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CEEC

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**Engineering and Design**  
**Advanced Modeling for Digital Project Delivery**

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FOR THE COMMANDER:

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COL, EN  
Chief of Staff

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**Purpose.** This engineer manual provides detailed technical guidance and procedures for compliance with policy in ER 1110-1-8156, which establishes general criteria for the use and development of geospatial technologies throughout the U.S. Army Corps of Engineers. The use of Advanced Modeling processes and related technologies for engineering and construction are required as described in this manual.

**Applicability.** Advanced Modeling requirements apply to all U.S. Army Corps of Engineers Commands, to include all districts, major subordinate commands, and centers, with a mission to support Military Programs within and outside the continental United States (such as Military Construction and Sustainment, Restoration, and Modernization programs) and Civil Works projects.

**Distribution statement.** Approved for public release; distribution is unlimited.

**Proponent and exception authority.** The proponent of this manual is the Headquarters, U.S. Army Corps of Engineers, Engineering & Construction Directorate. The proponent has the authority to approve exceptions or waivers to this manual that are consistent with controlling law and regulations. Only the proponent of a publication or form may modify it by officially revising or rescinding it.

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## **Chapter 1 Introduction**

### **1–1. Purpose**

This engineer manual provides detailed technical guidance and procedures for compliance with policy in ER 1110-1-8156, which establishes general policy for the use and development of geospatial technologies throughout the U.S. Army Corps of Engineers. The use of Advanced Modeling processes and related technologies for engineering and construction are required as described in this manual.

### **1–2. Distribution statement**

Approved for public release; distribution is unlimited.

### **1–3. References**

See Appendix A.

### **1–4. Records management (recordkeeping) requirements**

The records management requirement for all record numbers, associated forms, and reports required by this publication are addressed in the Army Records Retention Schedule. Detailed information for all related record numbers is located on the U.S. Army Corps of Engineers (USACE) Records Management Site <https://usace.dps.mil/sites/INTRA-CIOG6/SitePages/Records-Management.aspx>. If any record numbers, forms, and reports are not current, addressed, and/or published correctly, see DA Pam 25-403 for guidance.

### **1–5. Associated publications**

Policy associated with this manual is found in ER 1110-1-8156.

### **1–6. Scope**

a. This manual specifically applies to functional areas that involve geospatial technologies and services for Building Information Modeling (BIM), Computer-Aided Design (CAD), and Geographic Information Systems (GIS).

b. Advanced Modeling encompasses all aspects of civil infrastructure and facilities design, construction, and management for military construction and civil works.

### **1–7. Exclusions**

There are no applicable exclusions.

## **1–8. Waivers**

To request a waiver for any mandatory requirement outlined in this manual, send the waiver request to the Headquarters, U.S. Army Corps of Engineers (HQUSACE), Engineering & Construction Directorate, CEEC.

## **1–9. Brand names**

HQUSACE promotes interoperability using widely-recognized and compatible data standards and processing procedures. However, contract terms requiring USACE to use specific products or software must be followed.

## **Chapter 2**

### **U.S. Army Corps of Engineers Advanced Modeling Program**

#### **2–1. Program description**

The USACE Advanced Modeling Program provides the execution of the CAD-BIM Community of Practice (CoP) mission within the USACE Enterprise Geospatial Information and Services (EGI&S) Program (EM 1110-1-2909) and establishes the applicability and implementation requirements for effective enterprise-wide implementation of Advanced Modeling.

#### **2–2. Applicability**

Advanced Modeling guidance applies to all USACE Commands (including all Districts, MSCs, and Centers) with a mission to support planning, design, and construction efforts within the Directorate of Engineering & Construction, Directorate of Military Programs, and the Directorate of Civil Works. This guidance applies to all Department of Defense (DoD) facilities within the continental United States (CONUS) and should be followed to the greatest extent possible for facilities outside the continental United States (OCONUS), its territories and possessions, including temporary and nonpermanent facilities as defined by UFC 1-201-01.

#### **2–3. Program goals and objectives**

The Advanced Modeling Program supports the USACE CAD-BIM Program governance established in EM 1110-1-2909. The CAD-BIM CoP aligns with the USACE Campaign Plan and Engineering & Construction Strategy to advance modeling through the following goals and objectives:

- a. Developing a highly skilled workforce proficient in Advanced Modeling technology as part of an innovative, forward-thinking product delivery process;
- b. Providing and refining standardized products to the greatest extent practicable;
- c. Ensuring that products seamlessly integrate into existing asset management systems for enhanced life-cycle management;
- d. Transitioning to advanced digital project delivery models by integrating current and future CAD-BIM technology, alongside emerging tools such as artificial intelligence, immersive technology, and knowledge management.

