New Jersey Turnpike Authority

Facilities Improvement Program

CADD/BIM Manual

March 19, 2013

BUILDING INFORMATION MODELING REQUIREMENTS

1.0 Section 1 - General

1.1. Definitions See Section 6 for definitions of terms used in this document.

1.2. Submittal Format

1.2.1. The Model shall be developed using Building Information Modeling ("BIM") supplemented with Computer Aided Design ("CAD") content as necessary to produce a complete set of Construction Documents. Printed design submittal drawings shall be full-size size, suitable for half-size scaled reproduction.

1.2.2. BIM submittals shall conform to the requirements of Sections 3 and 4 below.

1.2.3. For each Center of Standardization (CoS) facility building type included in this Project, all Models and associated Facility Data shall be submitted in Autodesk Revit 2013 or most current version. The Design Consultant may use Bentley v81 AECOSim BIM for the site/civil portion of the design, at its discretion. The submittals shall be fully operable, compatible, and editable within the native BIM tools.

2.0 Section 2 – Design Requirements

2.1. Use of BIM for Design Consultant shall use BIM application(s) and software(s) to develop Project designs consistent with the following requirements.

2.1.1. Baseline Model. The Consultant will not be provided a baseline multi-discipline BIM Project Model.

2.1.2 BIM Project Execution Plan

2.1.2.1. Develop a BIM Project Execution Plan ("Plan" or "PxP") documenting the BIM uses, analysis technologies and workflows. .

2.1.2.2. Consultants shall utilize the latest version of the BIM PROJECT EXECUTION PLAN. Template available at Computer Integrated Construction (CIC) Research Program's BIM Planning Website, to develop an acceptable Plan. The template can be downloaded from the (CIC) Research Program's BIM Planning Website BIM Project Execution Planning Guide Version 2.0 now available for download at http://www.bim.psu.edu/Project/resources/default.aspx

2.2. BIM Requirements.

2.2.1. Facility Data. Develop the Facility Data to include material definitions and attributes that are necessary for the Project facility design and construction as described in Section 4.0.

2.2.2. <u>Model Content.</u> The Model and Facility Data shall include, at a minimum, the requirements of Section 4 below.

2.2.3. <u>Model Granularity.</u> Individual elements may vary in level of detail within the Model, but at a minimum must include all features that would be included on a quarter inch (1/4" = 1'0") scaled drawing (e.g., at least 1/16th, 1/8th and 1/4th), or on appropriately scaled civil drawings.

2.3. <u>Output</u> Submitted Drawings (e.g., plans, elevations, sections, schedules, details, etc.) shall be derived (commonly known as extractions, views or sheets) from the Model and Facility Data. Drawings derived from the Model shall remain connected to the Model for the life of the Project and documented in the PxP. Drawings not derived from the Model shall also be documented in the PxP.

2.3.1. Drawings derived from the Model shall be compliant with the NJTA CAD Manual Standard. Deliver electronic CAD files used for the creation of the Construction Documents per requirements as noted herein. Submitted Drawings (e.g., plans, elevations, sections, schedules, details, etc.) shall be derived (commonly known as extractions, views or sheets) from the Model and Facility Data. Drawings derived from the Model shall remain connected to the Model for the life of the Project and documented in the PxP. Drawings not derived from the Model shall also be documented in the PxP.

2.3.2. The CAD file format specified for drawings shall not dictate which application(s) are used for development and execution of the Model and Facility Data. Application(s) used shall be documented in the PxP.

2.3.3 In addition to electronic submittals in its native platform (AutoCADD for the facility buildings as indicated above), the Final Electronic Deliverables to the Authority shall also include a 2-D version of the documents that will be compatible with MicroStation V8, latest edition, as indicated in the Authority's latest version of its *CADD Standards Manual*.

2.4. <u>Quality Control Parameters.</u> Implement quality control ("QC") parameters for the Model, including:

2.4.1. <u>Model Standards Checks</u> QC validation ensures that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements. Identify and report non-compliant elements and submit a corrective action plan. Provide the NJTA with detailed justification and request NJTA acceptance for any non-compliant element that the Consultant proposes to be allowed to remain in the Model.

2.4.2. <u>CAD Standards Checks</u> QC checking ensures that the fonts, dimensions, line styles, levels, file naming conventions, and other construction document formatting issues are followed per requirements in the Authority's *CADD Standards Manual*. Identify and report non-compliant content and submit a corrective action plan.

