# SECTION 01 3250

**BUILDING INFORMATION MODELING (BIM) REQUIREMENTS**

PART 1 - GENERAL

* 1. SUMMARY
     1. Section includes requirements for Building Information Modeling including, but not limited to, the following:
        1. Development of BIM Execution Plan**.**
        2. Development of Construction Model(s)**.**
        3. Development of Fabrication/Shop Drawings at Contractor’s option**.**
        4. Development of Coordination Model(s)**.**
        5. Development of Coordination Report**.**
        6. As-Built Model(s) and Drawings**.**
     2. Related Requirements:
        1. Division 01 section Operation and Maintenance Data for Facility Asset Data Requirements.
     3. Contractor’s Responsibility:
        1. Develop deliverables required in this Section.
        2. Contractor is solely responsible for the quality and accuracy of all documentation and submittals of this Section.
        3. The intent of BIM deliverables is to avoid interference and conflicts, optimize construction sequencing, achieve greater efficiencies in cost estimating and project coordination, and ensure access for maintenance, replacement, or repairs.
           1. Coordination: Contractor is solely responsible for the coordination of facility systems and equipment.
           2. Construction sequencing: Contractor is solely responsible to sequence construction activities to facilitate the fabrication and installation of systems and equipment without interference, conflicts, or delays in construction, and providing adequate access to effectively maintain and replace systems and equipment.

* + 1. Existing Documents:  The following building information, obtained and developed by the Architect and/or Engineer during the design phase, may be available to the Contractor:
       1. Design Intent Model(s) (.rvt, .ifc, & .nws / .nwd)
       2. Contract Documents (.pdf)
       3. CAD Files (.dwg)
       4. Point Clouds (.rcs)
       5. Scans of the original building design drawings (.pdf)
       6. BIM PxP (.docx, .pdf)
       7. LOD Matrix(.xlsx, .pdf)
    2. SI BIM Practice Requirements:
       1. The following documents related to are available on the Smithsonian A/E Information Center website, under the SI Design Standards (SDS) section and are applicable to BIM requirements:
          1. Smithsonian OPDC BIM Guidelines: Describes information, procedures, and responsibilities relevant to BIM work completed by architecture, engineering, and construction (AEC) consultants in order to assure accurate and consistent deliverables.
          2. OPDC Revit Templates: BIM templates developed by Smithsonian OPDC are available for the Contractor to use when utilizing Autodesk Revit as the model authoring software to populate with accurate project-specific facility asset data.

Scope of required facility data is described in the template and should be modified to reflect actual Project requirements.

* + - * 1. OPDC Revit Template Users Guide: This document, prepared by Smithsonian OPDC, describes how to incorporate and “OPDC Revit Templates” and develop the project BIM.
        2. OPDC BIM Project Execution Plan (PxP): Template document that defines the expected BIM deliverables and guides the coordination of the project team, throughout the project lifecycle.
  1. DEFINITIONS
     1. As-Built Model: Building Information Model(s) developed by the Contractor that represents the installed condition of facility elements.
     2. Building Information Model (BIM): A digital representation of physical and functional characteristics of a facility.

* + 1. BIM Project Execution Plan (PxP): A document prepared by the contractor, utilizing a standard OPDC PxP template that defines the expected BIM deliverables and guides the coordination of the project team, throughout the project lifecycle.
    2. Construction Model: Building Information Model(s) that demonstrates and communicates the facility data necessary to procure, fabricate, schedule or construct the Project.
    3. Coordination: A process implemented to ensure the efficiency and harmony of the relationship of facility elements. Typically performed in a BIM environment by evaluating interferences, also called “clash detection”.
    4. Coordination Model: Building Information Model(s) that demonstrates and communicates the spatial relationship of facility elements.
    5. Coordination Report: A report developed to communicate and demonstrate that the facility elements have been properly coordinated and identify areas where issues may still exist.
    6. Design Intent Model: Building Information Model(s) that demonstrates and communicates the creative objectives of the designer.
    7. Fabrication/Shop Drawing: Drawing generated by the contractor from a Construction Model based on the contract documents that communicates the information necessary to fabricate facility elements. Fabrication/Shop Drawings typically contain one system and are intended for use of trade personnel to fabricate, assemble, and install facility elements.
    8. Facility Breakdown Structure: a system-oriented hierarchical decomposition of a facility into smaller components. Typically, the facility breakdown structure is based on disciplines, trades, described by Master Format.
    9. Facility Asset Data: Non-graphical information attached to an object in a Building Information Model that defines various characteristics of an object.

