

BIM & Computer Aided Design (CAD) Requirements

Introduction

A. Why CAD Conventions and Standards?

1. Standardization in the use and implementation of CAD in the AE industry has been a goal from the very beginning of CAD development. This drive for a standard, in fact, has resulted in many standards. Most large architectural/ engineering firms have created their own standards as the only way to internally manage the creation of Contract Documents. Since the end product was a plot, a hard copy of the electronic information, there was not an urgent requirement for the electronic files to meet external standards, only that they could produce a plot. Transfer of electronic CAD information was the exception rather than the rule. This process resulted in projects made up of electronic files created under different CAD “standards”, and, in fact, utilizing different and incompatible programs. As long as the final product was the plot, this incompatibility did not present a major problem - certainly not to the Owner of the facility who had no reason to care about the electronics.

B. Why University of Alabama’s Standards?

1. The University of Alabama, like other Owners of large facility complexes, has recognized that the information contained in the electronic CAD files used to construct the facility can also be used to maintain and manage the facility through its “life-cycle”. Utilizing electronic graphical information, CAD and other graphic files, along with non-graphical information associated with the graphics, is the only practical way to manage space in today’s changing world. No longer is the print the final product deliverable from the Architect, in fact, the print will be just a step in the development of a true “Life-Cycle” electronic document to manage space at The University of Alabama.
2. The University of Alabama has implemented a Facilities Information Management System (FIMS) which integrates Maintenance Management and Space Management information relating to The University of Alabama’s physical environment. It is envisioned that The University of Alabama’s Facilities Management system, along with Internet project collaboration, will play a significant role in the workflow of all construction related tasks, from minor renovations to major Capital projects. As the workflow of the design process expands to provide distance collaboration, it will be essential that all operations employ the same procedures and formats.
3. In order to ensure uniformity and compatibility from one design operation to another, it is essential that all operations employ the same procedures and format when performing design work, particularly, when using computer aided design in preparing drawings. To allow for the distribution, sharing, modifications and exchange of this electronic information, product standards and guidelines must be established. To this end, The University of Alabama has adopted the standards contained herein to be used both internally at The University of Alabama and by all architects, engineers, contractors and other consultants providing CAD information to The University of Alabama.
4. This user’s CAD Requirements Manual is intended to serve as both policy and guidelines in order to achieve the stated objectives.

C. Purpose of Manual

1. The purpose of the CAD Requirements Manual is to:
 - a. Establish minimum electronic deliverables.
 - b. Establish consistent quality and appearance of computer generated drawings.
 - c. Establish standard file naming conventions.
 - d. Establish standard symbology.
 - e. Establish uniform GIS information.

Basic Requirements & Deliverables

A. General

1. University of Alabama has developed very specific CAD and other electronic file standards for facility project information, the following shall be used as a guide of required deliverables. These deliverables must be submitted in the standard formats to be provided by The University of Alabama.
2. The requirement and submission of Drawings, Specifications and other documents in electronic format does not change the use of Architect's Drawings, Specifications and other documents from the requirements stated in the Architect's contract with The University of Alabama. Concern for the misuse due to change of documentation by the Owner or others is lessened due to the files being transferred in "read-only" format. The following is the **only** acceptable disclaimer to be printed on the deliverable disk:

This disk contains electronic file versions of Drawings, Specifications and other documents prepared specifically for this project. The information may be compiled from many sources and to the best of the Author's knowledge is accurate with regard to industry standards, however, all information has NOT been field verified. Any and all uses of these files, or the information contained herein, is bound to the same terms and conditions specified under "Use of Architect's Drawings, Specifications and other Documents", as may be amended, of the Architect/Owner Agreement for this project.

- B. Architects, Engineers, or Other Design Consultants: The following type of documents shall be submitted to The University of Alabama in electronic format as part of the Basic Architectural-Engineering Services:
 1. Programming, Schematic Design and Design Development Phases:
 - a. It is not mandatory, but preferred, that floor plans be developed using **Autodesk Software** during the design phases of the project. **All floor plan information submitted for review at key milestones during the design process should also be submitted in AutoCAD format.** These submittals may begin with architectural only information at Programming, but shall include engineering information as it is developed and added to the submittals. Submittals during this period not only assist in reviews, but will help assure final CAD compatibility. These files should be on CD, DVD or transferred electronically.

