

## **CHAPTER 15**

### **Advanced Modeling and Digital Document Submittals (BIM, CIM, GIS, and CAD)**

# Advanced Modeling and Digital Document Submittals

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## **15.1 GENERAL**

Comply with the requirements of this chapter per Engineering and Construction Bulletin (ECB) 2018-7, “Advanced Modeling Requirements on USACE Projects”, June 2018, which provides direction and policy for the implementation of BIM, CIM, GIS, and CAD.

This chapter is based on Unified Facilities Guide Specification (UFGS) 01 33 16.00 10, "DESIGN DATA (DESIGN AFTER AWARD)" from May 2016 and serves as a stand-alone reference point for all BIM, CIM, GIS, and/or CAD-related requirements for a project. Consult all appropriate agency guidance and policies as well as stakeholder requirements to determine the components of this chapter that apply to a particular project. Other commonly related UFGS Sections that may contain BIM, CIM, GIS, and/or CAD-related requirements include but are not limited to 01 33 00 SUBMITTAL PROCEDURES AND 01 78 00 CLOSEOUT SUBMITTALS.

Consult the USACE CAD-BIM Technology Center for additional information regarding all types of Advanced Modeling requirements, <https://cadbimcenter.erdcdren.mil/>

Consult ECB 2018-6, Operations & Maintenance Facility Data Requirements, March 2018 and UFGS 01 78 24.00 10, "OPERATIONS & MAINTENANCE FACILITY DATA REQUIREMENTS", May 2016 for guidance and specifications for the optional implementation of O&M Facility Data requirements.

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### **15.1.1 APPLICABLE CRITERIA AND REQUIRED COMPLIANCE**

Engineering and Construction Bulletin (ECB) 2018-7, “Advanced Modeling Requirements on USACE Projects”, June 2018

Engineering and Construction Bulletin (ECB) 2018-6, “Operations & Maintenance Facility Data Requirements”, March 2018

Engineering and Construction Bulletin, ECB 2017-22, "Electronic Red-lines, As-Builts, and Record Drawings"

EM 1110-1-2909 (2012) Geospatial Data and Systems

ERDC-ITL-TR-19-6, A/E/C Graphics Standard Release 2.1

ERDC-ITL-TR-19-7, A/E/C Computer-Aided Design (CAD) Release 6.1

NBIMS-US (V3) National BIM Standard - United States

NCS (V6) United States National CAD Standard

CAD-BIM Technology Center Website, <https://cadbimcenter.erdcdren.mil/>, hosts all standard CAD/BIM content for USACE.

Unified Facilities Guide Specification (UFGS) 01 33 16.00 10, "DESIGN DATA (DESIGN AFTER AWARD)", May 2016.

Unified Facilities Guide Specification (UFGS) 01 78 24.00 10, "OPERATIONS & MAINTENANCE FACILITY DATA REQUIREMENTS", May 2016.

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ISO 19005-3 (2012) Document Management -- Electronic Document File Format for Long-Term Preservation -- Part 3: Use of ISO 32000-1 with Support for Embedded Files (PDF/A-3)

ISO 19115-1 (2014) Geographic Information – Metadata -- Part 1: Fundamentals

ISO 32000-1 (2008) Document Management -- Portable Document Format -- Part 1: PDF 1.7

USACE Advanced Modeling Submittal Review Checklist (CHX) V2.0 May 2020

USACE Advanced Modeling Submittal Review Checklist Guide (CHX Guide) V2.0 May 2020 - optional for Contractors

USACE Advanced Modeling Project Execution Plan (PxP) Template V4.0 April 2020

USACE Advanced Modeling Project Execution Plan Submittal Review Checklist Guide (PxP CHX) Template V4.0 April 2020

USACE Minimum Modeling Matrix (M3) V1.3 20140919

### 15.1.2 DEFINITIONS

Advanced Modeling – is a subset of geospatial technologies as defined in EM 1110-1-2909 to include BIM, CIM, GIS, and CAD. Advanced Modeling is comprised of models and drawings that form a digital representation of the project, or part thereof, that are comprised of model elements with facility data.

CAD – Computer-Aided Design

DOR- Designer of Record

BIM – Building Information Modeling

CIM – Civil Information Modeling

GIS – Geographic Information System

Government Furnished Material (GFM) – Government material that may be incorporated into, or attached to, an end item to be delivered under a contract or which may be consumed in the performance of a contract. It includes, but is not limited to, raw and processed material, parts, components, assemblies, and small tools and supplies.