These high-level objectives guide specific enterprise implementation goals that are reviewed by the EGI&S Program Manager for the CAD-BIM CoP in coordination with the CAD-BIM Executive Committee, Technology Center (CBTC), and CoP members.

## 2–4. Data development

The Advanced Modeling process is essential for data development and creation, promoting collaboration among all Project Delivery Team (PDT) members and stakeholders. Advanced Modeling tools create digital representations that embed critical life-cycle data relevant to design, construction, operations, and maintenance. This data-rich approach enables the sharing of project information throughout its life cycle, from inception to decommissioning, ensuring informed decision-making. By improving design and construction processes, Advanced Modeling reduces errors and omissions, generates more complete and accurate deliverables, and supports long-term maintenance for a higher-quality building life span.

a. Contracted designs and Internal USACE PDTs must conform to deliverable requirements described in ER 1110-1-8156 and herein, as applicable.

b. The installation or stakeholder coordinates with the PDT to prescribe additional specific design and construction guidance to be included as requirements of the final Advanced Modeling deliverables.

c. USACE hosts example contract language, the Advanced Modeling Project Execution Plan (PxP) template, and the Minimum Modeling Matrix (M3) at the CAD-BIM Technology Center website (<https://cadbimcenter.erdcdren.mil/default.aspx?p=a&t=1&i=14>). For all projects, the Advanced Modeling PxP must be included in the Design Analysis.

d. BIM deliverables include the following:

(1) Design models: BIM design models are developed using design authoring applications and submitted in their respective native formats (for example, Autodesk Revit, Bentley OpenBuilding Designer, Autodesk Civil 3D, Bentley OpenRoads Designer), in a format specified by the PDT. Development of these models must use appropriate USACE BIM templates and work structure.

(2) Construction drawings: Construction drawings (in PDF format) produced from the BIM design models must adhere to the Architecture Engineering Construction (A/E/C) CAD and Graphics Standards.

(3) As-builts: PDTs should confirm that all as-builts adhere to the markup guidelines outlined in Unified Facilities Guide Specifications (UFGS), sections 01 33 16.00 10 and 01 78 00. Additional guidance for delivering as-built submittals are in the best practice document titled “Record Package Guidance” in ERDC/ITL SR-21-6.

(4) Record models and drawings: BIM record models and drawings must reflect all approved changes during construction including red-lines, requests for information, and contract modifications and submitted in their native format. Record models and drawings also include updated construction phase facility/site data for all components. All record models and drawings must be delivered consistent with the A/E/C CAD and Graphics Standards.

(5) BIM design models: BIM design models and drawings in native design software format in a version that is compatible with current versions in use by USACE, using appropriate USACE BIM templates and work structure.

(6) Construction drawings: Construction drawings produced from BIM design models must adhere to A/E/C Graphics Standards.

(7) BIM drawings and models: BIM-generated record drawings and BIM record models are required through construction completion.

e. For projects within the Directorate of Military Programs and vertical construction projects within the Directorate of Civil Works, BIM-generated, space utilization drawings (architectural floor plans in specified CAD format) for vertical construction features must be delivered by Beneficial Occupancy Date. These space utilization drawings must be composed of one file per floor level and must contain:

- (1) Dimensions;
- (2) Facility footprint polygons;
- (3) Room footprint polygons;
- (4) Door locations, sizes, types, and swings;
- (5) Window locations and sizes;
- (6) Freestanding columns;
- (7) Counters with annotated heights;
- (8) Floor openings;

(9) One text node per room, centered in room, with room number, space type, and usable square footage annotated;

(10) Attached exterior features such as supports, storage stairs, docks, and ramps; and

(11) North arrow.

f. Any additional CAD deliverable requirements must be identified prior to design. For in-house design, the requirements are identified in the PxP. For Architect-Engineering (A-E) design, the requirements are identified in the A-E scope of work or Design Build specifications.

g. For information regarding GIS deliverables used in engineering design projects, refer to EM 1110-1-2909.