* + 1. Furnishings: Built-in or movable cabinets, casework, seating, or other appurtenances provided by the Contractor.
    2. Interference: Spatial conflict between facility elements.
    3. Level of Development: Describes the minimum dimensional, spatial, quantitative, qualitative, and other data includes in a model element as defined in the OPDC BIM Guidelines.
    4. Level of Accuracy: Describes the minimum dimensional accuracy of element(s) as defined in the OPDC BIM Guidelines.
    5. Conformed Model – Updates the Design Intent Model for those aspects maintained by the designer to record authorized design changes during construction.
  1. SUBMITTALS
     1. BIM Project Execution Plan (PxP): Prepare and submit a plan utilizing the “OPDC BIM Execution Plan” framework document available on the Smithsonian Architectural-Engineer Information Center website. Submit the PxP in Portable Document Format (PDF) within 60 days after contract award. BIM Project Execution Plan (PxP) shall be updated as required and submitted with Final As-Built Model(s).

* + 1. Submit plans, sections, and other review documents monthly, in .pdf format. To include field changes that affect the accuracy of the Construction and As-Built Models.
    2. Construction Model(s): Prepare and submit, on a quarterly basis**,** Construction Model(s) that contain spaces, objects and data required to purchase, fabricate, and install project elements. Graphically indicate construction progress in Construction Model(s). Construction Model(s) are to be submitted with all Coordination Model(s) link into one central model using Autodesk Navisworks with all disciplines.
    3. Coordination Model(s): Prepare and submit Coordination Model(s) on a monthly basis. Coordination Model(s) are to be based on the facility breakdown structure of the Design Intent Model.Contractors are to perform all work utilizing 3D modeling software in order to facilitate seamless coordination with BIM workflows and file integration. All design elements should be produced three-dimensionally in programs that can output file formats supported by Autodesk Navisworks. Coordination Model(s) are to be submitted using Autodesk Navisworks with all disciplines.
       1. Coordination Model(s) are to be submitted prior to fabrication, and installation of any element within the area represented within the Coordination Model(s).
       2. Fabrication/Shop Drawings and Construction Model(s) are to be integrated into the Coordination Model(s) or otherwise referenced in the Coordination Model(s).
    4. CAD Drawings. Export CAD documents from the BIM authoring application in a format conforming to SI requirements. Reference the “OPDC Revit Template Users Guide” and “OPDC CAD Guidelines”.
    5. Coordination Report: Prepare and submit a written Coordination Report generated from the Coordination Model(s) prior to fabrication, and installation of any facility element within the area represented within the Coordination Model(s).
       1. Coordination Report is to be submitted in Portable Document Format (PDF).
    6. Final As-Built Model(s): After installation of all Facility Elements, update and submit As-Built Model(s) to document the condition of the facility upon completion of construction. As-Built Models are to be submitted with all Model(s) and link into one central model using Autodesk Navisworks with all disciplines.
    7. As-Built Fabrication/Shop Drawings: After installation of all Facility Elements, update and submit Fabrication/Shop Drawings to document the condition of the facility upon completion of construction.
    8. By submitting the As-Built Model(s) and Coordination Report(s), the Contractor confirms that the following have been accomplished:
       1. Existing and As-Built conditions have been adequately identified, documented, and field verified.
       2. Facility elements are properly represented within the Model(s) to align with field verified conditions.
       3. Access to maintain, repair, or replace facility elements has been identified and validated.
       4. Clearances, such as those required by code and equipment specifications, have been identified and validated.
       5. Interferences have been identified and resolved.
    9. Data Capture (Laser Scan): Survey, prepare and submit Point Cloud files at key stages during the construction process including but not limited to: post-demo, open trenches, rough-in / close-in, project completion, etc. as directed by COTR. This survey to be utilized to ensure all As-Built conditions for the project are documented properly. This will include establishing the necessary Survey Control Network throughout the site and scanning as many points as may be required to create a reliable point cloud of all interior and exterior surfaces of the building. The required object surface density of scanning shall be a minimum of 6mm (¼”). RGB color shall be mapped to both the exterior and interior scans. Point Cloud data should be broken into separate data sets as directed by COTR and be registered in the same coordinate frame (origin point) as the As-Built Model(s). Point cloud data to be submitted using Autodesk Recap.

