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US Army Corps of Engineers®
New York District

NEW YORK DISTRICT
U.S. ARMY CORPS OF ENGINEERS
OFFICIAL MANUAL FOR

BUILDING INFORMATION MODELING PROJECTS

VERSION 1.0

MAY 2009

NEW YORK DISTRICT
OFFICIAL MANUAL
FOR
BUILDING INFORMATION MODELING (BIM) PROJECTS

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ABBREVIATIONS

CENAN	Corps of Engineers, North Atlantic Division, New York District
BIM	Building Information Modeling
USACE	United States Army Corps of Engineers
A/E	Architect-Engineer contractor or firm
CADD	Computer-Aided Design and Drafting (used interchangeably with CAD)
DB	Design-Build contractor or firm
A/E/C	Architect/Engineer/Construction
CSI	Construction Specifications Institute
2D	Two-dimensional
3D	Three-dimensional
COBIE	Construction Operations Building Information Exchange (an information-related project delivery process)
IFC	Industry Foundation Class (industry-standard data structures for exchanging information about construction projects)
USAR	United States Army Reserve
ERDC	U.S. Army Corps of Engineers, Engineer Research and Development Center
SOW	Scope of Work
AS-BUILT	For purposes of this Manual, the term “as-built” is used interchangeably for record drawings.

REVISION RECORD

Revision Letter	Change Number	Description	Date
		Basic Issue	1 May 2009

LIST OF EFFECTIVE PAGES

THE TOTAL NUMBER OF PAGES IN THE DOCUMENT IS 49, CONSISTING OF:

Note: A vertical line in the outer margin of page indicates the changed portion of the document.

Page No.	Issue	Page No.	Issue
i thru. *iii*	Original		
1 thru 49	Original		

PREFACE AND INTRODUCTORY INSTRUCTIONS

1. Purpose: This Manual presents guidance and requirements for New York District Corps of Engineers projects utilizing Building Information Modeling (BIM). This Manual may be incorporated into contracts by reference.

2. Target Audience: CENAN design professionals with demonstrated expertise in CADD/BIM and CENAN Technical Managers tasked with procuring BIM services and products. Contracted A/E and DB firms. (All CENAN personnel are encouraged to read through this document, especially the initial slides, as it is in everyone's best interest to be familiar with BIM and its relevance to the New York District U.S. Army Corps of Engineers.)

3. The source of the main documents is the Army Reserve Design Process and Submittal Requirements manual prepared by Louisville District U.S. Army Corps of Engineers (CELRL), the Center of Standardization (CoS) for Army Reserve Centers. Some of the wording and formatting has been changed as applicable to CENAN projects, along with minor editorial changes, but the document remains essentially the same. The original CELRL manual was made available through the USACE BIM Sub-Community of Practice (Sub-CoP). CELRL was the first USACE District to harness BIM.

4. Use of this Manual: This manual is both a reference and a guide for accomplishing BIM projects. It is not a scope of work in and of itself. The best use of this manual is twofold:

4.1. In-house BIM Team: It is assumed that the in-house BIM Team is comprised of individuals with clearly demonstrated mastery of CENAN's CADD software (i.e., MicroStation). Louisville District has done an outstanding job of defining BIM requirements, processes, workflows, and expectations. Become intimately familiar with this manual and consider its instructions standard for all BIM work.

5. A/E (and DB) contracts: The most efficient use of this manual regarding contracting documents (i.e., an RFP) is to incorporate it by reference in the Design After Award or similar contract section and provide it to the A/E as "Government furnished." If an A/E's Scope of Work calls for application of BIM technology, all design drawings will be created using Building Information Modeling (BIM) technology and shall conform to the New York District CAD Standard. Unless otherwise required, the version of Bentley Building compatible with what the New York District is using will be used, incorporating specific USACE workspace and data sets, Model Files and all relevant design files. This information will be provided, either on digital media or via web link, to the A/E as "Government-Furnished." The A/E will provide the Building Information Model (BIM) and its supporting data set/library that supports the BIM available to the Government in electronic format as a contract submittal requirement.

6. Note: Bentley Building software tools are described throughout this document. If there exists no specific project requirement to specifically use Bentley Building software, then it is acceptable to use any BIM software provided the submissions are delivered in the format required by the contract.

7. Point-of-Contact for this Manual is David N. Rackmales, P.E., Structural Engineer, Engineering Division, Design Branch, david.n.rackmales@usace.army.mil.

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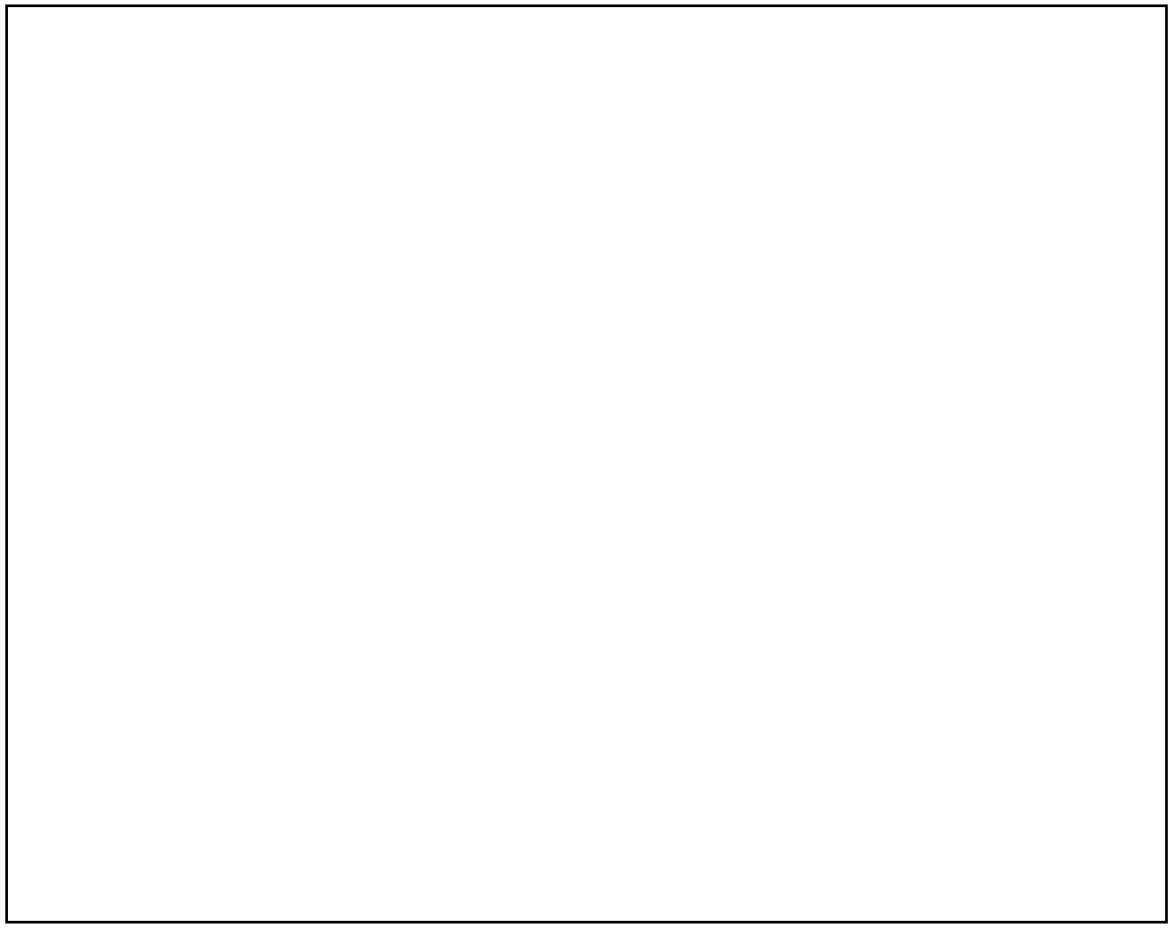
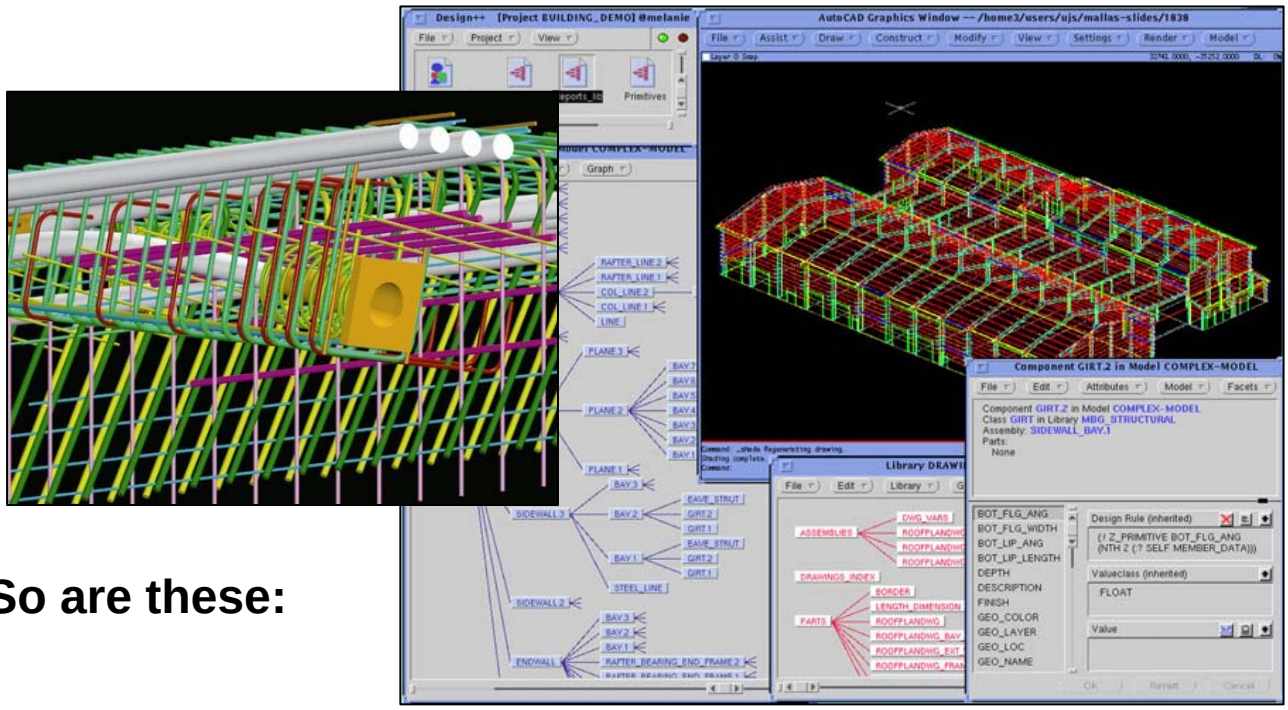
BIM PRIMER

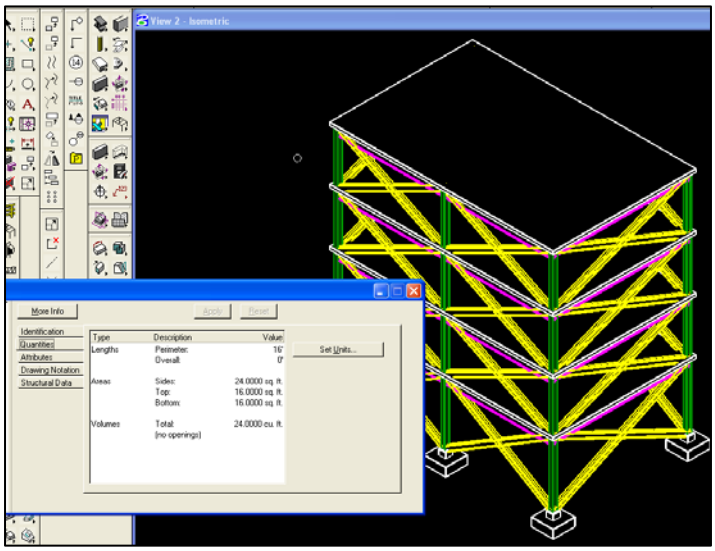


What's "BIM"?