## **Appendix A References**

Unless otherwise indicated, all Army and USACE publications are available at <https://armypubs.army.mil> and <https://publications.usace.army.mil>. DoD publications are available at <https://www.esd.whs.mil>. Unified Facilities Guide Specifications (UFGS) publications are available by searching <https://www.wbdg.org>. Architecture Engineering Construction (A/E/C) standards are available at <https://cadbimcenter.erdcdren.mil/CAD>.

### **Section I**

#### **Required Publications**

##### **DA Pam 25-403**

Army Guide to Recordkeeping

##### **EM 1110-1-2909**

Engineering and Design: Geospatial Data and Systems

##### **ER 1110-1-8156**

Engineering and Design: Policies, Guidance, and Requirements for Geospatial Data and Systems

##### **ERDC/ITL SR-21-6**

Spangler, S. C., R. J. Fujan, C. A. Broyles, B. M. Baker, J. L. Jameson, G. L. Piotrowski, J. A. Groboski, and S. P. Hutsell. 2021. "The CAD/BIM Technology Center for Facilities, Infrastructure, and Environment – Record Package Guidance Best Practices." U.S. Army Corps of Engineers, Engineer Research and Development Center/Information Technology Laboratory. ERDC/ITL SR-21-6. (Available at <https://erdc-library.erdcdren.mil/server/api/core/bitstreams/70323a53-35a8-47c9-941b-511f34530e40/content>)

##### **UFC 1-200-01**

DoD Building Code

##### **UFC 1-201-01**

Non-Permanent DoD Facilities in Support of Military Operations

##### **UFGS 01 33 16.00 10**

Design Data (Design After Award)

##### **UFGS 01 78 00**

Closeout Submittals

### **Section II**

#### **Prescribed Forms**

This section contains no entries.

## **Glossary of Terms**

### **Section I**

#### **Acronym List**

<b>Term</b>	<b>Definition</b>
A/E/C	Architecture Engineering Construction
A-E	Architect-Engineer
BIM	Building Information Modeling
CAD	Computer-Aided Design
CAD-BIM	Computer-Aided Design-Building Information Modeling
CBTC	CAD-BIM Technology Center
CONUS	Continental United States
CoP	Community of Practice
DoD	Department of Defense
ECB	Engineering and Construction Bulletin
EGI&S	Enterprise Geospatial Information and Services
EM	Engineer Manual
ER	Engineer Regulation
ERDC	Engineer Research and Development Center
GIS	Geographic Information Systems
HQUSACE	Headquarters, U.S. Army Corps of Engineers
ITL	Information Technology Laboratory
OCONUS	Outside the Continental United States
M3	Minimum Modeling Matrix
PDF	Portable Document Format
PDT	Project Delivery Team
PxP	Project Execution Plan
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specifications
USACE	U.S. Army Corps of Engineers

## Section II

### Terms

#### **Advanced Modeling**

A subset of geospatial technologies referring to the use of BIM, CAD, and GIS for the development of design and construction deliverables. The Advanced Modeling process supports collaboration among all PDT members and stakeholders. A design generated using BIM virtually represents the physical and functional characteristics of the project and contains embedded life-cycle information and data specific to the design.

#### **Building Information Modeling (BIM)**

BIM is a process for creating and managing a multifaceted digital representation that integrates the physical and functional characteristics of projects. A BIM deliverable is a shared knowledge resource and a business process, enabling all stakeholders to access and manage data for design, construction, and operation across the project's life cycle. BIM provides a 3D, fully attributed portrayal of both natural and man-made features, serving as a reliable decision-making foundation from inception to decommissioning. BIM covers the entire process of generating and using data, which includes organizing and managing the process itself and serves as the digital prototype itself. This holistic approach enables centralized communication, efficient design, and integration of various disciplines. BIM forms a comprehensive resource for project details, thus facilitating an effective asset life-cycle management.

#### **Computer-Aided Design (CAD)**

The use of computers to aid in creating, modifying, analyzing, or optimizing a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create databases for manufacturing. While CAD deliverables may be two-dimensional (2D), they may also be three-dimensional (3D), fully attributed, digital representations of natural features, man-made features, and functional characteristics of a project.

#### **Geographic Information System (GIS)**

A computer system capable of capturing, storing, analyzing, and displaying geographically referenced information, which is information attached to a location such as latitude, longitude, or street location (as defined by U.S. Geological Survey).