2.4.3. <u>Other Parameters</u> Develop such other QC parameters as Consultant deems appropriate for the Project and provide to the NJTA for acceptance.

2.5. <u>Design and Construction Reviews.</u> Perform design and construction reviews at each submittal stage under Section 3 to test the Model, including:

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2.5.1. <u>Visual Checks.</u> Checking to ensure the design intent has been followed and that there are no unintended elements in the Model.

2.5.2. <u>Interference Management Checks.</u> Locate conflicting spatial data in the Model where two elements are occupying the same space. Log hard interferences (e.g., mechanical vs. structural, or mechanical vs. mechanical, overlaps in the same location) and soft interferences, (e.g., conflicts regarding equipment clearance, service access, fireproofing, insulation, code space requirements) in a written report and resolve.

2.5.4. Other Parameters. Develop other design and construction review parameters as the Consultant deems appropriate for the Project and provide to the NJTA for acceptance.

3.0 Section 3 – Submittal Requirements

3.1. <u>General Submittal Requirements</u>

3.1.1. Provide submittals in compliance with the PxP deliverables at stages as described below. .

3.1.2. For each Interim Design Submittal as set forth in Paragraphs 3.3 through 3.6, provide a Consultant-certified written report confirming that consistency checks as identified in Paragraphs 2.4 and 2.5 above have been completed. This report shall be discussed as part of the review process and shall address cross-discipline interferences, if any.

3.1.3. At each Interim Design Submittal as set forth in Paragraphs 3.3 through 3.6, provide the NJTA with:

> 3.1.3.1. The Model, Facility Data, Workspace and CAD Data files in the native BIM/CAD format.
>
> 3.1.3.2. A copy of the Model in an interactive review format such as Bentley Navigator, Autodesk Design Review, Autodesk Navisworks, Adobe 3D PDF 7.0 (or later), Google Earth KMZ or other format per PxP requirements..
>
> 3.1.3.3. A list of all submitted electronic files including a description, directory, and file name for each file submitted. For all CAD printed sheets, include a list of the sheet titles and sheet numbers. Identify which files have been produced from the Model and Facility Data.

3.2. <u>Initial Design Conference Submittal</u>

3.2.1. Submit a digital copy of the PxP To NJTA to confirm acceptability of the Plan or advise as to additional processes or activities necessary to be incorporated into the PxP. .

3.3. <u>Interim Design Submittals.</u>

3.3.1. <u>BIM and CAD Data.</u> Submit the Model with Facility Data per the requirements identified in Paragraphs 2.2 and 2.3 as applicable to the Interim Design package(s).

3.4. <u>Final Design Submissions and Design Complete Submittals.</u>

    3.4.1. <u>BIM and CAD Data</u>. Submit the Model with Facility Data per the requirements identified in Paragraphs 2.2 and 2.3 as applicable to the Interim Design package(s).

3.5. <u>Construction Submittals.</u> Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model, including interference management and design change tracking information.

3.6. <u>Final As-Built BIM and CAD Data Submittal</u>. The construction contractors will provide as-built information to the Authority's Resident Engineer. The Resident Engineer will provide as-built markups to the Design Consultant. The Design Consultant shall prepare and submit the final Record Set, including the Model, Facility Data, and CAD files reflecting as-built construction conditions for NJTA acceptance.

4.0 Section 4 – BIM Model Minimum Requirements and Output

4.1. <u>General Provisions</u> The Model shall be developed to include the systems described below as they would be built, the processes of installing them, and to reflect final as-built construction conditions. The deliverable Model at the Interim Design Stage and at the Final Design Stage ("released for construction") shall be developed to include as many of the systems described below as are necessary and appropriate at that design stage.

4.2. <u>Architectural/Interior Design.</u> The Architectural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include

    4.2.1. <u>Spaces</u> The Model shall include spaces defining actual net square footage and net volume, and holding data to develop the room finish schedule including room names and numbers. Include program information to verify design space against programmed space, using this information to validate area quantities.