These are BIM models:



So are these:



What's "BIM"? (cont'd)

B.I.M. or simply "BIM" is an industry-accepted acronym for "Building Information Modeling."

According to the National Institute of Building Sciences:

> A Building Information Model (BIM) is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward.

Basically, BIM is a computer-aided engineering and design process. It's similar to CADD, but instead of representing building components and elements with lines and shapes, simple to complex, these components and elements have information associated with them. That is, a steel beam drawn in a BIM model has isn't just a shape composed of lines and points: these lines and points have related data to them. This data is information such as beam designation per industry standards, material density, engineering properties of the beam (E, I, etc.), just how many of these beams are used in the building, etc. Naturally, all of this information may be electronically exchanged with, for example, Cost Engineering programs.

Also, BIM software serves to automate the generation of plans and specifications through the process of "extraction." Extraction is simply an automated, computerized way of extracting drawing views that one would typically see on paper plans from a 3D computer model.

BIM work is accomplished by a BIM Team. The BIM Team consists of a BIM Manager and the design professionals from the various technical disciplines (Architectural, Civil, Electrical, Mechanical, and Structural). It would not be unusual for the BIM Manager to play two roles on the BIM Team. The BIM Team creates the BIM model in a collaborative design environment. In plainer terms, the BIM Team sequesters itself, with the right hardware and software, until the BIM model is sufficiently complete. Determination of completeness is at the discretion of the BIM Team Leader (who is usually the BIM Team's Architect), and will typically represent an agreed-to design milestone (e.g., 35% design).

The software the New York District generally uses for BIM work is called Bentley Building (a legacy name is "Tri-Forma"), ProjectWise and Bentley Navigator. There are other BIM software packages such as AutoDesk's Revit that are popular with the AEC Industry as well.

FURTHER READING:
ERDC TR-06-10. Building Information Modeling (BIM):
A Road Map for Implementation To Support MILCON Transformation and Civil Works Projects within the U.S. Army Corps of Engineers. October 2008.
https://cadbim.usace.army.mil/MyFiles/ERDC_TR-06-10.pdf.
Building Information Models (BIM) http://www.wbdg.org/design/bim.php
Implementation of CAD Standard for Building Information Model (BIM).
https://cadbim.usace.army.mil/MyFiles%5C4%5C3%5CASCE_BIM_0116.pdf
Construction Operations Building Information Exchange (COBIE) Requirements Definition and Pilot Implementation Standard
http://www.wbdg.org/pdfs/erdc_cerl_tr0730.pdf

GOALS

- Use this technology to meet customer expectations.
- Provide the customer with the product originally asked for.
- Provide ourselves with a BIM model that can be used in the future.
  - As-builts
  - Facility management
  - Future Expansion

A BIM Cycle

1391
Design Basis
Charette: Use BIM for space modeling

Preparation of Plans and Specifications
Design Team refines BIM model initially built during Charette:
- Utilize BIM to contain scope creep and change management
- Provide required submittals (35%, 65%, 90%, etc.):
  - 2D CAD Extractions
  - 3D .pdfs
  - Fly-through animations
- Extract construction plans
- Provide project quantities to Cost Engineer
- Integrate engineering analyses software tools with BIM model

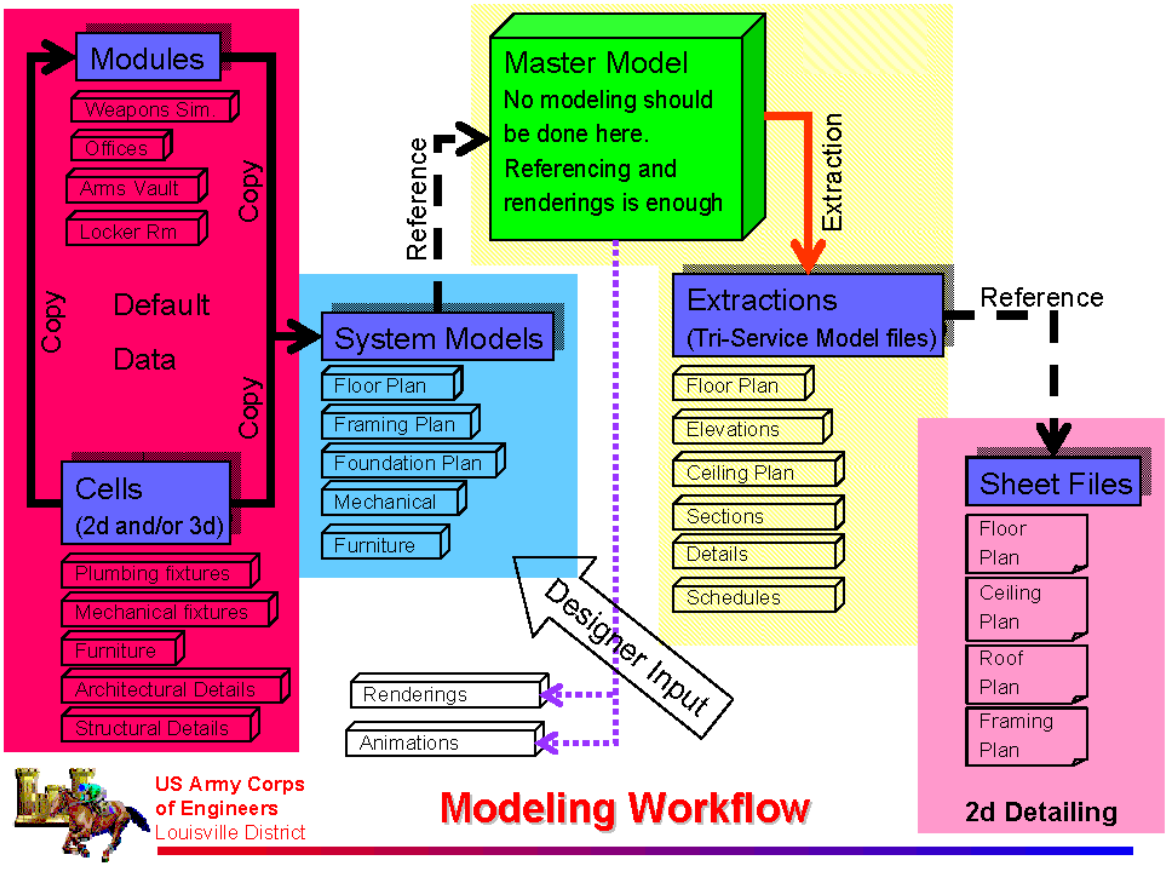
After Award/During Construction:
- BIM Model provided to Contractor as "Government-furnished" documentation.
- Contractor updates BIM model as work progresses
- Contractor extracts as-built drawings from BIM model
- Contractor gives as-built BIM model to CENAN after completion of construction

Customer Occupies Building
BIM Model provided to customer for use in building management

BIM model used for planning of future expansion

For Experts Only…

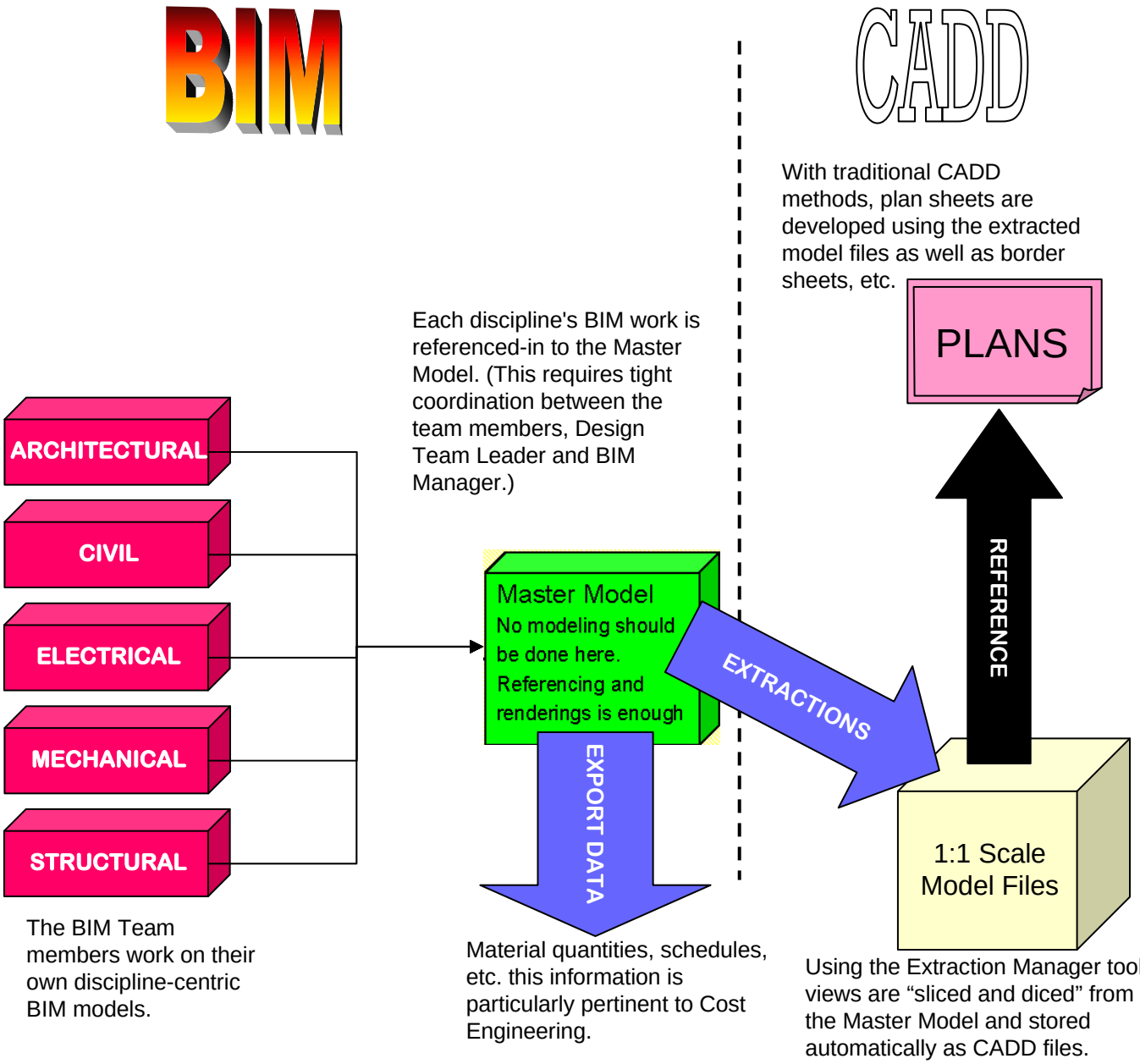
BIM Team Members are expert designers† and modelers† – not to mention CADD users.



†Engineers and Architects.

Did you understand that last slide?

Here's the BIM Workflow simplified:



Now let's consider our goals again…

Here's the Goals slide simplified:

Remember, we want two things:

- Plans that will get the customer what was originally asked for.
- A BIM model that can be reused for the life of the facility.

Start with properly scoping the 1391 with the customer. Out of this, generate the initial BIM model (probably just a space layout with some architectural and site plan features) that will serve as the final Charette product.

With the Charette-generated BIM model, the BIM Team can now get to work on the project, ultimately finishing with a set of final construction plans.
The customer is regularly presented the BIM model, likely on a large screen in a "theater"-like venue. The object being that the customer understands how the design team in implementing the customer's requirements.
We've just about met the first goal when this phase is finished.

After award, the construction contractor is provided with the means to generate accurate and precise as-built drawings. (Eventually, this would be the BIM Models including extractions and referenced plan sheet files. This will require intense coordination between the BIM team and the construction contractor's BIM staff. At this point in time (Q1 FY2008), I don't see this happening. Right now, the most efficient way to accomplish this would be to have the contractor provide the BIM team with mark-ups (electronic or paper) that the BIM team would transfer to their models. As-built plan sets would then be generated in-house. Generation of a complete as-built model would satisfy our second goal.)

Customer occupies the building.
Customer is given the BIM model for O&M.
First Goal is completely met.

Re-use BIM model for future expansion.