PART 2 - EXECUTION

* 1. CONTRACT DOCUMENTS AND DESIGN INTENT MODEL(S)
     1. The Contract Documents and Design Intent Model(s) will be provided to the Contractor for reference in the development of the Construction and Coordination Model(s) and Fabrication/Shop drawings. The Contract Documents and Design Intent Model(s) communicate creative objectives of the Architect and/or Engineer and are not intended to be used for fabrication and construction of the facility in that the size, arrangement, and level of development of facility elements may not have the necessary tolerances to allow for fabrication.
     2. The Contract Documents are the binding document(s) of record, the Design Intent Model(s) are provided for reference only.
  2. DEVELOPMENT OF BUILDING INFORMATION MODELING PLAN (BIM PxP)
     1. The BIM PxP shall be approved by SI prior to development of Construction / Coordination Model(s), and development of Facility Asset Data. Information contained in the BIM PxP shall conform to the “OPDC BIM Guidelines”.
  3. INSPECTION OF EXISTING CONDITIONS
     1. Prior to the development of the Construction / Coordination Model(s), inspect and verify accuracy of information communicated in the Contract Documents and Design Intent Model with respect to the existing conditions. Notify Architect if any conflicts among Contract Documents, the Design Intent Model, and existing conditions are discovered. Do not proceed with development of Construction / Coordination Model(s) until conflicts are resolved to the satisfaction of SI.
  4. FACILITY ASSET DATA
     1. See spec 01 section OPERATION AND MAINTENACE DATA for asset data requirements

* + 1. The Contractor is responsible for incorporating Design Intent Model and Facility Asset Data Spreadsheet revisions into the Construction and As-Built Model(s) in order to maintain an up-to-date basis for Building Information Modeling throughout construction.
    2. Contractor is responsible for incorporating the following Asset Data from SI Facility Asset Data Spreadsheet into the Construction and As-Built Model(s):
       1. Asset ID# (SI will provide)
       2. Asset Name (SI will provide)
       3. SpecID (CSI Master Format 2016)
       4. Manufacturer
       5. Description
  1. DEVELOPMENT OF CONSTRUCTION MODEL(S)
     1. The intent of the Construction Model(s) is to communicate the necessary information to construct the facility including size, location, and arrangement of both existing to remain and new elements and to incorporate the as-built conditions.
     2. Develop Construction Model(s) based upon Contract Documents, Design Intent Model(s), and verified existing conditions.
     3. Construction Model(s) shall accurately reflect the geometry and details of existing and new elements within the facility.
        1. Use manufacturer or custom model elements to accurately reflect the components de- tailed in documents submitted for approval.
        2. Update the model elements to accurately reflect any revisions to geometry or details arising from the submittal review process.
     4. Construction Model(s) are to have a consistent origin that can be referenced to a real world datum or benchmark, located as required in the “OPDC Revit Template Users’ Guide”.
     5. Quality Control. The Construction Model(s) will undergo automated model checks utilizing rulesets, as described in the “OPDC BIM Guidelines” document and visual review by SI.
     6. The Construction Model(s) are to reflect all necessary access and clearances.
     7. The Construction Model(s) will include, but not be limited to, the following elements with all necessary intelligence included to produce plans, sections, elevations, riser diagrams, and schedules as applicable:
        1. Substructure: All foundations, subgrade enclosures, slabs-on-grade, and water and gas utility connections. Substructure elements shall be depicted with all necessary recesses, curbs, pads, slopes, closure pours, expansion/construction joints, and major penetrations depict-ed.
        2. Shell: All superstructure, exterior vertical enclosures, and exterior horizontal enclosures, including a depiction of expansion/construction joints.
           1. Superstructure: All columns, primary and secondary framing members, and bracing for the roof and floor systems (including decks).
           2. Exterior Vertical Enclosures: Exterior vertical enclosures shall be depicted to the exact height, length, width, and ratings (thermal, acoustic, fire) to properly reflect element types. Exterior windows, doors and grilles including hardware sets, louvers and vents, and wall appurtenances shall be depicted to represent their actual size, type and location.
        3. Interiors: All interior partitions, windows, doors and grilles, louvers, and vents, raised floors, and ceilings, depicted to represent their exact location, height, length, width, and ratings (thermal, acoustic, fire) to properly reflect element types.
        4. Services: All elevators, escalators, plumbing, HVAC, fire protection, electrical, communications, electronic safety and security, and integrated automation elements, including all major openings and penetrations, cable trays, cable bundles and pipe grouping. All clearances and insulation shall be accounted for in the model for use in interference management and maintenance access requirements. Nonpermanent items are not required to be modeled or contain facility data.
           1. Plumbing: All plumbing elements including plumbing piping and fixture layouts, floor and area drains, and related equipment.
           2. Heating, Ventilation, And Air Conditioning (HVAC): All heating, ventilation, and air conditioning (HVAC) elements including piping, valves, ductwork fixture lay- outs and related equipment.
           3. Fire Protection: All fire protection elements including piping, valves, and related equipment.
           4. Electrical: All electrical elements including conduit, fixture layouts and related equipment (including power for systems furniture).