    4.2.2. <u>Walls and Curtain Walls</u> Each wall shall be depicted to the exact height, length, width and ratings (thermal, acoustic, fire) to properly reflect wall types. The Model shall include all walls, both interior and exterior, and the necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

    4.2.3. <u>Doors, Windows and Louvers</u> Doors, windows and louvers shall be depicted to represent their actual size, type and location. Doors and windows shall be modeled with the necessary intelligence to produce accurate window and door schedules

    4.2.4. <u>Roof</u> The Model shall include the roof configuration, drainage system, penetrations, specialties, and the necessary intelligence to produce accurate plans, building sections and generic wall sections where roof design elements are depicted

    4.2.5. <u>Floors</u> The floor slab(s) shall be developed in the Structural Model and then referenced by the Architectural Model.

    4.2.6. <u>Ceilings</u>. All heights and other dimensions of ceilings, including soffits, ceiling materials, or other special conditions shall be depicted in the Model with the necessary

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intelligence to produce accurate plans, building sections and wall sections where ceiling design elements are depicted.

4.2.7. Vertical Circulation All continuous vertical components (i.e., non-structural shafts, architectural stairs, handrails and guardrails) shall be accurately depicted and shall include the necessary intelligence to produce accurate plans, elevations and sections in which such design elements are referenced.

4.2.8. Architectural Specialties All architectural specialties (i.e., toilet room accessories, toilet partitions, grab bars, lockers, and display cases) and millwork (i.e., cabinetry and counters) shall be accurately depicted with the necessary intelligence to produce accurate plans, elevations, sections and schedules in which such design elements are referenced.

4.2.9. Signage. The Model shall include all signage and the necessary intelligence to produce accurate plans and schedules.

4.2.10. Schedules. Provide door, window, hardware sets using BHMA designations, flooring, wall finish, and signage schedules from the Model, indicating the type, materials and finishes used in the design.

4.3. Furniture. The furniture Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing, and has necessary intelligence to produce accurate plans. Representation of furniture elements may be 2D or 3D. Consultant may provide a minimal number of 3D representations as examples. Examples of furniture include, but are not limited to, desks, furniture systems, seating, tables, and office storage.

4.3.1. Furniture Coordination Furniture that makes use of electrical, data or other features shall include the necessary intelligence to produce coordinated documents and data.

4.4. Equipment The Model may vary in level of detail for individual elements. Equipment shall be depicted to meet layout requirements with the necessary intelligence to produce accurate plans and schedules, indicating the configuration, materials, finishes, mechanical, and electrical requirements. Examples of equipment include but are not limited to copiers, printers, refrigerators, ice machines and microwaves

4.4.1. Schedules Provide furniture and equipment schedules from the model indicating the materials, finishes, mechanical, and electrical requirements

4.5. Structural The Structural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

4.5.1. Foundations All necessary foundation and/or footing elements, with necessary intelligence to produce accurate plans and elevations.

4.5.2. Floor Slabs Structural floor slabs shall be depicted with all necessary recesses, curbs, pads, closure pours, and major penetrations accurately depicted.

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4.5.3. <u>Structural Steel</u> All steel columns, primary and secondary framing members, and steel bracing for the roof and floor systems (including decks), including all necessary intelligence to produce accurate structural steel framing plans, related building/wall sections, and schedules.

4.5.4. <u>Cast-in-Place Concrete</u>   All walls, columns, beams, including necessary intelligence to produce accurate plans and building/wall sections, depicting cast-in-place concrete elements.

4.5.5. <u>Expansion/Contraction Joints.</u> Joints shall be accurately depicted.

4.5.6. <u>Stairs</u> All framing members for stair systems, including necessary intelligence to produce accurate plans and building/wall sections depicting stair design elements.

4.5.7. <u>Shafts and Pits</u> All shafts and pits, including necessary intelligence to produce accurate plans and building/wall sections depicting these design elements.

4.5.8. <u>Openings and Penetrations</u>. All major openings and penetrations that would be included on a quarter inch (1/4"=1'0") scaled drawing.

4.6. <u>Mechanical</u> The Mechanical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Small diameter (less than 1-1/2" NPS) field-routed piping is not required to be depicted in the Model. Additional minimum Model requirements include:

4.6.1. <u>HVAC</u> All necessary heating, ventilating, air-conditioning and specialty equipment, including air distribution for supply, return, ventilation and exhaust ducts, control systems, registers, diffusers, grills, and hydronic baseboards with necessary intelligence to produce accurate plans, elevations, building/wall sections and schedules.

4.6.1.1. <u>Mechanical Piping</u> All necessary piping and fixture layouts, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, and schedules.

4.6.2. <u>Plumbing</u> All necessary plumbing piping and fixture layouts, floor and area drains, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules.