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PART 1– BIM INSTRUCTIONS

1.0 Purpose. This work instruction will serve as a guide to the Building Information Model (BIM) design teams in the use of the USACE Dataset. The work instruction will guide the enhancement of the USACE BIM Dataset and corresponding module catalogue. It will be used during CENAN (BIM) design projects. It describes how the New York District will identify, check and implement changes to the USACE BIM Dataset and module catalogue based on input from in-house and AE design submittals, enhancements to project criteria, and BIM software improvements. It will also provide BIM design teams with direction of the BIM workflow and how to handle changes to this dataset during the design phase and at each submittal.

2.0 Applicability. This work instruction applies to all drawing plans, cost estimates, specifications and design analysis generated utilizing Building Information Modeling (BIM) techniques for all design phases, including design review submittals, documents issued to bidders, as-award documents, and as-built documents for CENAN projects designed in-house and by others.

3.0 References. New York District CAD Standard Version 1.0, May 2009 and A/E/C CADD Standard Release 3.0, September 2006.

4.0 Responsibilities

New York District BIM Manager is responsible for the maintenance, distribution and use of the New York District's copy of the USACE BIM Dataset CD, which includes the USACE Workspace. The BIM Manager reports to Chief, Design Branch.

The design team is required to deploy the USACE BIM Dataset and the USACE Workspace on their server system as to allow their design team the proper tools to create the BIM as it is defined for their specific project. Instructions for server deployment are provided with each release of the USACE BIM Dataset.

Design team leaders are responsible for creating project designs within the provided framework and establishing a BIM that contains useful and valuable data for the Corps of Engineers.

5.0 Definitions

BIM Manager (BM). – The BIM Manager is responsible for carrying out, directing, and coordinating all work associated with Building Information Models (BIMs), including project planning, design, engineering management, construction, operation and overall coordination, and for providing authoritative advice, assistance and information on all matters related to BIM. The BIM Manager coordinates closely with the New York District's Information Management Office on computer network requirements for BIM efforts.

Building Information Model (BIM) – A collection of electronic drawing and data files in a logical, rational project folder structure. The collection is coordinated and has relationships built so that the

information can be easily extracted in the form of drawings, details, schedules, quantity takeoffs, renderings, animations, and any other format needed during the design and/or construction process. USACE utilizes Bentley's TriForma for BIM file creation and data extraction.[1] This set of files contains many different types of files including .dgn and .xml.

A/E – Architect-Engineer firm

2D – (In the context of BIM) A two-dimensional representation, e.g., a drawing showing the length and width or width and height, etc. of a particular item. Most construction plans are 2D.

3D – (In the context of BIM) A three-dimensional representation, e.g., a drawing showing the length, width and height or depth of a particular item. Perspective drawings, isometric drawings, etc. are 3D representations. The BIM model is generated as a 3D representation.

4D – (In the context of BIM) A four-dimensional representation. The three spatial dimensions of length, width and height or depth are now joined by a fourth dimension, *time*. This *temporal* dimension is manifest as a *construction schedule*.

5D - (In the context of BIM) A five-dimensional representation. The three spatial dimensions (length, width, height or depth) and fourth temporal dimension (schedule) are now joined by a fifth, that being *cost*. This *cost* dimension is manifest as a *construction cost estimate* (that may comprise materials quantities and costs, labor and crew costs, etc.).

BIM Pit - An environment where the architects and engineers are in a single room collaborating at the same time on a BIM model.

CAD or CADD - Computer-Aided Drafting and Design. Computer-Aided Drawing. Also may be referred to as CAE or Computer-Aided Engineering. CAD and CADD are used interchangeably in this document.

Cell – A cell is a type of drawn object. It is saved in a specific format in order to allow ease of replication and reuse. There are three types of TriForma cells; parametric, compound and regular cells. They can be either 2D or 3D.

COBIE - Construction Operations Building Information Exchange (COBIE) is an open-source methodology that captures information during design and construction that is ultimately provided to facility operators. BIM software is used to generate COBIE data that is a BIM project deliverable.

Component – A component is specific data which is tied to a part and is defined within the TriForma Dataset explorer. A single component may be tied to many different parts because a component can describe measurements for quantity takeoffs, specification sections based on Unified Facilities Guide Specifications (UFGS) format and even cost data.

Data Group – Specific spatial and text data connected to BIM objects contained in specific dataset folders. These same files contain the information that describes how this information is requested for each object and displayed in schedules.

Dataset-The information that describes the non-graphical and graphical data tied to the objects within the TriForma BIM.

[1] Unless a different software platform is explicitly requested by the customer.

DB – Design-Build Contractor.

Deliverable -The product of engineering and design efforts. Typically, this would be the concept submittal and the corrected final design. A deliverable may have multiple phases.

Design - For the purpose of this work instruction, it is limited to the preparation of plans, specifications, and design analyses. All plans and specifications developed shall be clearly identified as to the phase of design represented (e.g., charette, interim, final, etc.).

Design Guide – An agency publication providing a comprehensive facility type or facility element type design reference. An example would be DG 1110-3-122 *Design Guide for Interiors*.

Design Team – Those design professionals (architects and engineers) responsible for developing the BIM and all associated design products. For purposes of this Manual, it is interchangeable with the term BIM Team.

Design Team Leader (DTL) –Engineer or Architect responsible for coordinating the efforts of all modelers and technicians within the model. The DTL is selected for each project from the modelers (technical professionals on the BIM Team) assigned to a project and is usually an Architect. This person may also be called the BIM Team Leader.

Family – A family is a logical organization of parts within the TriForma Dataset Explorer. The USACE dataset organizes the parts into constructions systems such as “Exterior Walls” or “Spaces”.

Granularity – Granularity describes the *expected depth of detail* in the BIM model. Typically, the limit of detail is all features that would be included on a quarter inch (1/4” = 1’0”) scaled drawing. Minimum granularity requirements will be stated in a scope of work. An example of a granularity limit would be to require all plumping piping greater than 1/5 inches in diameter be modeled.

Interference - A problem in a model where two objects occupy the same space.

Level Library – A level library file is utilized during the boot up of TriForma by configuration files to attach levels required for all parts within a dataset. It does not replicate the seed file levels needed to comply with the A/E/C CADD Standard. It is provided to make sure that parts are placed on their proper level.

Model File -See A/E/C CADD Standard release 3.0. In the BIM process this is also the extraction file.

Module – A module is a collection of objects required for a specific project space as described in the design requirements or pertinent Design Guide. The size of the module is base on the design guide programmed area, but it may be edited and manipulated for use within specific designs. All objects and elements in a module are modeled to the A/E/C CADD Standard.

Object – This term is used to describe an electronic element within a BIM that represents a design element. It may be a 2D or 3D object and it must either have data connected to it (intelligent object) even if it is simply named for counting purposes or it can be a programmed to respond to input automatically (Smart object) such as a parametric cell.

Parts – A part is the name of the center of information within the TriForma dataset Explorer for repetitive or single objects within a BIM. A part holds AEC CADD Standard-compliant graphic and non-graphic information about those objects. It contains component and extraction information.

Project Engineer-Individual assigned as the technical manager responsible for day-today coordination of the design. The Project Engineer represents the design team on the project team.

Seed File -A seed file is a file with as many default configuration settings required for a particular project. The seed files provided in the Default Dataset have been created with the proper working units, color table, and many other settings complete. This does not mean that the seed file will have everything needed for all projects, but it is provided in order to clarify and simplify specific settings.

Sheet File – A CAD drawing file that will be plotted as part of a plan set.

Workspace – The framework in which a set of folders together with MicroStation, TriForma, and discipline application configuration files which are created to manipulate where and how TriForma records data and operates. This is utilized by the Corps of Engineers in order to gain consistent data when receiving BIM submittals and deliverables.

6.0 Procedure

6.1 USACE BIM Dataset At the beginning of each project the BIM Manager will provide the BIM Team with the most recent release of the USACE BIM Dataset.[2] It will include the following:

a. Module Catalogue
b. Cell Libraries (2D, 3D, compound, and parametric)
c. Data Group System
d. Family, Part, and Component Definitions
e. Seed Files
f. Level Libraries
g. BIM Workspace
h. Sheet Border
i. Text Styles
j. Dimension Styles
k. DGN Libraries
l. Color Table
m. Font Library

6.2. Contracted A/E and DB firms shall download the USACE BIM Dataset from https://cadbim.usace.army.mil/BIM. Under the Links heading, click the *Software Downloads* folder and then the *Dataset* folder. Thence, download the *USACE Dataset ReadMe File* marked as **** Current Version****. At end of the document is a link for download registration (*Download Dataset*). Follow this link to an online registration form and from there the dataset will be accessible. Note that regarding CAD drawings, the New York District CAD Standard governs. Thus, all CAD drawings shall utilize the New York District Standard border and cover sheets available at http://www.nan.usace.army.mil/business/buslinks/contract/ae/index.htm.

[2] The USACE BIM Dataset is maintained by the USACE CADD/BIM Technology Center.

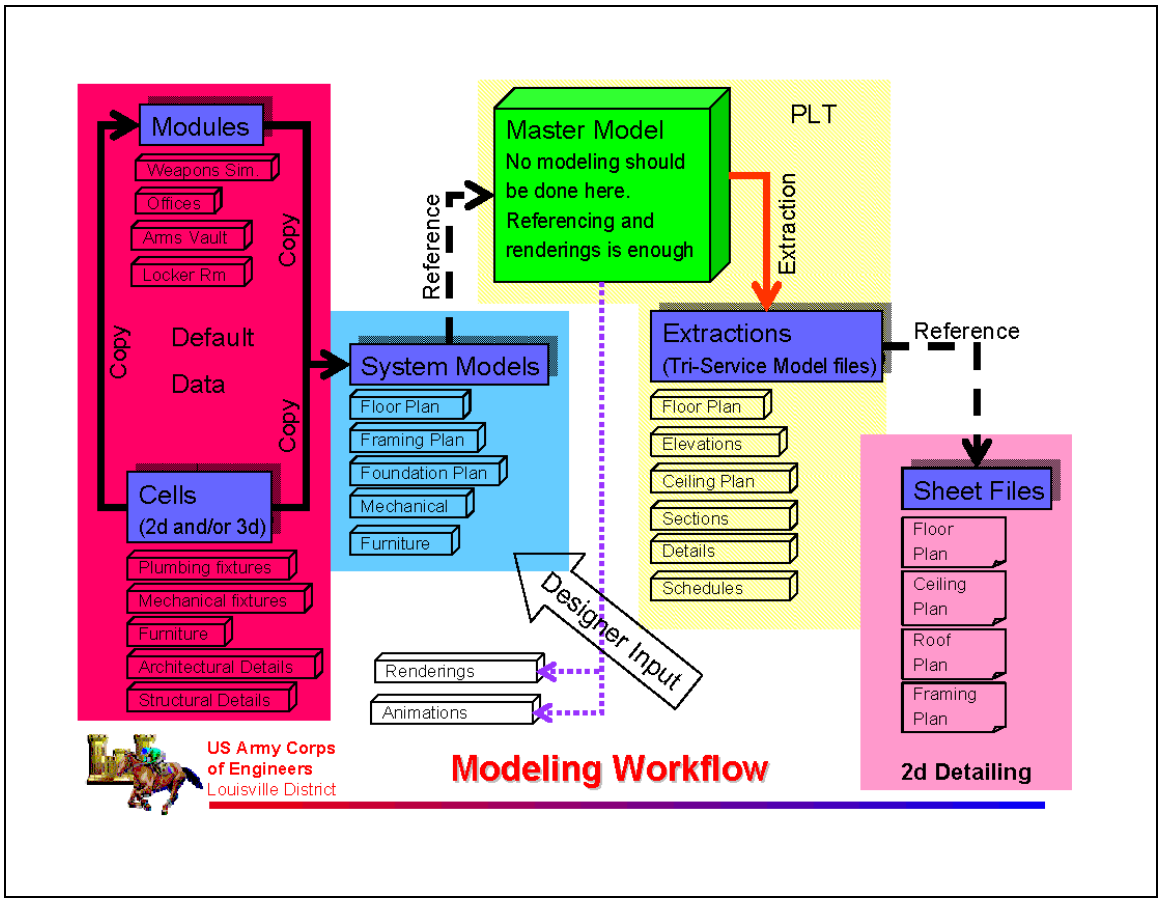

Figure 1. USAR BIM Workflow NOTE: Any design changes to the extraction or sheet file makes the BIM obsolete. Best practice is to make changes to the *system models*, and then re-run the extractions.

