties to accurately automate annotation tags, generate schedules, and report Construction Operations Building Information Exchange (COBie) data from the model. All general annotations must comply with the MDOT MAA CAD Standards graphics. Where the MDOT MAA Standards does not explicitly define a standard for an annotation, the latest version of the National CAD Standards applies. The models must use the appropriate tool within the BIM software designed for that purpose.

All references including, but not limited to, elevations (interior or exterior, partial, or whole), sections (building, wall, or object), plan, and detail callouts or marks must be created using the appropriate tools/commands from within the BIM software and remain dynamically connected throughout the project. Manual overrides are not permitted.

Title block identification values (e.g., sheet number and sheet name) must be associated and automatically populated and remain current throughout the project. Annotation symbols such as tags are to read and display information contained within the model properties. Fire rating fill patterns must be constructed within 3D wall types so that the partition's respective rating shows through all scales and views, including 2D drawings.

6.2 Common Parameters

Table 13 shows Revit Categories considered MDOT MAA assets. MDOT MAA Asset Management Standard identifies the assets MDOT MAA is tracking. Tracking is reported with COBie or an approved excel report.

TABLE 13: REVIT CATEGORIES - ASSETS			
Air Terminals	Lighting Fixtures	Communication Devices	Furniture
Duct Accessories	Mechanical Equipment	Data Devices	Telephone Devices
Electrical Equipment	Sprinklers	Fire Alarm Devices	Specialty Equipment
Electrical Fixtures	Pipe Accessories	Security Devices	Plumbing Fixtures
Lighting Devices			

Each Asset has parameters to be populated throughout the project. Some parameters are unique to product types; others are common for all types of assets. Common parameters are created as a shared project parameter.

Table 14 list Common Parameters:

TABLE 14: COMMON PARAMETERS					
Asset Type	Instance Name	OmniClass Group	Serial Number	Type Description	Warranty Start Date
Category	Location	OmniClass Number	Space Name	Type Name	Warranty End Date
Design Basis	Manufacturer	Option Name	Space Number	UniFormat	
Documents	MasterFormat	Phase Created	Tag Number		

6.2.1 Properties

Construction assemblies and products represented as objects must include the properties of the object as described in the MDOT MAA Scope of Work (SOW) and the MDOT MAA Construction Operations Building Information Exchange (COBie) requirements. The consultant may use external BIM tools to manage the data during design. The final deliverable must provide the required information in a COBie format for import into Maximo.

6.3 System Families

System Family Categories such as Walls, Ceilings, Floors, Roofs, Pipes, Ducts, Rooms should be created per best practices and reside on proper worksets. All System Family Elements should accurately represent final construction assemblies, have no gaps, and correctly join intersecting elements.

6.3.1 Use of Generic Elements

If a material or type of assembly is not established at the early stages of the design, Generic Family types with Generic Materials should be used to represent undefined Geometry. New family types with proper layering, materials, and exact sizes should be created only after the appropriate Work Result category is selected for model elements. System families' naming conventions will vary based upon the Category of Elements.

6.4 Modeling Spaces

Spatial and room objects shall adhere to the MDOT MAA space standards in PEGS V1, Chapter 2 Building & Space Naming, Identification, Addressing, and Measurement Standard.

Define spatial and room objects as departments, areas, mechanical spaces, and zones, which are typically part of the Architectural, Mechanical, Electrical, Plumbing, Fire Protection, Security, and Communication Technology (MEPFT), or Interior Design models. Use the appropriate tool to generate spatial or room objects and associate them with bounding elements (walls, doors, windows, floors, columns, ceilings). All properties information related to spatial or room objects appearing in schedules, exports, tags, and diagrams must be generated from and connected to the model geometry, which defines its boundaries.

The Net Square Footage (NSF) must be modeled for each functional room and space. Rooms must be represented and broken down into functional areas even though they may be parts of a larger designed physical area. A physical area may contain several functional areas treated as individual "rooms" in the spatial program. If two rooms have different functional space classifications within the same physical area, they are modeled as two separate spaces. For example, a security checkpoint not enclosed by walls is defined as two different non-overlapping spaces. These spaces may be grouped into a Zone for visualization and analysis purposes (e.g., for thermal simulation calculations).

1. **Operational Areas, Airline Departments, Leased Spaces, Security:** The MDOT MAA will define the organizational arrangement for providing services. Group rooms into departments for space management and square footage analysis.
2. **Circulation, Egress Calculations:** Calculate values based on the spatial areas derived from the model floorplates.

6.4.1 Spatial Data

Spatial data includes the properties of the spatial object and applies to areas of four-square feet or higher. Model submissions at the end of the Study Phase and Design Development Phase must contain data to generate a tabular calculation from the model for comparison with the proposed project program space requirements. Spatial objects and data must be maintained throughout the project lifecycle.

6.4.2 Modeling Space Reservations for Maintenance

The consultant and the General Contractor (GC) must model space reservations for maintained equipment and systems. Managed systems include mechanical, electrical, plumbing, fire protection, security, and communication technologies (MEPFT). Grouped space objects shall be hidden as necessary. Space reservations are shown in design and construction coordination facility maintenance and asset management activities.