Model Element – a self-contained graphical element with a unique identification that is used to populate a model, and whose behavior and properties are defined by facility/site data and software processes. Model elements can represent a physical entity, such as a pump, a concrete wall, or a utility vault and range from the simple to the complex and can be custom modified.

USACE Minimum Modeling Matrix (M3) - USACE Standard contract requirement for establishing the specific Level of Development (LoD) for BIM objects that are part of the model produced for the contract. The requirements are for record modeling as well as design.

Facility Data - on-graphical data attached to surface and subsurface components for both building and site model elements that describe various facility characteristics such as parametric values that drive physical sizes, material definitions (e.g. wood, metal), manufacturer data, industry standards (e.g. AISC steel properties), location, and

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project identification numbers. Facility data can also define supplementary physical entities that are not shown graphically in the model, such as the system of a duct, hardware on a door, content of conduit, site surface, alignment, levee, channel or transformer properties.

Industry Foundation Class (IFC) – a standard and file format used for the exchange of model elements and data; see <http://www.iai-tech.org>. In the context of this section, IFC does not mean "Issued For Construction."

Model Uses – a method or strategy of applying modeling during a facility's life cycle to achieve one or more specific objectives. Reference NBIMS-US for list of model uses and definitions.

USACE A/E/C Work Structure - a common environment that can be used across agencies and engineering applications. This environment contains folder structures, tools, and resource files that implement the A/E/C CAD Standard and the A/E/C Graphics Standard documents. By utilizing one environment across agencies and applications it will give greater consistency when delivering A/E/C Standards-compliant deliverables.

USACE Bentley AECOsims and InRoads Workspace - is contained within the A/E/C Work Structure. It is comprised of a collection of content libraries and supporting files that define and embody a BIM standard. Libraries include content such as wall types, standard steel shapes, furniture, HVAC fittings, and sprinkler heads. The Workspace also contains sheet libraries such as print/plot configurations, font and text style libraries, and sheet borders and title blocks. The Workspace includes pre-defined data group parameters.

USACE Revit Templates are discipline specific and include family content pertinent to that discipline. The templates share standard symbology such as annotation families, line styles, and text styles. The templates include pre-defined shared parameters.

### **15.2 MEETINGS**

Projects requiring Building Information Modeling shall use the Advanced Modeling Kick-Off Meeting and Advanced Modeling PXP demonstration Meeting to specify the extent to which the parties intend to utilize BIM. Meetings can be included in project kick-off meetings, the location should be agreed upon by all parties and can be conducted on-site, web conferencing or conference call.

#### **15.2.1 ADVANCED MODELING KICK-OFF MEETING**

Conduct an Advanced Modeling Kick-Off Meeting prior to submission of the Advanced Modeling PXP, within 45 days after Notice to Proceed. Required meeting attendance includes, at a minimum, the DOR, the design drawing and modeling specialist and the Geographic District BIM Manager or delegate. The intent of this meeting is to coordinate the expectations for the Advanced Modeling PXP.

#### **15.2.2 ADVANCED MODELING PXP DEMONSTRATION MEETING**

Within 30 days after the acceptance of the Advanced Modeling PXP and M3, conduct a demonstration to review the Plan for clarification, and to verify the functionality of planned Model technology workflow and processes. If modifications are required, complete the modifications and resubmit the Advanced Modeling PXP performing a subsequent demonstration for Government acceptance.

## **15.3 QUALITY CONTROL**

### **15.3.1 ADVANCED MODELING PROJECT EXECUTION PLAN (PXP)**

Develop an Advanced Modeling Project Execution Plan ("Plan" or "PxP") documenting mandatory and Contractor-elected BIM Uses, analysis technologies and workflows. Submit the PxP within 45 days after issuance of Notice to Proceed.

Use the USACE ADVANCED MODELING PROJECT EXECUTION PLAN (PxP) Template located at the USACE CAD/BIM Technology Center website to develop an acceptable Plan and update to include platforms and processes to meet the requirements of the project.

Use the M3 Template located at the USACE CAD/BIM Technology Center website and submit as part of the Advanced Modeling PxP.

Mandatory Model Uses are predefined in the Project Execution Plan (PxP) and cannot be modified. Identify additional elected Model Uses in the PxP.