6.2 Modeling Workflow

Figure 1 shows a suggested workflow for the BIM design team. It was developed by the Louisville District U.S. Army Corps of Engineers, the Center of Standardization for U.S. Army Reserve facilities. Using this modeling workflow is not required nor checked, but the US Army Reserve Center BIM Dataset was created with this workflow in mind.

Modules and Cells. The model workflow begins with pre-defined data known as cells and modules. This data is provided at the start of a project and contains only data that has been through the quality control process. These are used to give the designer a starting point in the creation of a BIM. Each module is a space (room) from the pertinent Design Guide. It does not contain all of the data needed to create a BIM, but it is a good start and everything provided is compliant with the A/E/C CADD standard as well as the Design guide.

System Models. The default data is a tool for the designer during the creation of the system models. System models are the heart and soul of the BIM. This is where the design is worked out and all model output comes from this location.

Master Model. The BIM Team Leader references all system models in order to create a Master Model. Other less encompassing Master Models can be created for specific reasons such as specific discipline extractions.

Extractions. Each discipline creates their extractions. These extractions must be created within the discipline's tools in order to make use of discipline-specific rules created for them. Extractions as well as other types of output should not be put off until modeling is complete. They are easily updated and can be created at the earliest phases. There are default extractions and schedules within the USACE BIM Workspace, though these should be verified as adequate for a particular project.

Sheet Files. The extractions are referenced to the New York District standard border sheet file.

Quality Check (not shown in fig. 1) The BIM Manager must check all of the files against drawing library files using the standards checker utility within Bentley tools. This ensures that the proper family, parts, dimension style, line styles, text styles, among others were used and that the output complies with CADD standards. In order to take advantage of this tool, a strong dataset and workspace must be established. Model interferences must also be checked. Each discipline and the Design Team Leader should run the Interference Manager in order to identify design or model conflicts.

6.3 Types of Changes to the Dataset. The following are avenues of change to the default dataset considered in this work instruction:

Design Changes – The Default Dataset is dynamic; thus, additions and changes to the delivered dataset are expected. The Default Dataset is not considered complete. It is a work in progress and will remain so.

Criteria Changes – Due to the changing needs of our clients, minor changes to design guides will take place from time to time. These changes must be accounted for in the dataset module catalogue and the dataset.

Updates to the Software -BIM is an evolving process. The Bentley Building tools are continually updated to account for additional data and disciplines being included in the model.

BIM Standards – The A/E/C CADD Standard was developed from a 2D perspective. It utilizes levels in order to differentiate vector elements. They are sometimes used to represent a 3rd dimension that is not modeled (e.g., topographic elevation or ceiling grid). There are obvious differences in the use of for levels when creating a BIM, therefore the need of additional levels is inevitable. Levels are the biggest area of change to the A/E/C CADD standard, but not all and it is impossible to estimate all needs, and so for now, a BIM Standard must rely on the established CADD Standard. The National BIM Standard (NBS) has not been finalized, though it should be noted that USACE ERDC is a signatory to the NBS charter.

6.4 QA/QC and Detection of Changes to the Dataset

At present, change suggestions to the USACE BIM Dataset should be provided to the BIM Manager. These will be forwarded to the USACE CADD/BIM Technology Center.

Designers, both AE and In-House, will perform Quality Control (QC) checks of the dataset prior to each submittal. Documentation created during those checks shall be submitted at the time of the project submittal BIM Data Report. Any elements within the model not meeting the requirements shall have an explanation of the reason that they were left as they were. These issues should be brought to the

attention of the CENAN BIM Manager for consideration of standards updating at the dataset review meeting. There are four types of checks that must be made on the model:

Visual Check – This can be accomplished by checking the model in small segments at a time using view tools within MicroStation or the entire model using Bentley Navigator. The main reason for this check is to insure the design intent has been followed and that there are no unintended elements in the model.

Interference Check – This check is performed using Bentley Navigator together with Bentley's Interference Manager. It is used to locate problems in the model where two objects are occupying the same physical space.

Standards Check – This is performed using the "standards checker" tool within the Bentley software. This is used to insure that the fonts, dimensions, line styles, levels and other issues are followed per the A/E/C CADD standard.

TriForma Element Validation – Using the validation tool on the datagroup dialogue to insure that the dataset has no undefined or incorrectly defined elements.

At the time of delivery of each design submittal, the design team will make arrangements for a dataset review meeting with the CENAN BIM Manager. This meeting is intended to communicate suggested changes and additions to the USACE BIM Dataset. This meeting will also give the BIM Team or AE an opportunity to suggest changes to the process, workspace, standards, or dataset.

Each delivered design submittal will be reviewed for quality assurance (QA) as explained in the QC/QA Processes for Study/Design Phase[3]. In addition, BIM files delivered with each submittal will be evaluated for differences from the default dataset folders and files to determine if the proper files within the dataset have been edited. The CENAN BIM manager will also do QA of the submitted BIM files to insure that the quality control (QC) was properly performed.

6.5. Collaborative Design Environment

The "BIM Pit" (as nicknamed by Louisville District) is an environment where the architects and engineers are in a single room collaborating at the same time on a BIM model. This is where all the immediate communication and collaboration on the BIM model will occur. This is a fundamental shift in design philosophy within the Corps, since typically the disciplines are physically located in separate areas, each working on their own part of the design. Networked desktop computers should be set up for each Designer in the BIM Pit with access to a projector, whiteboard, and conference phone. This BIM Pit should be comfortable for all the Designers to work in, with access to both the model and the Internet (figure 2). The ultimate goal of the designers when they leave the BIM Pit is to have a substantially complete master model with extractions and sheet files comprising a draft submission (usually at least a 50% design submission).

While it is anticipated that the BIM Pit, as described above, will be (or is already) the standard design team process for generating BIM models, it is recognized that there are A/E/C firms with established BIM processes that may or may not make use of the BIM Pit as described above.

[3] References to project processes and requirements outside the scope of this Manual are of a general nature. The reader should assume that there exists a project-specific SOW detailing such processes and requirements.

What should be required concerning the collaborative design environment is that contracted A/E/C firms provide a written framework or implementation plan describing their BIM team and how the different disciplines produce concurrent BIM models. Also, Corps managers and others will need to monitor the BIM model development process and, obviously, the best way to accomplish this is to watch the BIM Pit or similar collaborative design environment in action. Thusly, USACE BIM reviewers should anticipate site visits to the designer's office to, literally, watch them design.

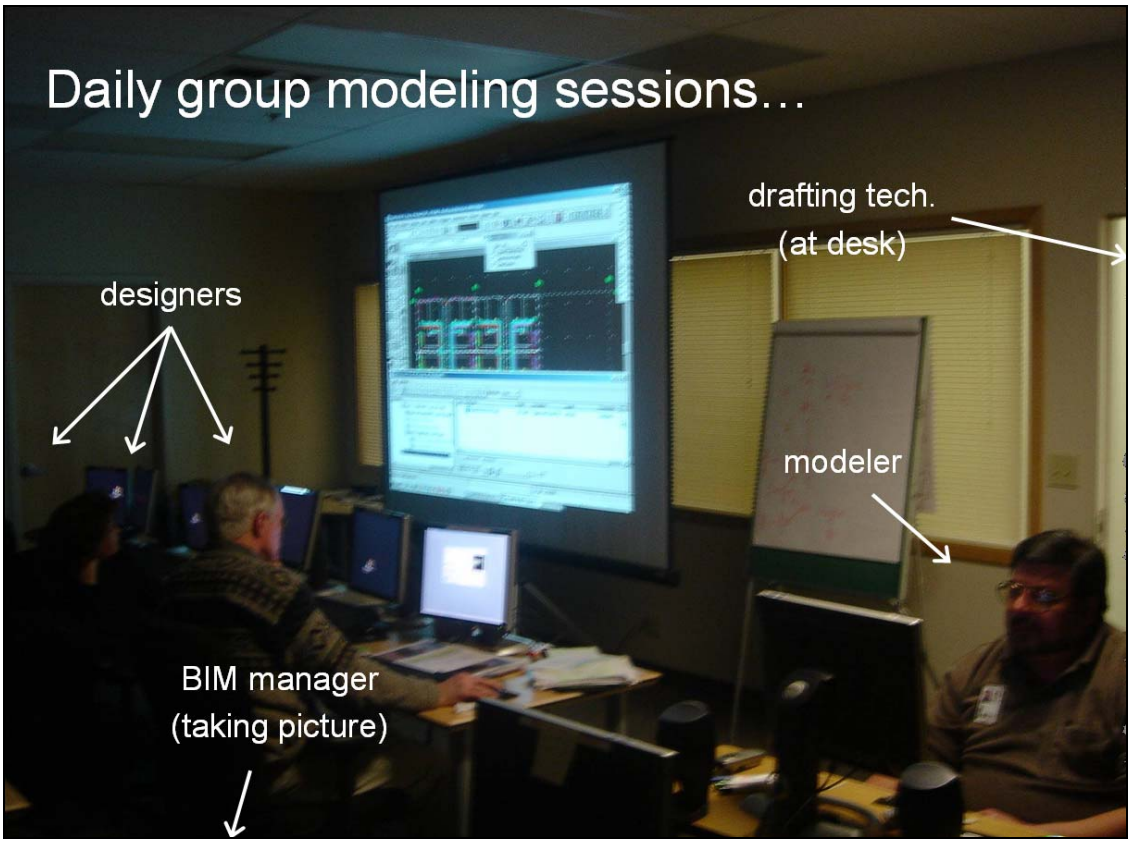

Figure 2. BIM Pit. Source: Selected BIM Case Studies. Major Patrick C. Suermann, P.E., University of Florida, 2007.

Project Timeline

Task	Work to be accomplished	Output / Result	Disciplines
Floor plan	Distribute floor plan to team for design preparation	Approved initial floor plan	Architecture
BIM PIT 1	Multi-discipline design, modeling, extractions to drawings, schedule filling, standards and interference check	Model, Extractions, Drawings, Schedules, Quantities	Architecture, Structures, Mechanical, Electrical
Interim Submittal	Over the shoulder review. Fly through model and review drawings with Client present and make changes to model during review	Interim Submittal drawing set	All
Detailed design work	Running loads, check design calcs, finalize the discipline modeling.	Design	All
BIM PIT 2	Finalize model, extractions, drawing sheets, output data, schedules, standards and interference check	Model, drawings and schedules	Architecture, Structures, Mechanical, Electrical
BCOE	Back check 2d output, add notes and dimensioning as required, compile drawing set	Model, drawings and schedules	All

US Army Corps
of Engineers
Louisville District

Figure 3. Collaborative Design Team Schedule. Note how the BIM Pit fits in.

END OF PART 1.

NEW YORK DISTRICT
OFFICIAL MANUAL
FOR
BUILDING INFORMATION MODELING (BIM) PROJECTS

PART 2 – MINIMUM BIM SUBMITTAL REQUIREMENTS

The following pages are typical of design-build project Request For Proposal (RFP) BIM requirements. Current procedure is to supply these requirements as "Attachment F" of specification section 01 33 16 Design After Award. For all such projects, the requirements of Attachment F shall govern and the contents of Part 2 of this Manual should be considered informational only.

The following pages describe minimum submittal requirements for New York District BIM projects.

BUILDING INFORMATION MODELING REQUIREMENTS

Section 1 -Submittal Format

1.1 Design Deliverables. Develop all designs using Building Information Modeling (BIM) and Computer Aided Design (CAD) software. Design submittal drawings shall be ANSI-D size (22 X 34), suitable for half-size (11" x 17") scaled reproduction.

Section 2 -Design Requirements

2.1 Drawings. Deliver CAD files used for the creation of the Construction Documents Drawings per requirements in Section 01 33 16, the criteria of the USACE New York District, and as noted herein. Specification of a CAD file format for these Drawings does not limit which BIM applications (s) or software(s) may be used for project development and execution.