Space reservation zones are modeled as 3D transparent (volumetric) shapes, as shown in Figure 13. Transparency shall be between 65% and 85%, labeled by discipline, color-coded, and designated "Not in Contract" (when applicable) in the model and plans. Space reservations must accommodate:

1. Operations, adequate physical access, and tool/tool cart access (including unobstructed paths of travel) for repair, maintenance, and replacement.
2. Significant equipment removal, equipment replacement pathways, access hatches, knockout panels, doors, and elevators, and access to equipment, systems, and attachments located above ceilings.
3. Space accessibility reservations for code requirements, manufacturer's maintenance zones, equipment specifications, and any manufacturer specific design requirements.

Spaces for existing equipment are not required unless the new design elements impact the existing open space.

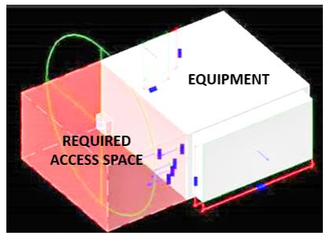


Figure 13 – Space Reservation Modeling

6.4.3 Construction Coordination

Space reservation settings represent the physical access requirements of the maintained system or equipment (e.g., Fire Protection) by the General Contractor (GC) for installation. The GC must confirm with MDOT MAA Maintenance the routing and sizes needed for business systems, etc., and assure that the space reservations are free spaces. MDOT MAA will approve the final routing and space reservations. The GC must install the building systems to the approved Construction Coordination locations. Examples must be modeled as space reservations and be included in Design and Construction Coordination. Each project must have these systems identified.

TABLE 16: SPACE RESERVATION MODELING	
Low-voltage systems	Radio/Wireless
IT system components	Video
Internet/WIFI	Security
Telephone	Wayfinding – Signage
Public Address	Television – Information Screens

6.5 Wall Naming Convention

Subdivide walls into groups: Structure, Exterior, Partitions, Finish, etc.

Structure Walls, Exterior, Partitions, and Finishes, should be modeled as separate elements. Wall finishes belong to a different Building system, Omniclass (21-03 20 00 Interior Finishes), and should be separate from (21-03 10 00 Interior Construction). It is a requirement for model verification and audit, cost estimation exercises, and other BIM Uses, during construction and facility management.

Furring walls placed next to the Structural Concrete walls or Masonry Shaft walls should be modeled as separate elements. Wall sweeps are allowed but as independent objects. They should not be built into the Wall Family structure.

Finish materials (tiles, wall coverings, floorings) should be modeled as separate elements and joined to partitions.

Structure, Exterior, Partitions, and Finish walls shall be assigned to their designated worksets.

Wall names should start with their group name, followed by a brief description. For example:

A. Structure - Concrete 0' 8"
B. Exterior - Brick on Studs 1' 2 1/2 "
C. Partition - M10
D. Finish - CT-2 Ceramic Tile

For partition wall types, include a Partition Type Mark in the Type Name of the wall.

For finishes, include a designated Material tag in-wall Type Name.

6.5.1 Partition Types

Interior Partitions, Fire-Rated Partitions, and Smoke Barriers must include fire resistance ratings in the wall object properties and be graphically depicted in 2D plan sets and 3D model views. A different partition name is created for each type of wall used in the models.

Fire rating fill patterns must be constructed within 3D wall types so that the partition's respective rating shows in all scales and types of views, including 2D drawings. An example of fire-rated walls is shown in Figure 14.

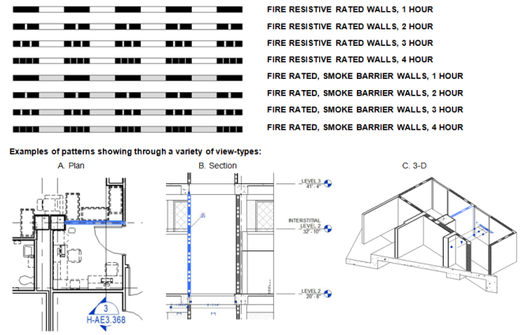


Figure 14 – Fire Rated Walls

6.6 Loadable Families

Loadable Families include numerous categories of objects edited outside of the Project file in a Family Editor and loaded back into the project for use. All loadable families must be created and optimized by the design team to satisfy MDOT MAA BIM guidelines. Any manufacturer or third-party content should be reviewed and optimized. They should fulfill but are not limited to, the requirements in Section 6.6.1 General Requirements of Loadable Families.