2. Contract Document Phase:
 - a. All graphical portions of the contract documents (Plans, Elevations, Details, etc.) for all disciplines, shall be prepared in Autodesk software and submitted to The University of Alabama at completion of Contract Documents.
 - b. All non-graphical portions of the contract documents (Specifications) shall be submitted in Microsoft Word[®] 6.0 format.
 - c. These files shall be “read only” format and, if the project is proceeding immediately in the Bid phase, may be on CD, DVD or transferred electronically. If the project will be on hold for more than 60 days, these files shall be submitted on CD or DVD.
3. Bid Phase:
 - a. During the Bid Phase, all addenda and other changes to the contract documents shall be made on the appropriate electronic files using appropriate “clouds” and other designators to reference the addendum number.
 - b. A CD or DVD, to include all Contract Document electronic files, updated during the Bid Phase, shall become a part of the contract documents and be provided to all parties of the Contract (The University of Alabama, Contractor and Architect) within 30 days of notice to proceed issued to contractor.
4. Construction Document Phase:
 - a. The General Contractor shall be responsible for coordinating use of the electronic CAD "As-Built" and "Coordination" documents with periodic reviews by the Architect. The "Contract" CAD files shall be used as XREF to "As-built" and Shop Drawing files. Contractor(s) may rely on general information on the CAD file but shall be responsible for verifying dimensions. Any discrepancies should be reported to the Architect, who will make corrections to the basic XREF files. The Contractor MUST NOT make any changes to the base XREF files.
 - b. All parties participating in use of these CAD files must adhere to The University of Alabama Standards in order to assure coordination and compatibility.
5. Construction Close-out:
 - a. The General Contractor shall assemble and submit to the Architect, all shop drawing electronic files, CAD, Word[®] documents, into an appropriate file structure and placed on a read-only CD or DVD. **The Architect shall incorporate all outstanding “As-Built” information into the final CAD files as per 01 70 00 Record Documents.** The Architect shall submit final electronic files with remainder of close out document submittals.
6. Target CAD System
 - a. The target CAD system consists of the platform (hardware and operating system), the CAD software (basic and application), and the database software (when applicable) currently used by The University of Alabama which will be receiving and using the CAD-generated drawings and data. It is recommended, but not required, that the Consultant develop their CAD drawings and data using the



specified target CAD system(s). However, it is **mandatory** that the Consultant deliver the CAD files and data in the format used by the target CAD system (.dwg). "Compatible" or "neutral" formats such as DXF or IGES are NOT ACCEPTABLE.

7. Target Platforms

- a. The University of Alabama will be operating the CAD system on MS Windows 10 Pro[®] Workstation on a Novell[®] network with central CAD server.

8. Basic CAD software

- a. The University of Alabama currently uses AutoCAD 2018, Autodesk Revit 2018 and Autodesk Civil 3D as its "basic" CAD and Modeling products providing fundamental drafting, modeling and design capabilities. It is required that all CAD and Modeling deliverables be in the latest Autodesk software that is available for that current year. Any CAD and Modeling deliverables that are in an older version will be rejected.

9. CAD application software

- a. The University of Alabama uses AutoCAD 2018 and Revit 2018 for most architectural design and development. AutoCAD 2018, in conjunction with AIM, is The University of Alabama's Space Management CAD software. The University of Alabama also uses Autodesk Civil 3D for civil engineering and survey drawing.

10. "Neutral" file exchange formats

- a. **Submittal of files in a "neutral" file format is NOT acceptable.** If files are developed in different software than AutoCAD[®] the A-E is responsible for verifying the translation results meet The University of Alabama's requirements.
- b. CAD graphic files copied to "neutral" file exchange formats such as drawing exchange format (DXF) and initial graphics exchange specification (IGES) can be read by AutoCAD[®]. However, caution should be exercised since the neutral file exchange formats may not transfer all of the graphical entities, or the data needed for analysis and further review. This manual does include information on comparable MicroStation standards to improve the opportunities for good translation results.

11. "Life-Cycle" documentation

- a. Many of the standards and guidelines contained herein are stated so as to provide complete and easy instructions for a contractor to construct a building. However, it is important to keep in mind that the intent is to provide electronic facility documentation that can be utilized throughout the life of the structure – not just the set of paper documents for construction.

12. Responsibility for Accuracy

- a. The University of Alabama will be responsible for the accuracy of data provided to the consultant. The consultant will be responsible for the completeness and accuracy of work it produces.



13. Ownership of Data

- a. All data/CAD documentation produced by the consultant will become the property of The University of Alabama. The data/CAD documentation can be re-used by The University of Alabama and other consultants/contractors granted permission to do so by The University of Alabama without any additional compensation to the consultant. The consultant will not maintain copies of or use the data/CAD documentation produced without the written permission of The University of Alabama.