2.2 BIM Model and Facility Data. Contractor shall select BIM application(s) and software(s) and develop project designs using BIM software. Use 3D graphic model(s) (the "Model") and associated intelligent attribute data ("Facility Data") created by this software to produce accurate Construction Documents. The Contractor will be provided with the Corps of Engineers BIM Workspace CD based on the Bentley System BIM to be utilized for submittals. The Contractor may be provided a baseline multi-discipline BIM Project Workspace for a CoS Facility Standard Design in the Bentley BIM v8 format for the purpose of site adaptation. The Workspace is dependent on specific versions of the Bentley BIM suite of products and only the versions of the software that are listed in the Contractor instructions included on the USACE BIM Workspace CD are permitted to be used.

2.2.1 IFC Coordination View. The Contractor's selected BIM application(s) and software(s) must be certified in the IFC Coordination View (2x3 or better. See www.iai-na.org). Submit any deviations from or additions to the IFC property sets for any new spaces, systems, and equipment for Government approval.

2.2.2 Submittal Requirements. BIM submittals shall be fully compatible with the Bentley BIM format version V8/XM and conform to the requirements of Section 3 and 4 below.

2.2.3 Implementation Plan.

2.2.3.1 Prior to the Initial Design Conference, submit an Implementation Plan, documenting viability of the BIM design and analysis technologies selected for the Project Model (integrated with the AEC CAD Standard) from concept development through As-Builts as a design, production, coordination, construction, and documentation tool and the collaborative process by which it shall be implemented.

2.2.3.2 The Implementation Plan shall describe uses of BIM during design and construction phases to include value management, interference management, and design-change tracking, or such other uses as the Contractor proposes. The implementation plan shall include a list of software being used and how it will share data. The implementation plans shall also include a plan for generating COBIE data.

2.2.3.3 The Implementation Plan shall identify how the BIM data shall be managed and interoperate (data storage, sharing, viewing, quality control parameters in Section 2.3 Quality Control, and updating, as necessary) among all Contractor team members.

2.2.3.4 Conduct an Implementation Plan demonstration at the Initial Design Conference to review the Implementation Plan for clarification, and to verify the functionality of Model technology workflow

and processes. The Government shall confirm acceptability of the Plan or advise as to additional processes or activities necessary to be incorporated into the Plan. If modifications are required, the Contractor shall execute the modifications and resubmit the final Implementation Plan for Government acceptance. There will be no payment for design or construction until the Plan is acceptable to the Government. The Government may also withhold payment for design and construction for unacceptable performance in executing the Implementation Plan,

2.2.4 Model Components. The Model shall include the following, subject to Government concurrence:

2.2.4.1 Project Specific BIM Facility Data. Develop the Facility Data, consisting of a set of intelligent elements for the Model (e.g., doors, air handlers, electrical panels). This Facility Data shall include all material definitions, qualities, and attributes that are necessary for the Project facility design.

2.2.4.2 Project Specific Minimum Requirements. The Contractor's Model shall include, at a minimum, the requirements of Section 4 below. The Government must agree with any proposed modifications to minimum requirements before incorporation into the Model.

2.2.4.3 Facility Data Output. Each submittal under Section 3 shall include a list of Construction Documents (e.g., drawings, elevations, design sections and schedules, details) that shall be produced from the Facility Data and updated as necessary.

2.2.4.4 Model Granularity. Models may vary in level of detail for individual elements within a 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 appropriately scaled civil drawings.

2.3 Quality Control. Implement quality control (QC) parameters for the Model, including:

2.3.1 Standards Checks. QC checking performed to ensure that the fonts, dimensions, line styles, levels and other construction document formatting issues are followed per the *NE/C* CADD Standard.

2.3.2 Model Integrity Checks. QC validation used to ensure that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements. Report non-compliant elements and provide justification acceptable to the Government if allowed to remain within the Model.

2.3.3 Other Parameters. Develop such other QC parameters as Contractor deems appropriate for the Project and provide to the Government for concurrence.

2.4 Design and Construction Reviews. Perform design and construction reviews at each submittal stage under Section 3 to test the Model, including:

2.4.1 Visual Checks. Checking to ensure the design intent has been followed and that there are no unintended elements in the Model.

2.4.2 Interference Management Checks. Locating conflicting spatial data in the Model where two elements are occupying the same physical space. Log hard interferences (e.g., mechanical vs. structural or mechanical vs. mechanical overlaps in the same location) and soft interferences (conflicts regarding service access, fireproofing, insulation) in a written report and resolve.

2.4.3 IFC Coordination View. Provide an IFC Coordination View in IFC Express format for all deliverables. Provide exported property set data for all IFC supported named building elements.

2.4.4 Other Parameters. Develop such other Review parameters as the Contractor deems appropriate for the Project and provide to the Government for concurrence.

Section 3 -Design Stage Submittal Requirements

3.1 Submittal Requirements.

3.1.1 Provide submittals in compliance with Implementation Plan deliverables at stages as described hereinafter.

3.1.2 Provide a Contractor-certified written report with each design submittal, confirming that consistency checks as identified in Paragraphs 2.3 and 2.4 have been completed for the design submittal. This report shall be discussed as part of the design review conference and shall address cross-discipline interferences, if any.

3.1.3 Following Government review and concurrence at each Stage in Paragraphs 3.3 through 3.5, provide the Government a 3-D interactive visualization from the Model in Bentley Navigator, Navisworks, Adobe 3D PDF 7.0 (or later), Google Earth KMZ or equivalent format. The Government may request other formats if needed to address Project-specific requirements.

3.2 Preliminary Implementation Review. Prior to the first Interim Design Submittal or Over-the-Shoulder Progress Review, demonstrate preliminary development of Model components and Facility Data identified in Paragraph 'Model Components'. Review the Model with the Government for conformity to program, massing, circulation, fire protection, security and sustainability Project requirements consistent with the Implementation Plan.

3.3 Interim Design Submittals.

3.3.1 BIM and CAD Detail. The Model shall include architectural, interior design, structural, mechanical, electrical, plumbing and fire protection systems and Facility Data, as applicable to the Interim Design package(s). Provide the Model, Facility, Workspace and CAD Data files in native Bentley BIM/CAD and interoperable formats per Implementation Plan requirements, and any rendering files, on DVD/CD-ROM.

3.4 Final Design Submissions and Design Complete Submittals.

3.4.1 BIM and CAD Data. The Model shall include all design elements identified in Section 4, unless otherwise agreed by the Government. Secure Government acceptance of the Model from the Government before proceeding with commencement of construction, as described in paragraph 3.7.6 of Section 01 33 16. Provide the updated Model, Facility, Workspace and CAD Data and rendering files on DVD/CD-ROM.

3.5 Construction Submittals -Over-The-Shoulder Progress Reviews. 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 Final As-Builts BIM and CAD Data. Submit the final Model, Facility Data, and CAD files reflecting as-built conditions for Government Approval, as specified in (as applicable to a specific project) Specifications Section 01 78 02.00 10, PROJECT CLOSEOUT.

Section 4 -BIM Model Minimum Requirements and Output[4]

4.1 General Provisions. The deliverable Model shall be developed to include the systems described below as they would be built and the processes of installing them, and to reflect final as-built 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. (Note: an effective demonstration of BIM capabilities will indicate an ability to comply with these provisions.)

4.2 Architectural Interior Design. 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 Spaces. The Model shall include spaces defining accurate net square footage and net volume, and holding data for the room finish schedule for including room names and numbers. Include Programmatic Information provided by the Government or validated program to verify design space against programmed space, using this information to validate area quantities.

4.2.2. Walls and Curtain Walls. 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 Doors, Windows and Louvers. 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 Roof. The Model shall include the roof configuration, drainage system, major 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 Floors. The floor slab shall be developed in the structural Model and then referenced by the architectural Model for each floor of the Project building.

4.2.6 Ceilings. All heights and other dimensions of ceilings, including soffits, ceiling materials, or other special conditions shall be depicted in the Model with the necessary intelligence to produce accurate plans, building sections and generic 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 and Woodwork. All architectural specialties (i.e., toilet room accessories, toilet partitions, grab bars, lockers, and display cases) and woodwork (i.e., cabinetry and counters) shall be accurately depicted with the necessary intelligence to produce accurate plans, elevations and sections 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] Refer to Part 3 of this Manual for further guidance.

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

4.3 Furniture/Fixtures/Equipment. 3D representation of FFE elements is preferred. For projects with an extensive systems furniture layout that may impact BIM system performance the Contractor will contact the Government for consideration of 2D representation. The FFE 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:

4.3.1 Furniture. The furniture systems Model may vary in level of detail for individual elements within a Model, but at n minimum must include all features that would be included on a quarter inch (1/4"=1 '0") scaled drawing, and shall include all relevant office equipment and furniture system layouts, with necessary intelligence to produce accurate plans, sections, perspectives and elevations necessary to completely depict furniture systems locations and sizes.

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

4.3.2 Fixtures and Equipment. Fixtures and equipment shall be depicted to meet layout requirements with the necessary intelligence to produce accurate plans, elevations, sections and schedules depicting their configuration

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

4.4 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 n quarter inch (1/4"= I'0") scaled drawing. Additional minimum Model requirements include:

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

4.4.2 Floor Slabs. Structural floor slabs shall be depicted, including nil necessary recesses, curbs, pads, closure pours, and major penetrations accurately depicted.

4.4.3 Structural Steel. 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 and related building/wall sections.

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

4.4.5 Expansion/Contraction Joints. Joints shall be accurately depicted.

4.4.6 Stairs. The structural Model shall include all necessary openings and framing members for stair systems, including necessary intelligence to produce accurate plans and building/wall sections depicting stair design elements.

4.4.7 Shafts and Pits. The structural Model shall include necessary shafts, pits, and openings, including necessary intelligence to produce accurate plans and building/wall sections depicting these design elements.

4.5 Mechanical. 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"= I '0") scaled drawing. Small diameter (less than 1-1/2" NPS) field-routed piping is not required in the model unless there are space constraints, is necessary for procurement or estimating purposes, or is essential to show operation. Additional minimum Model requirements include:

4.5.1 HVAC. All necessary heating, ventilating, air-conditioning and specialty equipment, including air distribution ducts for supply, return, and ventilation and exhaust ducts, including control system, registers. diffusers, grills and hydronic baseboards with necessary intelligence to produce accurate plans, elevations, building/wall sections and schedules. All piping 1-1/2" NPS and larger shall be modeled.

4.5.1.1 Mechanical Piping. All necessary piping and fixture layouts, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections. and schedules. All piping larger than 1.5" diameter shall be modeled.

4.5.2 Plumbing. 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. All piping larger than 1.5" diameter shall be modeled.

4.5.3 Equipment Clearances. All HVAC and Plumbing equipment clearances shall be modeled for use in interference management and maintenance access requirements.

4.5.4 Elevator Equipment. The Model shill I include the necessary equipment and control system, including necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.6 Electrical/Telecommunications. The electrical 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 1-112"0) field-routed conduit is not required in the BIM model unless there are space constraints, is necessary for procurement or estimating purposes, or is essential to show operation. Additional minimum Model requirements include:

4.6.1 Interior Electrical Power and Lighting. All necessary interior electrical components (i.e., lighting, receptacles, special and general purpose power receptacles, lighting fixtures, panelboards and control systems), including necessary intelligence to produce accurate plans, details and schedules. Cable tray routing shall be modeled without detail of cable contents. Lighting and power built into furniture/equipment shall be modeled.

4.6.2 Special Electrical Systems. All necessary special electrical components (i.e., security, Mass Notification, Public Address, nurse call and other special occupancies, and control systems), including necessary intelligence to produce accurate plans, details and schedules.

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

4.6.4 Communications. All existing and new communications 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. Communications conduit larger than 1.5" shall be modeled.

4.6.5 Exterior Building Lighting. All necessary exterior lighting with necessary intelligence to produce accurate plans, elevations and schedules. The exterior building lighting Model shall include all necessary lighting, relevant existing and proposed support utility lines and equipment required with necessary intelligence to produce accurate plans, details and schedules.

4.6.6 Equipment Clearances. All lighting and communications equipment clearances and no-fly zones shall be modeled for use in interference management and maintenance access requirements.

4.7 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:

4.7.1 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.