4.6.3. <u>Equipment Clearances</u> All Mechanical equipment clearances shall be modeled for use in interference management and maintenance access requirements.

4.6.4. <u>Elevator Equipment</u> All necessary equipment and control systems, including necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.7. <u>Electrical/Telecommunications</u> The Electrical and Telecommunications systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Small diameter (less than 1-1/2"Ø) field-routed conduit is not required to be depicted in the Model. Additional minimum Model requirements include:

4.7.1. Interior Electrical Power and Lighting   All necessary interior electrical components (i.e., lighting, receptacles, special and general purpose power receptacles, lighting fixtures, panelboards, cable trays and control systems), including necessary intelligence to produce accurate plans, details and schedules. Lighting and power built into furniture/equipment shall be modeled.

4.7.2. Special Electrical All necessary special electrical components (i.e., security, mass notification, public address, nurse call and other special electrical occupancy sensors, and control systems), including necessary intelligence to produce accurate plans, details and schedules.

4.7.3. Grounding All necessary grounding components (i.e., lightning protection systems, static grounding systems, communications grounding systems, and bonding), including necessary intelligence to produce accurate plans, details and schedules.

4.7.4. Telecommunications All existing and new telecommunications service controls and connections, both above ground and underground, with necessary intelligence to produce accurate plans, details and schedules. Cable tray routing shall be modeled without detail of cable contents.

4.7.5. Exterior Building Lighting All necessary exterior lighting including all lighting fixtures, relevant existing and proposed support utility lines and equipment with necessary intelligence to produce accurate plans, details and schedules.

4.7.6. Equipment Clearances All Electrical equipment clearances shall be modeled for use in interference management and maintenance access requirements.

4.8. Fire Protection   The fire protection system Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

4.8.1. Fire Protection System All relevant fire protection components (i.e., branch piping, sprinkler heads, fittings, drains, pumps, tanks, sensors, control panels) with necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules. All fire protection piping shall be modeled.

4.8.2. Fire Alarms Fire alarm/mass notification devices and detection system shall be indicated with necessary intelligence to produce accurate plans depicting them.

4.9. Civil The Civil Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a one inch (1"=100') scaled drawing. Additional minimum Model requirements include:

4.9.1. Terrain (DTM) All relevant site conditions and proposed grading, including necessary intelligence to produce accurate Project site topographical plans and cross sections.

4.9.2. Drainage All existing and new drainage piping, including upgrades thereto, including necessary intelligence to produce accurate plans and profiles for the Project site.

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4.9.3. <u>Storm Water and Sanitary Sewers</u> All existing and new sewer structures and piping, including upgrades thereto, with necessary connections to mains or other distribution points as appropriate, including necessary intelligence to produce accurate plans and profiles .

4.9.4. <u>Utilities</u> All necessary new utilities connections from the Project building(s) to the existing or newly-created utilities, and all existing above ground and underground utility conduits, including necessary intelligence to produce accurate plans and site-sections.

4.9.5. <u>Roads and Parking</u> All necessary roadways, parking lots, and parking structures, including necessary intelligence to produce accurate plans, profiles and cross-sections.

5.0 Section 5 - Ownership and Rights in Data

5.1. <u>Ownership</u> The NJTA has ownership of and rights at the date of Closeout Submittal to all CAD files, BIM Model, and Facility Data developed for the Project. The NJTA may make use of this data following any deliverable.

6.0 Definitions

6.1. The following definitions apply specifically in the context of this attachment only.

6.2. <u>"Model":</u> An electronic, three-dimensional representation of facility elements with associated intelligent attribute data ("Facility Data").

6.3. <u>"Facility Data":</u> The non-graphical information attached to objects in the Model that defines various characteristics of the object. Facility Data can include properties such as parametric values that drive physical sizes, material definitions and characteristics (e.g. wood, metal), manufacturer data, industry standards (e.g. AISC steel properties), and project identification numbers. Facility Data can also define supplementary physical entities that are not shown graphically in the Model, such as insulation around a duct, or hardware on a door.

6.4. <u>"Workspace":</u> A collection of content libraries and supporting files that define and embody a BIM standard. A workspace includes BIM libraries such as wall types, standard steel shapes, furniture, HVAC fittings, and sprinkler heads. It also contains sheet libraries such as print/plot configurations, font and text style libraries, and sheet borders and title blocks.