           5. Communications: All communications and low voltage systems elements including conduit and related equipment.
           6. Security: All Electronic Safety and Security elements including conduit and related equipment.
           7. Integrated Automation: All integrated automation elements including conduit and related equipment.
           8. Model all elements larger than 38mm (1-1/2 inch) in diameter for any trade. When equal or smaller element are grouped or run in a uniform path. That group of elements shall be modeled when larger than 152mm (6 inches).
        5. Equipment and Furnishings: All fixed equipment and furnishings, depicted to represent their exact location, height, length, width, configuration, materials, finishes, and mechanical and electrical requirements.
        6. Special Construction and Demolition: All special construction and demolition including special construction, facility remediation and demolition
        7. Sitework: All sitework elements, including site improvements, liquid and gas utilities, electrical site improvements, and site communications.
     8. Construction Model(s) must be revised and certified by the Contractor prior to installation of facility elements contained within the models.
  2. DEVELOPMENT OF COORDINATION MODEL(S)
     1. Develop Coordination Model(s) that combine facility elements contained within the Construction Models with other facility elements depicted in the Design Intent Model to review the efficiency and harmony of the relationship of the facility elements.
     2. Verify that all facility elements are properly represented within the Construction and Coordination Model(s) prior to coordination.
     3. Conduct the following interferences checks to ensure that there are no conflicts in the installation of facility elements.
        1. Substructure/Shell vs Interiors
        2. Substructure/Shell vs Equipment and Furnishings provided by Contractor
        3. Interiors vs Equipment and Furnishings provided by Contractor.
        4. Substructure vs. Shell
        5. Services vs other components:
           1. Services vs Substructure/Shell
           2. Services vs Interiors
           3. Services vs Equipment and Furnishing
           4. Services vs Site work
        6. Services
           1. Plumbing vs HVAC
           2. Plumbing vs Fire Protection
           3. Plumbing vs Electrical
           4. Plumbing vs Communications
           5. Plumbing vs Electronic Safety and Security
           6. HVAC vs Fire Protection
           7. HVAC vs Electrical
           8. HVAC vs Communications
           9. HVAC vs Electronic Safety and Security
           10. Fire Protection vs Electrical
           11. Fire Protection vs Communications
           12. Fire Protection vs Electronic Safety and Security
           13. Electrical vs Communications
           14. Electrical vs Electronic Safety and Security
           15. Communications vs Electronic Safety and Security
        7. ADA Accessibility
     4. Coordination Model(s) shall be free of interferences prior to installation of any associated facility element.
     5. Update the Coordination Model(s) to reflect changes throughout construction prior to installation of any associated facility element.
  3. COORDINATION REPORT(S)
     1. Develop Coordination Reports identifying outstanding issues after the development of the Coordination Model(s), including but not limited to:
        1. Clashes:
           1. Itemize number of clashes.
           2. Clash Category
           3. Describe clashes.
           4. Describe the resolution of clashes and other conflicts.
        2. Design changes.
        3. Differing site conditions.
        4. Hazardous or safety related issues.
        5. Assets installed and assets pending installation.
     2. The report shall be organized by CSI Master Format 2016 specification section or by trade
     3. The issues identified within the Coordination Report are to be addressed by the **Contractor** in consultation with the SI and the Architect / Engineer prior to installation of facility elements.
     4. The Contractor is solely responsible for the cost of remedying any clashes that could have been discovered during the clash detection process.
  4. INSTALLATION
     1. Install facility elements in accordance with approved Construction Model(s), Fabrication/Shop Drawings, Coordination Model(s), and Coordination Reports. Any variance from these documents shall require approval by the SI COTR prior to the installation of the associated facility elements.
     2. Adjust Coordination Model(s) throughout construction to reflect all changes made to the approved Contract Drawings and Specs, Design Intent Model, and Fabrication/Shop Drawings.
     3. Maintain an up-to-date Fabrication/Shop Drawing set and Coordination Model(s) for all parties to access.

* 1. AS-BUILT MODEL AND DRAWINGS
     1. Upon completion of the installation of facility elements, update and deliver As-Built Model(s) and Fabrication/Shop Drawings to document the condition of the facility upon completion of construction.
        1. The updated Construction and Coordination Model(s) are considered the As-Built Model for this facility. These models shall clearly indicate portions of the facility that are constructed and portions where construction is pending.
        2. As-Built Model(s) shall be field verified for accuracy and updated as required. The Level of Development (LOD) shall be LOD 500
        3. The Level of Accuracy (LOA) of the model(s) shall be minimal 12mm (1/2") for existing and align with construction tolerances for all new construction (minimal 24mm (1”)).
        4. Model(s), CAD and SI-GIS exports are to be delivered in native file formats as well as file formats and naming conventions consistent with SI standards. Reference the “OPDC Revit Templates Users Guide” and “Smithsonian OPDC BIM Guidelines” guidance documents.
        5. All models shall be linked and submitted using Autodesk Navisworks.

END OF SECTION 01 3250