## **15.4 DELIVERY, STORAGE, & HANDLING**

### **15.4.1 ADVANCED MODEL FILE PACKAGING**

Execute the following actions for all design drawing and modeling files:

#### **15.4.1.1 Bentley AECOsims, InRoads, and MicroStation**

Compress files with all options.

#### **15.4.1.2 Autodesk Revit, Civil3D, and AutoCAD**

- a. Purge unused
- b. Audit
- c. Compress

### **15.4.2 PDF FILE PACKAGING**

Utilize PDF file format in accordance with ISO 32000-1 and ISO 19005-3. Provide files from original sources, text-searchable, and saved in "Standard" (uncompressed) resolution whenever possible.

### **15.4.3 HYPERLINKING**

Hyperlinks can be used as a method to reference annotation symbology (e.g. section cut symbology, detail callout symbology, elevation callout symbology) to the sheet referenced by the annotation.

## **15.5 GOVERNMENT FURNISHED MATERIALS (GFM)**

The Government will provide Advanced modeling files as GFM for use in design development. Develop and maintain the information and level of detail contained in the GFM in the Project design.

The Contractor has the option of preparing their own Advanced Modeling files in the formats prescribed as a basis for design, design drawings, and interim design submittals. If so, maintain the same level of detail, properties, and functionality in the models that is prescribed in this specification.

### 15.5.1 GFM HANDOVER

The GFM handover shall be outlined in the Contract. Timing of the GFM handover will vary depending on the type of project.

### 15.5.2 GFM FILE FORMATS

GFM file formats shall be outlined in the Contract. File formats will vary depending the platform of the previous As-Built drawings and the Project's stakeholder requirements.

Government Furnished GIS may be furnished in the most current Standard GIS Database SDSFIE Adaptation, including features and attributes relating to current project. Documentation of the required attributes and schema definitions will be provided with the GIS Template. GIS source data and product data remain the property of the US Government. Be prepared to explain and demonstrate the company's process for protecting all geospatial data, including but not limited to geometry, attributes, metadata, topologies, and relational database schemas and operations used in association with this contract. Signing a non-disclosure agreement attesting to the same before source data are released may be required. Obtain further information about security and nondisclosure requirements from the Contracting Officer.

- a. Some installation map data, source and/or product, may be considered by the Government to be "Controlled Unclassified Information" (CUI) also known as "Sensitive but Unclassified" (SBU). Release of this information to any third party without the explicit consent of the Contracting Officer is not authorized.
- b. Return all source information to the Government or destroy upon completion of the Contract.

### 15.5.3 ADVANCED MODELING COMPLETION AND QUALITY

The Government makes no guarantee that the BIM/CIM models, GIS data, CAD files and Facility Data provide the level of completeness or quality required for a submittal. Develop or update files and data to completely and correctly represent the as-built conditions of the facility and the site.

However, use of any GFM for creation of contract submittals is at the Contractor's own risk. Any quality control issues discovered in the GFM do not absolve the Contractor from submitting contract compliant deliverables as described in this and other specifications.

### 15.5.4 DATA LOSS, CORRUPTION, AND ERROR

Use of GFM files is at the Contractor's risk. Verify data integrity upon receipt and request a replacement if necessary. Any adjustment of file structure, format, or software version required to make GFM compatible with computer systems and/or software is the responsibility of the Contractor.

## **15.6 SUBMITTALS**

Provide all of the following documents; Submittal File List, Advanced Modeling Checklist (CHX) optional for contactors, and Advanced Modeling Electronic Files with each design submittal.

### 15.6.1 SUBMITTED FILE LIST

Provide list of all submitted electronic files including a description, directory, and file name for each file submitted. Identify which files have been produced from the Model and Facility Data. For all Sheet files, include a list of the sheet titles and sheet numbers.



### 15.6.2 ADVANCED MODELING SUBMITTAL CHECKLIST (CHX)

Complete the USACE BIM/CIM Advanced Modeling Submittal Checklist (CHX) and include with each submittal. Download the Checklist from the USACE CAD/BIM Technology Center website. Review The Advanced Modeling Submittal Checklist Guide (CHX Guide) Overview Section for guidance.