6.6.1 General Requirements of Loadable Families

1. Assign all loadable families a proper Revit Category. The generic category may be used if no appropriate category is available.
2. No surface-based families are used in the project.
3. No face-based, floor-based, or roof-based families should be used in any MDOT MAA Project
4. Families in the Architectural model such as doors, windows, casework, lighting, plumbing fixtures may be created as wall-based or ceiling-based families.
5. MEP families should be "free-floating," associated directly to model levels. There should be no surface-based, wall-based, ceiling-based families in the MEP model.
6. Geometry should relate to the material parameter, called Material. If multiple materials exist, multiple parameters should be created, starting with the word Maternal, then followed by a brief description.
7. For families with no established Material, a Generic material should be used.
8. Assign an OmniClass Number as a family parameter to all loadable families.
9. Families should contain all shared parameters per model requirements.
10. Purge unused materials, hatches, line types, and other items from the model.
11. Purge referenced CAD and image files used during family creation from all loadable families.
12. Test all loadable families by changing parameter values and family types in the Family Editor in the project environment.
13. Loadable Families should be free of warnings and exceptions.
14. Parameters within families that have the same meaning or use, but different names must be renamed before use so that the names match.
15. Parameter lists should be intuitive, clearly defined, and organized. Use standard industry abbreviations. Parameter naming shall:
    a. Capitalize Each Work Case, with spaces.
    b. Have no underscores.
    c. Example: Refrigerant Inlet Connector Diameter, Data Circuit Connection, Design Task Number
16. Loadable families should contain all necessary parameters used during design, construction, and facility management. Remove unnecessary parameters from the model. Parameters within families that have the same meaning or use, but different names must be renamed before use so that the names match.
17. Complex families may contain nested families; however, nested families follow the same standards as the main family.
18. Loadable Families should contain the appropriate level of detail and visibility parameters appropriately managed, so families cleanly shown are various view scales.
19. Loadable Families should prioritize reference lines/planes.
20. Place Loadable Families under the appropriate categories. For example, a chair should not be a "generic model"– generic models may be allowed in some circumstances but must be documented in the BxP. Not everything gets placed in "specialty equipment" – the team should pay attention to non-cuttable families vs. cuttable family categories.
21. Loadable Families should never be "branded," meaning no product logos, or service provider company names. No links should appear within the Revit family.
22. Loadable Families should contain native Revit content, not imports from other programs (.dwg, .sat, .skp)

23. Loadable Families should be free of manufacturer data during the design process, nothing beyond the "basis of design." During construction, this data should be further populated in the As-built Model and aligned with MDOT MAA BIM Standards.
24. Keep Loadable Families under 2 Mb.
25. Clean and purge Loadable Families of extraneous data, non-functioning parameters, and unnecessary items (images, linework, useless reference planes not used for parametric functionality).
26. Loadable Families include numerous categories of objects edited outside of the project file in a Family Editor then reloaded into the project.
27. Loadable families should contain all necessary parameters used during design, construction, and Facility Management Work. Remove unnecessary parameters before the content is used in the model.

6.6.2 Loadable Families Naming Conventions

All loadable families should be named using the following naming convention:

[OmniClass Table 23 (Singular)] + [Manufacturer Name] + [Model Number]

Ex 1. 23-21 43 15 25 Paper Towel Dispenser Bobrick B-3699

Ex 2. (Omniclass No.) Centrifugal Pump Armstrong 4030

For Generic models where manufacturer and model numbers are not determined, a Unique Description should be used to differentiate one Generic model from the other.

[OmniClass Table 23 (Singular)] + [Unique Description]

Ex 2. 23-21 43 15 25 Paper Towel Dispenser with Disposal Unit

Ex 2. (Omniclass No.) Centrifugal Pump Centerline Axial

No manufacture families should be used in the project. All Families should be generic with a proper generic material assigned until specific equipment is selected for the project. Even after a manufacturer and model number is selected, manufacture families need to be optimized to comply with the MDOT MAA Revit template.

6.7 Door Numbering

MDOT MAA utilizes door numbering as a primary space identifier. Each entry or opening designated as a door, regardless of type, will be assigned a unique Door Identification Number per PEGS V1, Section 1.3.4.4 Assignment of Door Numbers. For additional information, refer to PEGS V1, Chapter 2, Building & Space Naming, Identification, Addressing, and Measurement.

7.0 General

The model Level of Development (LOD) supports construction documentation and schedules from the model. Figure 17. shows a general BIM workflow.