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

4.8 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:

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

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

4.8.3 Storm Water and Sanitary Sewers. All existing and new sewer structures and piping, including upgrades thereto, on the Project site with necessary connections to mains or other distribution points as appropriate, including necessary intelligence to produce accurate plans and profiles for the Project site.

4.8.4 Utilities. 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.

4.8.5 Roads and Parking. All necessary roadways and parking lots or parking structures, including necessary intelligence to produce accurate plans, profiles and cross-sections.

Section 5 -Ownership and Rights in Data

5.1 Ownership. The Government has ownership of and rights at the date of Closeout Submittal to all CAD files, BIM Model, and Facility Data developed for the Project in accordance with FAR Part 27, clauses incorporated in Section 00 72 00, Contract Clauses and Special Contract Requirement J.14

GOVERNMENT RE-USE OF DESIGN (Specification Section 00 73 00 of a specific project). The Government may make use of this data following any deliverable.

Section 6 -Contractor Electives

6.1 Applicable Criteria. If the Contractor elected to include one or more of the following features as an elective in its accepted contract proposal for additional credit during the source selection, as described in the proposal submission requirements and evaluation criteria, the following criteria arc requirements, as applicable to those elective feature(s).

6.2 COBlE Compliance. The Model and Facility Data for the Project shall fulfill Construction Operations Building Information Exchange (COBlE) requirements, including all requirements for the indexing and submission of Portable Document Format (PDF) and other appropriate file formats that would otherwise be printed and submitted in compliance with Project operations and maintenance handover requirements.

6.2.1 Electronic Exchange. The National Building Information Model Standard (NBIMS) COBlE format shall be used for electronic exchange on this Project. Compile a COBIE index on the Microsoft Excel spreadsheet provided by NBIMS at www.nbims.org. Unless otherwise noted, also provide information identified in the COBlE Pilot Implementation Standard worksheets.

6.3 Project Scheduling using the Model. In the Implementation Plan and during the Preliminary Implementation Review, provide an overview of the use of BIM in the development and support of the project construction schedule.

6.3.1 Submittal Requirements. During the Submittal stages, the Contractor shall deliver the construction schedule with information derived from the Model.

6.3.1.2 Construction Submittals -Over-The-Shoulder Progress Reviews. Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model for project scheduling.

6.4 Cost Estimating. In the Implementation Plan and during the Preliminary Implementation Review, provide an overview of the use of BIM in the development and support of cost estimating requirements, or other applications such as cost analysis and estimate validation.

6.4.1 Submittal Requirements. During the Submittal stages, the Contractor shall deliver cost estimating information derived from the Model.

6.4.2 Project completion. At project completion, the Contractor shall provide an MIT (Micro Computer Aided Cost Estimating System Generation II) Cost Estimate which follows the USACE Cost Engineering Military Work Breakdown System (WBS), a modified uniformat, to at least the sub-systems level and uses quantity information supplied directly from BIM output to the maximum extent possible, though other "Gap" quantity in formation will be included as necessary for a complete and accurate cost estimate.

6.4.2.1 Sub system level extracted quantities from the BIM for use within the estimate shall be provided according to how detailed line items or tasks should be installed/built so that accurate costs can be developed and/or reflected. Therefore, when developing a BIM, the designer shall be cognizant of what tasks need to be separated appropriately at the beginning stages of model development, such as tasks done on the first floor versus the same task on higher floors that will be more labor intensive and

therefore need to have a separate quantity and be priced differently. Tasks and their extracted quantities from the BIM shall be broken done by their location (proximity in the structure) as well ns the complexity of its installation.

6.4.2.2 At all design stages it shall be understood that BIM output As described in this document will not generate all quantities that are necessary in order to develop a complete and accurate cost estimate of the project based on the design. An example of this would be plumbing that is less than 1.5" diameter and therefore not expected to be modeled due to granularity; this information is commonly referred to as The Gap. Quantities from The Gap and their associated costs shall be included in the final project actual cost estimates as well.

END OF PART 2

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PART 3 –DISCIPLINE–BASED BIM SUBMITTAL REQUIREMENTS GUIDANCE

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Note: The previous Part of this Manual (2) provides the minimum requirements for BIM submittals. This Part of the Manual (3) provides further guidance regarding BIM submittals and expectations of the New York District regarding BIM work. As mentioned earlier, BIM is a rapidly evolving methodology and as it matures and becomes incorporated in the A/E/C industry certain aspects of BIM (methods, techniques, products) will become standardized. It is anticipated that Parts 2 and 3 of this Manual will eventually merge or be rewritten several times over the next two years.

1.0 – ALL DISCIPLINES

1.1 GENERAL

This chapter provides guidance for the Building Information Model (BIM) requirements for each submittal phase.

Since the concept of BIM is to digitally build the structure, it is inherent that all design work be preformed from the perspective that all elements and relationships between them are modeled as they would be built.[5] The designer shall use sound engineering, architectural, and construction judgment when placing elements on specific parts within families within BIM. The family and part configuration provided within this dataset does not intend to account for all types of construction elements; rather the intent is to establish a solid starting base to be built upon. The designer of record must understand the use of parts within the BIM in order for them to expand this list for their specific project needs. Family and parts must be used to differentiate groups of elements with the BIM in order to create the following:

- Quantity takeoffs for calculation of cost of all construction materials and activities related to the installation of those materials.
- Extraction and re-symbolization of model data to files for the creation of contract drawings on sheet borders.
- Renderings and stand-alone 3D output[6] of the BIM for communication of design and as a deliverable to the client.
- Support of the construction model data extraction.
- Querying elements facilitating simultaneous changes to multiple design elements.
- Level management – to comply with A/E/C CADD Standards and National BIM Standards.
- Design schedules and construction sequencing.

Note: Anti-terrorism/Force Protection (AT/FP) is a multidisciplinary subject. Designer judgment should be exercised when considering BIM modeling aspects of AT/FP and security engineering.

1.2 CHARETTE SUBMITTAL

The design team will complete this submittal in a maximum of 30 days. This BIM submittal shall include all of the major components of civil and architectural. All Drawings supporting this submittal shall come directly from the model using the extraction processes. Civil drawings for this submittal can be generated from models utilizing Bentley PowerCivil or Bentley InRoads. This is the most important submittal as it captures the customer's intent at the beginning of the project thus effectively facilitating change control.

A completed space layout drawing and the USACE Default Dataset shall be submitted. Spaces shall indicate room names and numbers along with the placed and programmed square footages. Spaces shall also have datagroup information associated with the USACE Default Dataset.

[5] This is simply an update of the tried and true adage "Build it on paper first!"
[6] .pdf, Navisworks, Solibri, etc.

Provide an exported Excel spreadsheet space schedule from the space layout drawing to validate the 1391/1390 and 5034R. Spreadsheet shall indicate the differences in areas between approved square footages and placed square footages.

Refer to detailed design requirements in the contract documents for drawing deliverables.

Also refer to disciplines specific BIM requirements that are outlined below.

1.2 INTERIM SUBMITTALS

These BIM submittals, as required in a specific project scope of work, shall include all of the major components of civil, architecture, interior design, structural, mechanical, electrical, fire protection, and information systems as well as complete building elevations. In general, all elements normally shown in ¼" – 1'-0' scale drawing or detail shall be included in the model as a minimum requirement. It is left to designer's judgment for additional detailing in the model.

All files must be in the proper location within the USACE Workspace provided by the CENAN BIM Manager. The New York District must be able to recreate the BIM process in order to review the drawings and model. Simple images are not acceptable and are not direct output of the BIM.

Schedules – Provide a door and room finish schedules from the BIM indicating the materials and finishes used in the design. The room finish schedule template is provided within the dataset. Also a special item schedule and/or notes shall be provided indicating any special items that will be required for the design. Due to the specific nature of the special items schedule, it shall not be required as output of the BIM, but there are additional templates in development, and these will be required on future projects to support specific output tasks of the design team.

Extractions – The extraction process shall be well established at the interim submittal. Most extraction definitions shall be completed within the master models. It is suggested that the design team begin with the extraction definitions provided with the dataset and build from there.

Datagroup – The Datagroup information shall be complete at the interim submittal and shall not be edited beyond this stage unless large building usage changes have been made. All spreadsheet output shall be linked to a sheet design file and submitted.

Dataset – All dataset issues shall be resolved at the interim submittal. Any additional families, parts, line styles, special dimension styles, or level not provided in the USACE Dataset shall be submitted to the New York District BIM Manager at this and every submittal.

Quality verification -All quality checks listed in Part 1-BIM Instructions "QA/QC and Detection of Changes to the Dataset" shall be completed for all files and disciplines created with BIM. Output of those checks shall be submitted with the normal submitted materials. In addition, documentation of all unresolved interferences, standards, TriForma elements along with an explanation, shall be submitted. A quality check for compliance with the A\E\C CADD Standard must also be completed on the final file condition prior to submittal and the results of that standard check must be included in the submittal.

Drawings – All drawings that contain information that resides in the model shall be generated from the BIM in the extraction process. Standard details, index sheet, and other typical drawings need not be included in the BIM. CAD Drawings shall comply with the New York District CAD Standard.

Part and Family Report – The model must support the Part and Families that are contained in the USACE BIM Dataset (Refer to Part 1 – BIM Instructions). A report will be submitted that validates the parts and families of the BIM model.

Interference Manager Report- Interferences shall be checked between structural, mechanical, electrical and architectural models. A report shall be generated showing sign off's for soft and hard interferences from the design team. This report shall be submitted as part of the interim and final submittals. Also a Bentley Navigator or similar file shall be submitted to highlight structural and mechanical interferences.

Configuration verification report-a configuration report shall be generated showing that all system valuables are using the correct workspace and datasets.

1.4 FINAL SUBMITTAL(S)

The final submittal(s) shall include all of the major components of civil, architecture, interior design, structural, mechanical, electrical, fire protection, and information systems created with BIM. All changes and comments from previous submittals shall be incorporated into all BIM models for this submittal. The following paragraphs describe most conditions for when an element shall or shall not be in the model. In general, all elements normally shown in ¼" – 1'-0' scale drawing or detail shall be included in the model as a minimum requirement. It is left to designer's judgment for addition detailing in the model.

All files must be in the proper location within the USACE Workspace (Refer to Part 1 – BIM Work Instructions). The New York District must be able to recreate the BIM output files from the BIM in order to review the drawings and model. Simple images are not acceptable and are not direct output of the BIM.

Schedules – All instance data shall be reported into the appropriate schedules. Also any special schedules and/or notes shall be provided indicating any special items that will be required for the design.

Extractions – The extraction process shall be completed at this time.

Datagroup – The Datagroup information shall be complete.

Dataset – All dataset issues shall be resolved at the interim submittal. Any additional families, parts, line styles, special dimension styles, or level not provided in the USACE BIM Dataset shall be submitted to the New York District BIM Manager at this and every submittal. (See Appendix 1 - "QA/QC and Detection of Changes to the Dataset" for guidance on standard and dataset change requests)

Quality verification -All quality checks listed in Appendix 1 -"QA/QC and Detection of Changes to the Dataset" shall be completed for all files and disciplines. Output of those checks shall be submitted with the normal submitted materials. In addition, documentation of all unresolved interferences, standards, elements along with an explanation, shall be submitted. A quality check for compliance with the A\E\C CADD standards must also be completed on the final file condition prior to submittal and the results of that standard check must be included in the submittal.

Design Analysis -The model must support the design analysis and vice versa.

Drawings – All drawings that contain information which resides in the model shall be generated from the BIM in the extraction process. Standard details, index sheet, and other typical drawings need not be included in the BIM. CAD Drawings shall comply with the New York District CAD Standard.

Part and Family Report – The model must support the Part and Families that are contained in the USACE BIM Dataset (Refer to Part 1 – BIM Work Instructions). A report shall be submitted that validates the parts and families of the BIM model.

Interference Manager-All BIM models shall be checked for interferences between structural, mechanical, electrical and architectural models. A report shall be generated showing sign off's for soft and hard interferences from the design team. This report shall be submitted as part of the interim and final submittals. Also a Bentley Navigator or similar file shall be submitted to highlight structural and mechanical interferences.