### 15.6.3 ADVANCED MODELING ELECTRONIC FILES

Include all Advanced Modeling files associated with the contract scope of work. In addition, provide the following:

#### 15.6.3.1 3D Interactive Review Model

Provide a copy of each BIM and CIM Model in an approved interactive review format. Approved format shall be documented in the PxP.

#### 15.6.3.2 Quality Control (QC) Reports

As a minimum, include the following reports:

##### *15.6.3.3.1 Model Standards Checks and Reports*

Provide QC checks demonstrating adherence to the NCS v6.0 BIM Implementation section. Identify and report non-compliant elements and submit a corrective action plan. Provide the Government with detailed justification and request Government acceptance for any non-compliant elements that the Contractor proposes to be allowed to remain in the Model. Verify the following for the Model(s) and Facility Data set:

- a. No undefined, incorrectly defined, or duplicated elements.
- b. No errors when opening.
- c. No broken Links, References, or X-References.
- d. Minimized extraneous information.
- e. Content uses the coordinate system defined in the approved PxP.
- f. Models share a common alignment point.
- g. For a Design Complete or Record Submittal; no unloaded Links, References, or X-References exist.

##### *15.6.3.3.2 Graphics Standards Checks and Report*

Provide QC checks on all graphic deliverables demonstrating that the fonts, dimensions, symbology and other construction document formatting are compliant with the requirements of this specification. Identify and report non-compliant content.

##### *15.6.3.3.3 CAD Standards Checks and Report*

Provide QC checks on CAD Output demonstrating that filenames, sheet borders, layer/level names, and symbology are compliant with the requirements of this specification. Identify and report non-compliant content.

##### *15.6.3.3.4 Interference Management (3D Coordination) Checks and Report*

Execute Interference Management checks and provide a summary of the results noting total 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).

##### *15.6.3.3.5 Additional Parameters*

Additional QC parameters as deemed appropriate for the Project may be developed and documented in the Advanced Modeling PxP.

### **15.6.4 ADVANCED MODELING RE-SUBMITTALS**

If components of an Advanced Modeling submittal are rejected, provide the following for each Advanced Modeling Re-Submittal, in addition to re-submittal information required by Section 01 33 00 SUBMITTAL PROCEDURES:

- a. Re-submit all components required under paragraph ADVANCED MODELING PACKAGE, including a new Advanced Modeling Checklist and updated content in response to Government comments.

### **15.7 PLATFORM AND FILE FORMATS**

The Contract shall include descriptions of the required platforms, versions, and file formats to be used for the Project. The platform and file format requirements shall be carefully coordinated with the project stakeholders and Geographic District BIM Manager.

#### **15.7.1 BIM**

May include but not limited to file formats for Autodesk Revit and Bentley Systems AECOSim. Provide the BIM submittals as fully operable, compatible, and editable within the native BIM/CIM tools.

#### **15.7.2 CIM**

May include but not limited to file formats for Autodesk Civil 3D and Bentley systems InRoads. Provide the CIM submittals as fully operable, compatible, and editable within the native BIM/CIM tools.

#### **15.7.3 GIS DATA**

may include Environment Systems Research Institute's (ESRI) ArcGIS, Personal Geodatabase, File Geodatabase, Autodesk AutoCAD Map3D, or Bentley Systems Map in compliance with SDSFIE and appropriate ISO 19115-1 metadata.

#### **15.7.4 CAD**

##### **15.7.4.1 Native CAD Authoring Content**

All content produced through CAD authoring software outside of any object/element based BIM or CIM platform must be compliant with ERDC-ITL-TR-19-6, A/E/C Graphics Standard Release 2.1 and ERDC-ITL-TR-19-7, A/E/C Computer-Aided Design (CAD) Release 6.1. Bentley MicroStation Seed Files and Autodesk AutoCAD Template Files can be downloaded from the CAD/BIM Technology Center website as part of the A/E/C Work Structure.

##### **15.7.4.2 CAD Extracted From BIM/CIM Authoring Platforms**

Provide editable CAD sheet files extracted from the BIM or CIM files. CAD content exported from a BIM or CIM modeling platform must comply with ERDC-ITL-TR-19-6, A/E/C Graphics Standard Release 2.1 and NCS BIM Implementation section, part "2.0 Clarifications" or ERDC-ITL-TR-19-7, A/E/C Computer-Aided Design (CAD) Release 6.1.