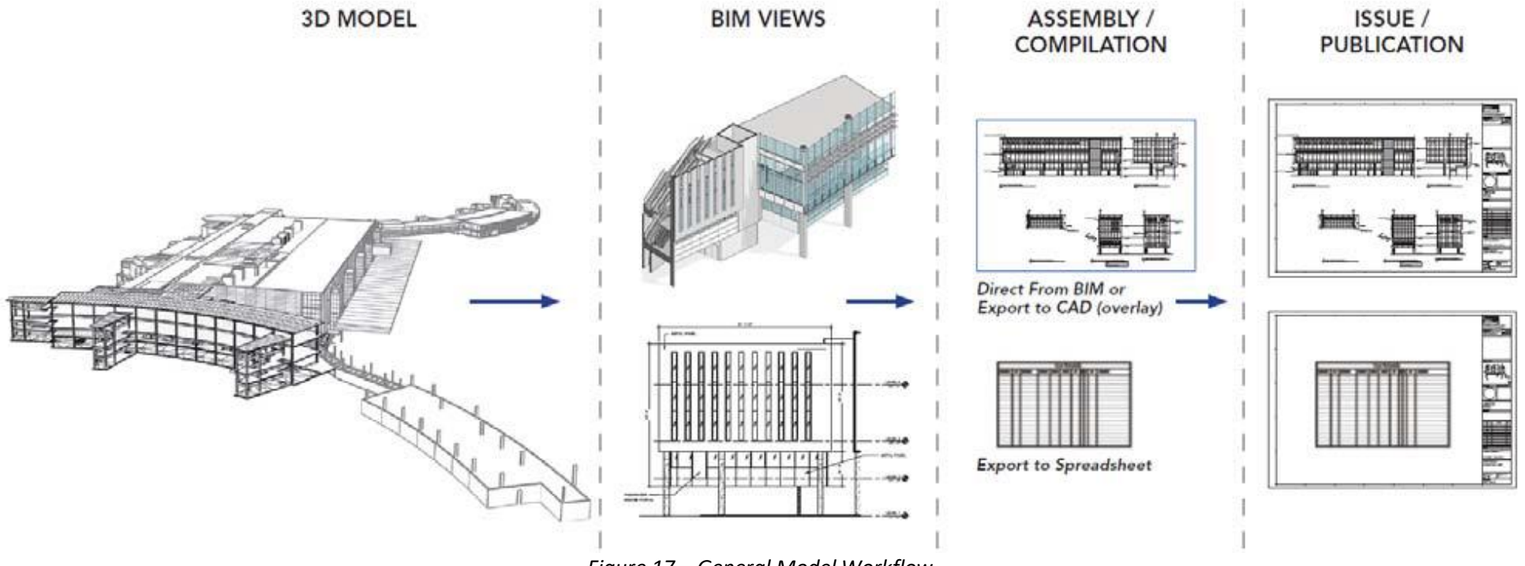


Figure 17 – General Model Workflow

Minimum Modeling Requirements

The following categories of a project are modeled.

1. Elements in the scope of work (SOW)
2. Items affected in the construction site
3. Building structures, equipment, and building systems
4. Utilities above or below ground inside and outside to service connections
5. Construction Details unless supplied by MDOT MAA
6. Preserved landscaping areas
7. Any protected areas during construction
8. Project site conditions affecting safety, logistics or public outreach
9. Equipment needed for facilities maintenance
10. Space reservation for maintenance
11. Existing conditions modeling