1.5 RTA / BCOE SUBMITTAL REQUIREMENTS

1.5.1 SYSTEM MODELS

The Systems models shall be complete and include any comments from the previous submittal that affect the models. Submittals must include the extraction files, sheet files, special patterning, line styles, cells, referenced files or other specific files used to create the drawings as output of the model.

1.5.2 DRAWING EXTRACTION REQUIREMENTS

All extractions shall be updated to include any comments from the previous submittal.

Also refer to applicable discipline specific requirements described in other project documentation.

1.6 AS-AWARDED MODELS

When applicable (see next paragraph) As-awarded models shall incorporate all amendments to the solicitation documents (Request for Proposal, Invitation to Bid, etc.). Delivery of the as-awarded models to the contractor needs to be coordinated as early as possible.[7]

1.7 AS-BUILT SUBMITTAL REQUIREMENTS

At present, until BIM is thoroughly established throughout the construction industry, New York District cannot confidently assume that all successful bidders will posses an appropriate level of BIM expertise necessary to submit as-built or record BIM models during the course of the project. Therefore, unless the contractor does, in fact, demonstrate adequate proficiency in BIM,[8] the most prudent way for accurate and precise as-built model generation is for the contractor to submit revised CAD files or hand-marked paper drawings. Upon receipt of as-built information, the BIM Team will revise the BIM model accordingly.[9] Note: it is outside the scope of this Manual, at this time, to provide guidance for use of BIM during construction other than the brief description in the previous sentences.

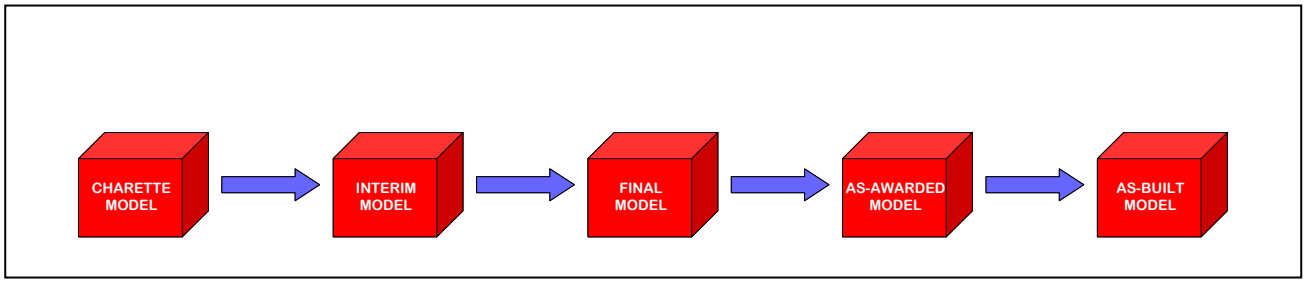

Figure 4. BIM Model submittals.

[7] Coordination of construction supervision and administration is beyond the scope of this Manual. Nevertheless, a good time to deliver the as-awarded models might be at a project's Pre-construction meeting.
[8] How this is to be gauged has yet to be determined.
[9] Project specific. Refer to the appropriate Project Management Plan for guidance.

2.0 – CIVIL

2.1 GENERAL

This chapter provides guidance for BIM requirements for each submittal phase.

2.2 CHARETTE SUBMITTAL

Using site survey information[10] the following model(s) shall be created and submitted:

Digital Terrain Model (DTM) -the DTM will show the new and existing contours together to make-up the overall site model.

The DTM will show roads, parking and building footprint(s) of the approved site and building layouts from the charette meeting.

All existing utilities need to be indicated in the DTM. The utilities can be placed as simple 2D geometry for this submittal.

All drawings will be extracted from this model. Also refer to project requirement documentation for drawing deliverables.

2.3 INTERIM SUBMITTAL

2.3.1 Civil Models

The Civil models may vary in level of detail for individual elements within a model, but at a minimum must include all features that would be included on an appropriately scaled drawing. Additional minimum requirements are listed below.

Digital Terrain Model (DTM) – This model will show existing and new grading contours. This model will also show all existing structures that are remaining. Indicate the new building(s), pavement, drainage inlets, structures, swales and/or detention areas.

Drainage Model – This model will show existing and proposed new piping.

Storm and Sanitary Model – This model will show sewer structures and pipes.

Utility Model – This model will show connection of new utilities from the building to the existing utilities. This model will also show all existing underground utilities along with all new and existing above ground utilities.

Road and Parking Model – This model will show roadway and parking lot facilities. Also existing ground and utilities crossing will be indicated in this model.

Master Site Model – this model will have all civil design models referenced in to create drawing extractions. All drawings shall be extracted form the BIM master model.

[10] How this data is acquired is not within the scope of this Manual.

2.3.2 DRAWING EXTRACTION REQUIREMENTS

See discipline specific requirements in Part B – Detailed Design (Phase II)

2.4 FINAL SUBMITTAL

The Civil models may vary in level of detail for individual elements within a model, but at a minimum must include all features that would be included on an appropriately scaled drawing. Additional minimum requirements are listed below.

Digital Terrain Model (DTM) – This model will show existing and new grading contours. This model will also show all existing structures that are remaining. Indicate the new building(s), pavement, drainage inlets, structures, swales and/or detention areas.

Drainage Model – This model will show existing and proposed new piping.

Storm and Sanitary Model – This model will show sewer structures and pipes.

Utility Model – This model will show connection of new utilities from the building to the existing utilities. This model will also show all existing underground utilities along all new and existing above ground utilities.

Road and Parking Model – This model will show roadway and parking lot facilities. Also existing ground and utilities crossing will be indicated in this model.

Master Site Model – this model will have all civil design models referenced in to create drawing extractions. All drawings shall be extracted form the BIM models.

2.4.1 DRAWING EXTRACTION REQUIREMENTS

All extractions shall be updated to include any comments from the previous submittal.

Also refer to applicable discipline specific requirements described in other project documentation.

3.0 – SITE MECHANICAL UTILITIES

3.1 GENERAL

This chapter states the minimum BIM requirements for each submittal phase.

3.2 CHARETTE SUBMITTAL

There are no BIM requirements for this phase.

3.3 INTERIM SUBMITTAL BIM

Guidelines have not been determined at this time.

3.4 FINAL SUBMITTAL BIM

Guidelines have not been determined at this time.

4.0 – ARCHITECTURAL

4.1 GENERAL

This chapter provides guidance for BIM requirements for each submittal phase.

4.2 CHARETTE SUBMITTAL

The design team will in a maximum of thirty (30) days to prepare the following documents:

- Completed single line space layout drawing using the Create Space tool in Bentley Building Suite of tools.
- Exported Excel spread sheet from the space layout using Instance Data tool. The spread sheet will contain the following information: Room name, room number, building type, floor location, authorized square footages and placed square footages.
- Validation of 1391 and 5034R in a spreadsheet format that will show approved square footages and area differences in program square footages.
- Project-specific standard modules that come with the USACE dataset (Refer to Part 1 – BIM Work Instructions) will be added. Examples: kitchen, weapons simulator, standard offices, and vaults.
- Extracted floor plan from the 3D model. Floor plan will have door locations and room names and numbers shown in the extraction. And key features from the placed modules.
- 3D massing model illustrating building exterior and key features. The massing model is to only identify scale of the building exterior. Material selection is not required. The massing model will be extracted from model to produce 2D building extractions. Also the massing model will be submitted in Bentley Navigator and 3D .pdf.
- A schematic roof plan will be extracted to produce a 2D roof plan. Roof plan will show how water is to drain, roof slope, and roof material.
- Charette participants will comment on the charette submittal using Dr. Checks. The Project Engineer will set this up for each submittal of the project.

4.3 INTERIM SUBMITTAL

4.3.1 ARCHITECTURAL MODELS

The Architectural systems models may vary in level of detail for individual elements within a model, but at a minimum must include all features that would be included on a ¼” to 1’-0” scaled drawing. Additional minimum requirements are listed below.

Walls -The architectural model(s) shall include all walls, both interior and exterior. Exterior banding or brickwork, entrance features, and special interior features shall be modeled at this stage for communication to the client at review. Extractions shall re-symbolize properly to identify them.

Doors and Windows – Doors and windows shall be modeled to represent the actual size and location on all exterior elevations. Doors and windows shall be placed using the Bentley door or window tool and they shall be of a cell type that supports the door and window templates provided by the USACE BIM Dataset CD as well as the datagroup system for labeling and other BIM functions.

Roof – The roof system shall be modeled within the BIM. The level of detail for the roof system must be adequate to communicate the roof configuration and the method by which the water is removed from structure. Again, this shall be modeled as it is built. This does not mean that the entire roof structure must be modeled at this submittal, but it does mean that an adequate place holder representing size, shape and configuration must be modeled. Most quantities can be derived from the surface area and the depth of the roof assembly.

Spaces – The spaces are a very important element in this submittal. They shall be modeled to complete accuracy as to obtain accurate net square footage requirements and to hold data for the room and finish schedules which draw information from them. Room names and numbers shall also be finalized within the model for output to schedules.

Space Layout – Final space layout shall be produced from the BIM; indicating room names, room number, and placed and authorize square footages shall be indicated. This layout shall reflect all modifications to the approved charette space layout. Any significant changes shall be address in a report stating reasons for the change.

Fly-Thru – A simple exterior fly-thru of the facility shall also be submitted. The fly-thru shall indicate key features of the facility to communicate to the USACE representatives and end users what the exterior materials are. The fly-thru shall indicate the massing and scale of the facility. This will give user buy-in early on in the design.

Renderings – Three or four exterior renderings shall be generated to illustrate key features and scale of interior and exterior design features. This rendering shall be used for communication purposes only, and is not the professional rendering.

4.3.2 DRAWING EXTRACTION REQUIREMENTS

Composite Floor Plan -If the main floor plans must be shown in segments in order to comply with the requirements of the proper scale, provide a smaller scale floor plan from the BIM showing exterior wall, interior partitions, and circulation elements and cross referencing for enlarged floor plans and sections. Show overall dimensions on the floor plan and gross building areas tabulation on the drawing. Tabulated data such as gross sq footage shall be considered output of the model.

Floor Plans -Provide floor plans from the BIM at 1/8"=1'-0" or ¼" = 1'-0" (1:100 or 1:50) scale. Show gross floor area tabulations if no composite sheet is included. Tabulated data such as gross sq footage shall be considered output of the model.

Building Elevations -Provide building elevations from the BIM showing openings, principal exterior materials and general profiles of the building (scale shall be the same as the floor plans).

Roof Plan -Provide a roof plan from the BIM showing the roof configuration and methods by which rain is directed to the building perimeter.

Building and Wall Sections -Provide typical wall sections (1:20 minimum scale) that indicate major elements. Wall sections shall be unbroken where practical and indicate materials and floor-to¬-floor

heights. Building and wall sections shall be output of the model, but building details are typical and at such a large scale that they shall not be required as output of the BIM.

Reflected Ceiling Plan -Provide a ceiling plan from the BIM that indicates ceiling. Indicate room names and numbers.

Fire Protection/Life Safety Plan -Provide fire protection/life safety drawings from the BIM that indicate travel distances. Provide a summary of the code analyses.

Also refer to applicable discipline specific requirements described in other project documentation.

4.4 FINAL SUBMITTAL

4.4.1 ARCHITECTURAL MODELS

The Architectural systems models may vary in level of detail for individual elements within a model, but at a minimum must include all features that would be included on a ¼" to 1'-0" scaled drawing. Additional minimum requirements are listed below.

Walls -The architectural model(s) shall include all walls, both interior and exterior. They shall be modeled as they would be built; meaning with enough detail to get quality quantity takeoffs on all construction materials used. They shall also be accurate enough that all floor plan and elevation extractions are accurate to the design intent. Exterior banding or brickwork, entrance features, and special interior features shall be modeled at this stage for communication to the client at review. Each wall shall be to the exact height, length and width so to properly account for space allocation. Fire rating of walls shall be indicated by utilizing the proper family and part for those wall types. Extractions shall re-symbolize properly to identify them.