### **15.8 ADVANCED MODELING REQUIREMENTS**

#### **15.8.1 BIM AND CIM**

##### **15.8.1.1 Minimum Modeling Requirements**

Model to the requirements of the USACE M3 as identified in the approved Advanced Modeling PxP.

##### **15.8.1.2 Graphics and Layer Standards**

All content produced with object/element based BIM and CIM authoring software platforms must be compliant with ERDC-ITL-TR-19-6.

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All content produced with layer-centric BIM or CIM authoring software must be compliant with ERDC-ITL-TR-19-6 and ERDC-ITL-TR-19-7.

### 15.8.1.3 USACE Platform Configuration Standards

Coordinate with the BIM Manager or delegate and use only the platforms, versions, and formats required for the Project. The selected version of the workspace/template at the start of the contract is the workspace/template to be used for the remainder of the project.

USACE Bentley Workspace. Download from the USACE CAD/BIM Technology Center website as part of the A/E/C Work Structure.

USACE Revit Templates. Download from the USACE CAD/BIM Technology Center website and, if required, upgrade to the Contract approved software version. Any deviation from the USACE Revit Templates should be approved by the BIM Manager or delegate, documented in the PXP and compliant with ERDC-ITL-TR-19-6, A/E/C Graphics Standard Release 2.1 and ERDC-ITL-TR-19-7, A/E/C Computer-Aided Design (CAD) Release 6.

### 15.8.1.4 Classification

Include Facility Data referencing one or more classification system(s) identified in the M3 for all modeled elements.

### 15.8.1.5 Space/Area Quantity Data

In the model, include spatial data for designed gross/net square footages. This information shall be used to inform and/or validate area quantities as they pertain to programmed space, as the project requires.

### 15.8.1.6 BIM and CIM Coordinate Systems

Provide and define Coordinate System, Zone (for State Plane or UTM), Horizontal Units of Measure, Vertical Units of Measure, and Horizontal Datum.

### 15.8.1.7 Modeling Schedules

Comply with the NCS BIM Implementation section, part "2.4 Schedules." Produce schedules from, and link to, the Facility/Site Data within the Model. Document any exceptions in the PXP and submit for review.

### 15.8.1.8 Details and Enlarged Sections

Comply with the NCS BIM Implementation section, part "3.2 Model Coordination and Delivery." Derive all details and enlarged sections necessary for construction from the Model when possible. For those details and enlarged sections not derived directly from the Model, verify that geometry and data depicting the details and enlarged sections are consistent with Model elements. Details with significant drafted content such as 'standard' and 'typical' details cannot contradict the model and must utilize the model as an underlay when possible for the purposes of verification and coordination. Three dimensional, isometric, and section isometric details derived from the model are preferred. Create details and enlarged sections that are not derived from the Model using native authoring tools within the Model or be embedded within the Model.

### 15.8.1.9 Drawing Indices

Comply with the NCS BIM Implementation section, part "2.3 Sheet Organization." Where BIM authoring platform supports it, derive drawing indices from a model-driven schedule.

## 15.8.2 GIS

### 15.8.2.1 Minimum Modeling Requirements

Provide final geo-referenced GIS database of the new building footprint, and site surface and subsurface features that exist outside the building footprint(s) out to the project extents compliant with current SDSFIE Adaptation.

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Collect GIS georeferenced data pertaining to location and attribute data of subsurface utilities obtained at the time of project site excavation.

Include the collection of elevation (Z) values in all data collection for underground utilities.

### **15.8.2.2 GIS Coordinate System**

Provide and define Coordinate System, Zone (for State Plane or UTM), Horizontal Units of Measure, Vertical Units of Measure, Horizontal Datum, and Vertical Datum

### **15.8.2.3 Standard GIS Database SDSFIE Adaptation**

Use the Standard GIS Database SDSFIE Adaptation provided by the Geospatial Support Office to produce the GIS deliverables required under this contract.

### **15.8.3 CAD**

All content produced through layer-centric CAD authoring software outside of any object/element based BIM or CIM platform must be compliant with ERDC-ITL-TR-19-6, A/E/C Graphics Standard Release 2.1 and ERDC-ITL-TR-19-7, A/E/C Computer-Aided Design (CAD) Release 6.

Bentley MicroStation Seed Files and Autodesk AutoCAD Template Files can be downloaded from the CAD/BIM Technology Center website as part of the A/E/C Work Structure.

---END OF SECTION---