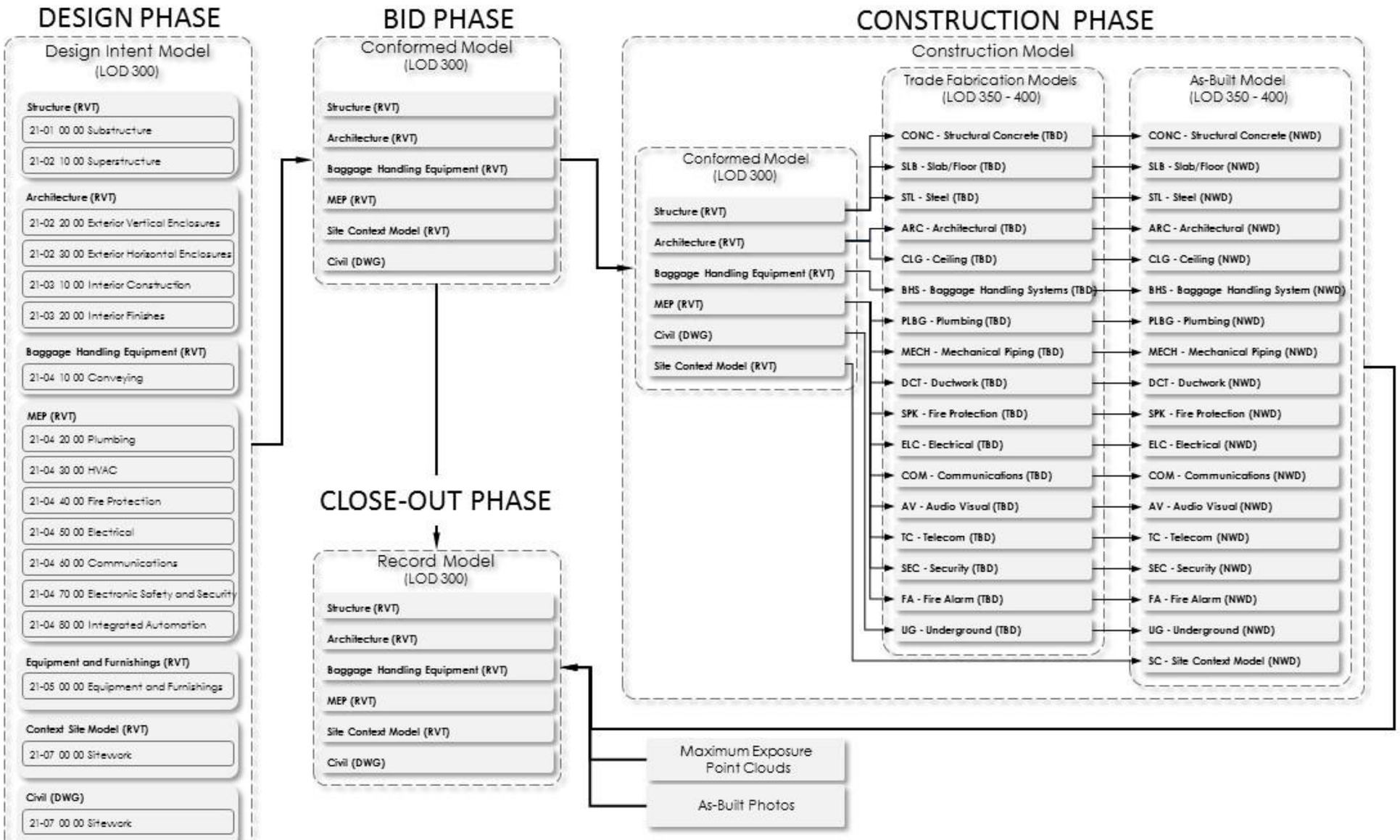


Figure 18- Models by Phases

7.1 Architectural Model

Architectural models include the objects relative to floors, exterior and interior walls, partitions, roofs, vertical transportation, windows, doors, stairs, ramps, railings, ceilings, grilles & gates, interior specialties, etc. Required structural blocking (such as restrooms) must be modeled for quantities, size, shape, and location, etc. Reference major structural components from the Structural model including, but not limited to, structural walls, floors, roof structure, columns, and foundations. Reference the Interiors model, the Equipment models, appropriate building equipment and systems models, and others as needed to coordinate the work.

1. **Interior Partitions, Fire-Rated Partitions & Smoke Barriers:** Must be modeled to include fire resistance ratings in the wall object properties and must graphically be depicted in 2D plan sets and 3D model views. A different partition name is to be created for each type of wall used in the models.
2. **Electrical Outlets:** Model the location of electrical outlets required for equipment.
3. **Door Objects:** LOD 300 and attribute data. Properties of door objects must include finish information, door swing, vision panels, seals, acoustical properties, hardware, locks and keying, electrical requirements, and applicable fire resistance ratings. Door objects must have an accurate offset in the model.
4. **Ceilings:** Properties include fire ratings and sound transmission coefficients.
5. **Raised Floors:** LOD 300 - Model Access or Raised Floors. Exclude secondary supports in the Design Intent model.
6. **Casework:** All architectural casework, millwork, and features provided by the GC include finish information and collected in the room properties to be included in the overall room finish tag. Casework materials will consist of a horizontal and vertical element. Model casework and countertops with correct dimensions (length/width, depth, and height).

7.2 Discipline Models

Provide Mechanical, Electrical, Plumbing, Fire Protection, Security, and Communication Technology (MEPFT) systems discipline models, referenced to the Architectural model and other discipline models as needed.

7.2.1 Mechanical

Mechanical equipment and distribution systems are a vital part of operating a facility. Consequently, all components of the mechanical systems must be model accurately and include the necessary space reservations for appropriate access during operations.

1. All system models must include all equipment necessary for operations including, but not limited to:
    a. Boilers
    b. Chillers
    c. Geothermal and solar energy systems
    d. Pumps and piping distribution systems (including modeling for pipe slope and insulation)
    e. Water-side terminal units
    f. Fans
    g. Air handlers
    h. Air distribution and evacuation systems including modeling for duct and equipment insulation
    i. Air-side terminal units
    j. VAV boxes
    k. Electrical feed and distribution systems transformers
    l. Electrical panels and switchgear
    m. Lighting
    n. Emergency circuitry
    o. Emergency generators
    p. All public utility systems from a tap
    q. All control systems, data, and phone wiring and terminal devices, data switches, data rooms, etc.
2. Fire protection must include fire ratings, sprinkler medium, pressure, and flow volume. Use OmniClass Table 21 to identify the system each asset is a part of, OmniClass Table 22 to align with specification sections, and OmniClass Table 23 to determine the asset type. Include all utility properties. Modeling will extend five feet beyond the project construction boundaries and to the first connection point of the system.

3. Model system elements 1.0 inch in diameter and higher (e.g., general plumbing, fire protection, etc. and other elements (ducts, cable trays, etc.) with a dimension of 4 inches. Conduit consolidated into cable trays are modeled as the tray.
4. Existing systems should be modeled in the Existing Phase if they affect New Phase development. Existing MEP elements should have the appropriate information to analyze MEP systems without referencing construction drawings per BxP. All information shown on construction drawings should appear as tags and keynotes, extracting information from model elements. No independent text should be used for annotating floor plans.

The designer shall incorporate the manufacturer, model, serial number, refrigerant type, capacity (full charge), number of circuits, and the circuit charge for any new HVAC equipment.

7.2.2 Electrical

The architect cosmetically arranges ceilings diffusers, light fixtures, etc. but the electrical engineer designs the systems. The architectural and electrical models must reference each other and be coordinated to eliminate mismatches between the models.

7.2.3 Plumbing

Restrooms are modeled to meet MDOT MAA requirements and fixtures classified using OmniClass designations.

7.2.4 Fire Protection

A "Design-Build" procurement executed by the General Contractor (GC) is used for Fire Protection systems. *The GC must assure that the Fire Protection system is a part of the BIM construction coordination management.* It is the GC's responsibility to ensure that the installed fire protection system does not interfere with the location or maintenance access of other building systems or equipment. The GC must provide as-built documentation to the designer showing the final location of systems and equipment to update the Record model.