Doors and Windows – Doors and windows shall be modeled to represent the actual size and location on all exterior elevations. They shall be the exact door or window that is intended by the Architect in all respects, including size and style. Doors and windows shall be placed using the Bentley door or window tool and they shall be of a cell type that supports the door and window templates provided by the USACE BIM Dataset as well as the datagroup system for labeling and other BIM functions. They cannot be placed as independent cells. They must be placed within these tools so that the datagroup system can accurately count and hold data for the doors and windows.

Roof – The roof system must be modeled within the BIM. The level of detail for the roof system must be adequate to communicate the roof configuration and the method by which the water is removed from structure. Again, this must be modeled as it is built. This does not mean that the entire roof structure must be modeled at this submittal, but it does mean that an adequate place holder representing size, shape and configuration must be modeled. Most quantities can be derived from the surface area and the depth of the roof assembly.

Floors – The floor slab shall be modeled in the structural model and then referenced by the architectural models for each floor slab.

Ceilings – All ceilings shall be modeled using either Bentley's ceiling tool or form modeling to create special ceiling features. All ceilings, including soffits or other special conditions shall be in the model at this submittal. Soffits and special feature do not have to be competed, but shall contain enough information to show design intent.

Fly-Thru – A simple exterior fly-thru of the facility shall also be submitted. The fly-thru shall indicate key features of the facility to communicate to the USACE representatives and end users what the exterior materials are. The fly-thru shall indicate the massing and scale of the facility. This will give user buy-in early on in the design. Fly-Thru shall be provided in .avi or .mpg file format.

Renderings – Three or four exterior renderings shall be generated to illustrate key features and scale of interior and exterior design features. This rendering shall be used for communication purposes only, and is not the professional rendering.

4.4.2 DRAWING EXTRACTION REQUIREMENTS

Composite Floor Plan -If the main floor plans must be shown in segments in order to comply with the requirements of the proper scale, provide a smaller scale floor plan from the BIM showing exterior wall, interior partitions, and circulation elements and cross referencing for enlarged floor plans and sections. Show overall dimensions on the floor plan and gross building areas tabulation on the drawing. Tabulated data such as gross sq footage shall be considered output of the model.

Floor Plans -Provide floor plans from the BIM at 1/8"=1'-0" or ¼" = 1'-0" (1:100 or 1:50) scale. Show gross floor area tabulations if no composite sheet is included. Tabulated data such as gross sq footage shall be considered output of the model.

Building Elevations -Provide building elevations from the BIM showing grading, openings, principal exterior materials and general profiles of the building (scale shall be the same as the floor plans).

Roof Plan -Provide a roof plan from the BIM showing the roof configuration and methods by which rain is directed to the building perimeter.

Building and Wall Sections -Provide typical wall sections (1:20 minimum scale) that indicate major elements. Wall sections shall be unbroken where practical and indicate materials and floor-to¬-floor heights. Building sections shall be output of the model, but wall sections and details are typical and at such a large scale that they shall not be required as output of the BIM.

Reflected Ceiling Plan -Provide a ceiling plan from the BIM that indicates ceiling material and open ceiling areas. Indicate room numbers, light locations, registers, and all ceiling mounted items such as exit signs.

Fire Protection/Life Safety Plan -Provide fire protection/life safety drawings from the BIM that indicate fire suppression information, exit signs, pull stations, exit devices, exit distance, emergency lights, detectors, alarm locations and fire panel locations. Completed code analyses.

All extractions shall be updated to include any comments from the previous submittal.

Also refer to applicable discipline specific requirements described in other project documentation.

5.0 – INTERIOR DESIGN

5.1 GENERAL

This chapter provides guidance for BIM requirements for each submittal phase.

5.2 CHARETTE SUBMITTAL

There are no BIM requirements for this phase.

5.3 INTERIM SUBMITTAL

5.3.1 INTERIOR MODELS

The interior system models may vary in level and detail for individual elements within a model, but the minimum must include all features that would be included on a ¼" to 1'-0" scaled drawing. Additional minimum requirements are listed below.

Furniture Plans – The furniture system model(s) shall include all office and system furniture layouts using the furniture cell library provided in the USACE BIM Dataset. It includes most instances of both system furniture and office furniture. System and office furniture shall be completely modeled.

5.3.2 DRAWING EXTRACTION REQUIREMENTS

Refer to applicable discipline specific requirements described in other project documentation.

5.4 FINAL SUBMITTAL

5.4.1 INTERIOR MODELS

Furniture Plans – The furniture system model(s) shall include all office and system furniture layouts using the furniture cell library provided in the USACE BIM Dataset. It includes most instances of both system furniture and office furniture. System and office furniture shall be modeled and be able to be supported using the Instance Datagroup tool to accurately quantify piece counts for furniture components that make up the overall furniture package. Piece count information shall be extracted from the BIM using the Instance Datagroup tools to export out to a spreadsheet.

5.4.2 DRAWING EXTRACTION REQUIREMENTS

Composite Furniture Plans – A composite floor plan will be required if partial floor plans are needed to comply with the requirements for the proper scale. The furniture plans shall match the architectural drawing layouts for sheets. Furniture plans will be extracted from the BIM showing furniture layout for office and system furniture. Extractions shall re-symbolize the 3D objects to properly identify them.

Component Plans – Shall be extracted from the BIM and be property re-symbolized to create the component floor plans. Component plans shall match architectural drawing layouts for sheets.

Panel Floor Plans – Shall be extracted from the BIM and be property re-symbolized to create the panel floor plans. Panel floor plans shall match the architectural drawing layouts for sheets.

All extractions shall be updated to include any comments from the previous submittal.

Also refer to applicable discipline specific requirements described in other project documentation.

6.0 – STRUCTURAL

6.1 GENERAL

This chapter provides guidance for BIM requirements for each submittal phase.

6.2 CHARETTE SUBMITTAL

Provide documentation describing coordination with architectural discipline pertaining to column grid geometry and bearing wall layout.

6.3 INTERIM SUBMITTAL

6.3.1 STRUCTURAL MODELS

The Structural systems models may vary in level of detail for individual elements within a model, but at a minimum must include all features that would be included on a ¼" to 1'-0" scaled drawing. Additional minimum requirements are listed below.

Foundations -The structural model(s) shall include all foundation elements (stem walls, strip footings, spread footings, and column pedestals) for both interior and exterior foundation. They shall be modeled as they would be built; meaning with enough detail to get quality quantity takeoffs on all construction materials used. They shall also be accurate enough that all foundation plan and elevation extractions are accurate to the design intent.

Floor Slabs – The floor slabs shall be modeled in the structural model and then referenced by the architectural models for each floor slab.

Primary Framing –The structural model(s) shall include all primary framing members for the roof and floors. They shall be accurate enough that all framing plan, sections and elevation extractions are accurate to the design intent.

6.3.2 DRAWING EXTRACTION REQUIREMENTS

Foundation Plans – Provide foundation / slab plans from the BIM at 1/8"=1'-0" or ¼"=1'-0" (1:100 or 1:50 for metric drawings) scale. Framing Plans -Provide foundation / slab plans from the BIM at 1/8"=1'-0" or ¼"=1'-0" (1:100 or 1:50 for metric drawings) scale.

Sections – Typical sections shall be furnished from the BIM or standard details may be used if the extraction would give the save result.

6.4 FINAL SUBMITTAL

6.4.1 STRUCTURAL MODELS

The Structural Systems models shall be complete and include any comments from the previous submittal that affect the models. The Structural systems models may vary in level of detail for individual elements within a model, but a minimum must include all features that would be included on a ¼" to 1'-0" scaled drawing. Additional minimum requirements are listed below.

Foundations -The structural model(s) shall include all foundation elements (stem walls, strip footings, spread footings, and column pedestals) for both interior and exterior foundation. They shall be modeled

as they would be built; meaning with enough detail to get quality quantity takeoffs on all construction materials used. They shall also be accurate enough that all foundation plan and elevation extractions are accurate to the design intent.

Floor Slabs – The floor slabs shall be modeled in the structural model and then referenced by the architectural models for each floor slab.

Framing – The structural model(s) shall include all (primary, secondary, etc.) framing members for the roof and floor systems, including the roof and floor decks. Any bracing that is required for the structural systems shall also be in the model(s).

Stairs and Elevators – The structural model(s) shall include all framing members for stairs and elevators.

6.4.2 DRAWING EXTRACTION REQUIREMENTS

Foundation Plans – Provide foundation / slab plans from the BIM at 1/8”=1’-0” or ¼”=1’-0”

(1:100 or 1:50 for metric drawings) scale. Framing Plans -Provide foundation / slab plans from the BIM at 1/8”=1’-0” or ¼”=1’-0” (1:100 or 1:50 for metric drawings) scale.

Sections and Details – Typical and special sections and details shall be furnished from the BIM or standard details may be used if the extraction would give the save result.

Wall Elevations – Provide wall elevations as required from the BIM at 1/8”= 1’-0” (1:100 for metric drawings) scale.

Building Sections – Provide building sections as needed from the BIM at 1/8”=1’-0 or ¼”=1’-0”

(1:100 or 1:50 for metric drawings) scale.

7.0 – MECHANICAL -HVAC, PLUMBING AND FIRE PROTECTION

7.1 GENERAL

This chapter provides guidance for BIM requirements for each submittal phase.

7.2 CHARETTE SUBMITTAL

There are no BIM requirements for this phase.

7.3 INTERIM SUBMITTAL

7.3.1 MECHANICAL MODELS

The Mechanical systems models may vary in level of detail for individual elements within a model, but at a minimum must include all features that would be included on a ¼" to 1'-0" scaled drawing. Additional minimum requirements are listed below.

HVAC -The mechanical model(s) shall include major pieces of heating, ventilating, and air-conditioning equipment. Include the air distribution duct layouts for supply, return, ventilation, and exhaust ducts. They shall be accurate enough that all HVAC plans and elevation extractions are accurate to the design intent.

Plumbing – The plumbing model(s) shall include fixture layout, floor and area drains, and plumbing equipment (hot water generator, storage tanks, air compressors, etc.)

Fire Protection – There are no BIM requirements for this phase.

7.3.2 Drawing Extraction Requirements

HVAC Plans – Provide foundation / slab plans from the BIM at 1/8"=1'-0" or ¼"=1'-0" (1:100 or 1:50 for metric drawings) scale. Plumbing Plans -Provide foundation / slab plans from the BIM at 1/8"=1'-0" or ¼"=1'-0" (1:100 or 1:50 for metric drawings) scale.

Sections – Typical sections shall be furnished from the BIM or standard details may be used if the extraction would give the save result.

7.4 FINAL SUBMITTAL

All extractions shall be updated to include any comments from the previous submittal.

Also refer to applicable discipline specific requirements described in other project documentation.

8.0 – ELECTRICAL

8.1 GENERAL

This chapter provides guidance for BIM requirements for each submittal phase.

8.2 CHARETTE SUBMITTAL

BIM guidelines have not been determined at this time.

8.3 INTERIM SUBMITTAL

8.3.1 ELECTRICAL MODELS

The Electrical systems models may vary in level of detail for individual elements within a model, but at a minimum must include all features that would be included on a ¼" to 1'-0" scaled drawing. Additional minimum requirements are listed below.

Interior Electrical Model – Interior electrical models shall show lighting, receptacles, telephone outlets, special and general purpose power receptacles and lighting fixtures. Model shall also indicate fire alarm/mass notification devices, fire alarm/mass notification and detection system.

Emergency Lighting Model – Shall show the location of emergency lighting fixtures including exit signs and exterior path illumination. Include this information on the life safety code drawings.

Communications Model – Shall include any existing and new communications service connections, both above ground and underground. Indicate characteristics and standards of design for aerial or underground communication lines

Exterior Lighting Model – Shall indicate location of exterior lighting proposed (street lighting, security lighting, or parking lot lighting).

Electrical Site Model – Shall indicate all existing and proposed support utility lines and equipment required to serve the project including electrical power lines, all roads and driveways, parking areas, and other items necessary for functional and operating adequacy. If extensive, provide separate drawings with independent legend for new work.

8.3.2 DRAWING EXTRACTION REQUIREMENTS

Refer to applicable discipline specific requirements described in other project documentation.

8.4 FINAL SUBMITTAL

All extractions shall be updated to include any comments from the previous submittal.

Also refer to applicable discipline specific requirements described in other project documentation.

END OF PART 3