7.2.5 Communications

Business systems infrastructure must be in separate models. These systems, if not a part of the GC's contract, must be modeled as Space Reservations and included in the Design and Construction coordination activities.

7.3 Structural Models

Structural models are the basis for evaluating and analyzing the building structure and include all the objects, elements, and components of the system. All material and material properties are included in objects. The building structure and geometry must be accurately defined and labeled as foundations, subgrade enclosures, slab-on-grade, superstructure, and exterior vertical enclosures and roofs.

8.0 Building Information Modeling (BIM) Templates Introduction

MDOT MAA uses National BIM Standard documents and templates as described throughout this standard. Download links for the materials and templates are provided in Chapter 8 of this standard.

8.1 Building Information Modeling (BIM) Execution Plan (BxP) Template, Version 1.0

MDOT MAA has two BIM Execution Plans templates for small and large projects:

A. MDOT MAA BxP Template 1
B. MDOT MAA BxP Template 2

See Chapter 3, Section 3.3.1 BIM Execution Plan (BxP) Templates for more information.

8.2 Building Information Modeling (BIM) Revit Template, Version 1.0

The MDOT MAA Revit template and supporting documentation align with the MDOT MAA BIM Standards. Files associated with the MDOT MAA Revit Template are for BWI and Martin State Airports. Files include:

File Name	Description
Baltimore City Vicinity Map.dwg	Reference map for BWI Thurgood Marshall Airport title block
BWI Site Map.dwg	Reference map for BWI Thurgood Marshall Airport title block
BWI-Thurgood Logo.jpg	BWI Airport logo to be used in Revit template
MAA Line Width Matrix.xlsx	Alignment of current CAD line weights to Revit template
MAA Origin.dwg	CAD file used to verify the true origin in the Revit file
MAA Revit Standards.xlsx	Listing of completed template standards
MAA Shared Parameters.txt	Shared parameters file for use in Revit
MAA Systems Naming Matrix.xlsx	Equipment and systems abbreviations in template
MAA Template.rvt	Revit template – BWI and MSA Title blocks included in the template
MTN Site Map.dwg	Reference map for Martin State Airport title block
MTN_LOGO.jpg	Martin State Airport logo to be used in Revit template

A. Use the MDOT MAA Revit template for BWI Marshall and MTN projects requiring BIM.
B. If a user changes any settings in the Revit template, they must record the changes in the and submit the worksheet to MDOT MAA for review before implementation. The project settings and the Revit template should always be in alignment.
C. Both the Project base point and Survey point can move in Revit. The only way to see the real file origin is to load the Origin.dwg using Origin to Origin settings. It is essential when establishing or verifying the building origin at the intersection of all major column grids. This file does not represent facility shared coordinates in any way.
D. Address any MDOT MAA Revit template questions and comments to the MDOT MAA BIM Manager.

8.3 COBie Spreadsheet Template, Version 1.0

The COBie spreadsheet is a report from the Record model providing the asset data required by MDOT MAA. The COBie spreadsheet template consists of the tables shown below. The required assets and asset information will vary by project and will be defined in the BxP. It may include things like location, asset type, model number, manufacturer, year manufactured, and date installed. The COBie data should be submitted ready to import into the MDOT MAA Maximo database.

	File Name
1.	Consumables-General
2.	Consumables-ProductTypes
3.	Files-Drawings
4.	Files-Photos
5.	InstalledProducts

6.	Plan-ProductTypes-Diagnostic
7.	Plan-ProductTypes-Maintenance
8.	Plan-Systems-Operations
9.	Schedule-Doors
10.	Schedule-RoomFinish
11.	Schedule-Signage
12.	Submittals-Hardware
13.	Submittals-Products
14.	Submittals-ProductTypes
15.	Submittals-System
16.	Warranties-ProductTags
17.	Warranties-ProductTypes
18.	InstalledEquipment-AirConditioner
19.	InstalledEquipment-AirHandler
20.	InstalledEquipment-Boiler
21.	InstalledEquipment-Burner
22.	InstalledEquipment-Compressor
23.	InstalledEquipment-Condenser
24.	InstalledEquipment-Controller
25.	InstalledEquipment-Evaporator
26.	InstalledEquipment-Fan
27.	InstalledEquipment-Furnace
28.	InstalledEquipment-HotWaterHeater
29.	InstalledEquipment-ValvesStrainers
30.	InstalledEquipment-Plumbing
31.	InstalledProducts-Electrical
32.	InstalledProducts-General
33.	InstalledProducts-ReadMeFirst.docx

8.4 Building Information Modeling (BIM) Submission Review Checklist

A BIM Submission Review Checklist is submitted with all model submissions to MDOT MAA as part of the review process. The submitting team provides answers and comments before submission. At the end of the document, the submitter will supply any additional information relevant to understanding the model content and structure for MDOT MAA reviewers.

8.5 Building Information Modeling (BIM) Construction Technical Specification

The MDOT MAA has developed a standard specification 010012X, Building Information Modeling (BIM) Use During Construction, available in PEGS Manual, Volume 1, Appendix 1F – Standard Specifications. This specification shall be used on all applicable projects. Consultants must coordinate with the MDOT MAA Task Manager and the GIS Engineering Technology Section (GETS) to determine appropriate projects.

SECTION 010012X BUILDING INFORMATION MODEL (BIM) USE DURING CONSTRUCTION

PART 1 – GENERAL

1.1 DESCRIPTION AND INFORMATION

The work to be performed under this Section includes, but is not limited to, the furnishing of all materials, labor, tools, equipment, services, and incidentals required to provide and maintain BIM information and model current and up to date during construction in accordance with the requirements of "MDOT MAA BIM Standards for Design and Construction Contracts at BWI Thurgood Marshall International and Martin State Airports (MDOT MAA BIM Standards)". This includes preparation of a BIM Execution Plan (BxP), approved by the Engineer, and monthly submissions of Clash Detection Reports, as well as, updated As-Built Revit (.rvt) model reflecting the installed geometry and equipment data necessary for a minimum Level of Development - LOD 300, as defined in "BIMForum, AGC LOD Specification (https://bimforum.org/lod/).

The MDOT MAA BIM Standards are available online at https://www.airportal.maa.maryland.gov, and is hereby incorporated into these specifications by reference. MDOT MAA BIM Standards include the latest versions of the following documents:

a. MDOT MAA BIM Standards for Design and Construction Contracts at BWI Thurgood Marshall International and Martin State Airports (MDOT MAA BIM Standards).
b. MDOT MAA BIM Execution Plan Template (BxP).
c. MDOT MAA Revit Template.

The final deliverables, at minimum, shall include ".dwg" as-built drawings delivered to the Engineer by the Contractor within 60 days of contract completion.

1.2 REFERENCED STANDARDS AND DOCUMENTS

All work related to this item shall be in accordance with the latest standards and references, including but not limited to:

a. National BIM Standard (NBIMS) – United States™
b. AGC BIMForum LOD Specification™ 2017
c. MDOT MAA BIM Standards
d. BIM Execution Plan Template
e. Conformed BIM Execution Plan (supplied by Design Team)
f. Conformed Design Model (supplied by Design Team)

1.3 MODEL WORKFLOW

NOTE TO ENGINEER – Engineer shall add to this section as required for items related/unique to the project.

BIM Execution Plan Life Cycle						
Design Phase	**Bidding Phase**	**Construction Phase**		**Final Deliverables**		
Design Intent Bid Model and Drawings	Comments made to **Bid Design Intent Model** by contractors during procurement	**Conformed Model** to the Contractor		**Record Model .rvt** based upon the **Conformed Model**	**As-Built Model. Navisworks**	**Record Drawings**
Provided for Bid Process by Designer	Approved changes made by design team and issued by addendum(s) – Becomes the **Conformed Model**	Conformed .rvt model basis of **Record Model**	Navisworks and Shop Models basis of **As-Built Model**	Developed by Designer with as-built changes.	Navisworks model of higher detail LOD 350 or higher based upon shop model information	AutoCAD drawings with As-Built information
Design Phase BIM Execution Plan provided to contractors during contract procurement		Construction Phase BIM Execution Plan		Final BxP provided to MDOT MAA by the Contractor		

1.3.1 Design Intent Model and Drawings. Bid Model delivered to MDOT MAA by the Designer for bidding purposes. This federated Revit (.rvt) model is the basis of the construction documentation and includes the linked drawings. The prospective contractors will receive the Design Intent Bid Model prior to submitting a bid, so that the contractors can submit any questions, deficiencies, or errors in the model and documentation.

1.3.2 Conformed Model. The Design Intent model updated by the Designer with any/all addenda incorporated. The resulting model is the Conformed ".rvt" Model. The selected contractor shall receive the Conformed Model and the design phase BIM Execution Plan (BxP) prior to the Construction Notice to Proceed (CNTP). The contractor shall be responsible for maintaining and real-time updating the Conformed Model during construction.

1.3.3 Construction Model & BIM Execution Plan (BxP). The contractor shall utilize the Conformed Model for BIM construction requirements, such as quantities, shop model development, and constructability reviews.

a. **BIM Execution Plan (BxP).** The contractor shall supply a Construction Phase BIM Execution Plan (BxP) with the Contractor's Final Detailed Schedule #1 due 30 calendar days from Notice of Recommended Award (NORA). This will identify

how the model will be used, responsible parties, Level of Development (LOD), review and submission schedules. BIM Execution Plan shall include:

1) Identification of Models that are created and their BIM Uses (purpose)
2) Data for equipment objects – LOD for geometry and data
3) Established coordinate system shall be checked and remain
4) Established unit conventions shall be checked and remain
5) Conventions for defining critical dimensions and critical Model content
6) File formats used
7) Quality Control and Clash detection procedures
8) Data security
9) File structure used – per MDOT MAA BIM Standard for deliverables
10) File-naming and object-naming conventions – per MDOT MAA Standard for deliverables
11) Software versions - .rvt of Design Intent Model
12) Procedures and protocols for confirmation of field changes
13) Use of model content in collaboration meetings and project issue communications
14) Connectivity to project schedule

b. Submit BxP to the Engineer for approval. The Engineer shall return comments within 21 Calendar days. Deficiencies in the BxP identified by the review process shall be corrected and a revised plan shall be submitted within 10 calendar days of the receipt of comments. This review and revision process shall repeat until the BxP is approved but must be completed prior to CNTP.

c. Conduct a BxP review at the initial Construction Review Meetings for clarification, and to verify the functionality of the Model, technology, workflow, and processes. Additional processes or activities shall be incorporated into the BxP based upon review. If modifications are required, the Contractor shall execute the modifications and resubmit the final BxP for approval.

1.4 SHOP MODELS

Shop models shall be federated in Navisworks for clash and constructability reviews. These models and shop drawings shall be submitted for the Engineer's review and approval. The minimum duration for this activity shall be twenty-one (21) calendar days. The Clash Detection report shall include the resolution activity and schedule for resolution. MDOT MAA, their agents, and Designer shall have access to the updated model during construction for review.

1.5 RECORD & AS-BUILT MODEL AND DRAWINGS

Additional requirements to Standard Provisions for Construction Contracts Volume 2, SP-8.08-Record Drawings/As-Built Drawings.

1.5.1 The Contractor shall supply monthly as-built information in drawings and ".rvt" model. This includes any changes in model geometry to reflect as-installed and as-built conditions at a defined level of development (LOD 300) and required asset data specified by MDOT MAA. If issues are found the Contractor shall complete the corrections and return the As-Built marked drawings and model to the Engineer within ten (10) calendar days.

PART 2 – PRODUCTS AND REQUIREMENTS

NOTE TO ENGINEER – Engineer may add to this section as required for items related/unique to the project.

2.1 SYSTEM REQUIREMENTS

A. Computer with enough compute power, graphics card, and RAM to manipulate the model in review meetings, perform clash detection, and model integration.
B. On-site Network Capability

2.2 SOFTWARE REQUIREMENTS

A. Revit version used by design team on project
B. Navisworks
C. Blue Beam
D. Solibri

PART 3 - EXECUTION

3.1 BIM DELIVERABLES

NOTE TO ENGINEER – Engineer may add to this section as required for items related/unique to the project.

3.1.1 As-built Documentation and BIM deliverables shall conform to SECTION 8 of the Standard Provisions.

3.1.2 Deliverables Required Prior to CNTP: The following deliverables shall be provided under this section. Project startup deliverables:

a. BIM Execution Plan (BxP): Due 30 calendar days from Notice of Recommeded Award (NORA). Allow 14 calendar days for comments. Resubmit for approval based upon comments. Process of review and resubmission of the BxP shall continue until acceptance by MDOT MAA. This activity is considered incidental to this pay item and no separate payment will be made to the Contractor.

3.1.3 Deliverables Required During Construction Phase

a. As-built Model (rvt.) Monthly submission of updated model and drawings to include work performed during the previous 30-day period.
b. Updated BIM Execution Plan (BxP) when any changes occur.

c. Monthly submissions of Clash Detection Reports and the updated Navisworks integrated model for reviews
d. Shop Models –In accordance with Special Provisions SP-8.06

3.1.4 Project deliverables required at project closeout: Record Drawings, Record Model, and Navisworks Model, and Record Drawings with as-built information are required deliverables at the completion of construction.

a. Submit final Record and Navisworks Model within 14 calendar days of notification of substantial completion.
b. The Design Team shall have 21 calendar days to review the Record Documents and Model and issue comments.
c. Upon receipt of Design Team's comments, the Contractor shall complete revisions to the model and record documents and resubmit within 14 calendar days. This review and revision process shall repeat until all comments are addressed and the model is approved.

PART 4 – METHOD OF MEASUREMENT

4.1 BUILDING INFORMATION MODEL (.rvt) MONTHLY UPDATES

Payment under this item for each monthly update submitted on schedule and approved by MDOT MAA shall be made in equal monthly installments based upon the lump sum bid amount divided by the contract construction schedule duration (in months). Monthly payments shall be forfeited for any month that an acceptable update is either not submitted or is submitted more than 5 calendar days late. The lump sum paid for this item shall be considered full compensation for performing the work specified herein and for furnishing of all materials, labor tools, equipment, and incidentals necessary to complete the work to the satisfaction of the Engineer.

4.2 FINAL AS-BUILT MODEL – AS BUILT CONDITIONS

Payment under this item shall be made as a single lump sum upon MDOT MAA acceptance of the final model. The lump sum paid for this item shall be considered full compensation for performing the work specified herein and for furnishing of all materials, labor tools, equipment, and incidentals necessary to complete the work to the satisfaction of the Engineer.

PART 5 – BASIS OF PAYMENT

Payment will be made under:

Item 010012X-1 Building Information Model (rvt.) Monthly Updates - (Lump sum amount bid shall not be less than $XX,XXX.00) – per lump sum

Item 010012X-2 Final As-Built Model - As-Built Conditions - (Amount bid shall not be less than $XX,XXX.00) – per lump sum

END OF SECTION 010012X