AutoCAD Drawing Convention

- A. General: Drawing sheet size shall be in “architectural” sizes as appropriate for the project. The preferred size is “D”.

Drawing Size	Standard Dimensions
Arch D	24” x 36”
Arch E1	30” x 42”

- 1. Drawing Conventions: The Architect or Design Consultant is fully responsible for producing quality documentation for construction of the project. The following items in this section, Drawing Conventions, are guidelines and The University of Alabama preferences, but are not mandatory unless prefaced by “**”.
- 2. Text Size: All text shall be 1/8” minimum height for drawings on 24” x 36” sheet size or larger.

- B. Graphic Layout

- 1. ** Site Plan Drawings for all Engineering disciplines shall be drawn in actual World Coordinate System (WCS) based on the NAD83 Alabama State Plans, West Zone, US Foot Projection. (Layers are assigned for GIS location information) A consistent User Coordinate System (UCS) shall be established with the orientation of “Job North” to be upward on drawing sheets unless rotating the drawing is absolutely necessary.
- 2. ** The origin, (0,0) for the UCS shall be in the lower left corner of the drawing sheet.
- 3. ** Orient large scale partial plans and details of larger drawings in the same orientation as the drawing on which the partial plan or detail are based on.
- 4. ** Since floor plans will be the main Life-Cycle document, they MUST be drawn as one complete floor. If, due to size of floor or to provide clarity for construction purposes, the plan must be printed using Match Lines or large scale plans, it is recommended that this be accomplished through reference files so that there is just one electronic version of the information.

- C. Title Blocks: Text locations in the standard title block (provided by University of Alabama) have been assigned specific attribute fields, with pen and font assignments as part of the attribute. All title block text shall be entered using a CAD attribute command (DDATTE) and NOT entered as text. The information to be included in the title block is described below.

- 1. The University of Alabama Project Number - A/E Commissioning Number: The project number will be assigned by The University of Alabama Project Manager. This number shall appear on every sheet.

2. Consultant and Sub-consultant: Firm name, address (street, city, state and zip) and phone number shall be provided by the Consultant and/or Sub-consultant.
3. Project Title: The project title should provide information as to the location and description of the project. The presentation of the project title information is to be in the following order:
 - a. Subject, i.e., Building or Project (may be more than one line)
 - b. Street Address
 - c. City, State, Zip Code
4. Key Plan: A key plan should be provided which shows the north arrow and the extent of the work associated with the project number.
5. Date: The date should coincide with the date the drawing is issued. On A/E drawings the date should coincide with the date of the project specifications. The date format is to be Day- Month-Year, i.e. 22 JAN 18
6. Drawn By/Checked By/Approved By: These fields are for the initials of the Consultant's (or Sub-Consultants) staff.
7. Drawing Use: The intended use of the drawing is to be indicated in one of the following manners:
 - a. Not for Construction
 - b. Released for Construction
 - c. Record Drawing
8. Drawing Title: The drawing title should provide information as to the subject of the drawing. The presentation of this drawing title information is to be in the following order:
 - a. Discipline
 - b. Subject, i.e., Floor plan, Reflected Ceiling Plan, Interior Details
 - c. Floor Name i.e., Plaza, First Floor, etc.
 - d. Floor Level i.e., Level 1, Level 2, etc.
9. Scale: Floor plans and schematics shall be shown in one of the following manners:
 - a. Scale: 1/8" = 1'0" – With Graphic Bar Scale
Use appropriate scale (1/8" = 1'-0" scale with enlarged area plans is preferred)
 - b. No Scale: on plans and schematics where there is no scale.
 - c. As Shown: located on details where varying scales are used.
 - d. Engineer Scales: Shall not be GREATER than 1"=10' nor SMALLER than 1"=100' unless pre-approved by the OWNER.

10. Drawing Number: The assignment of the drawing number shall correspond to the drawing type and sheet number using CSI Uniform Drawing System format. (See also file naming)

11. Revision Block

- a. Revisions to a drawing should be identified in the following manner:
- b. Use an equilateral triangle as the symbol to locate the area of the revision(s) on the drawing. This location will be identified by a revision indicated in the revision block. The revision indicator and block will be filled in with corresponding revision number, revision date, revision identification (brief description of the revision) and proper approvals.

Note: Revision clouds are to be placed on the appropriate CAD layer.

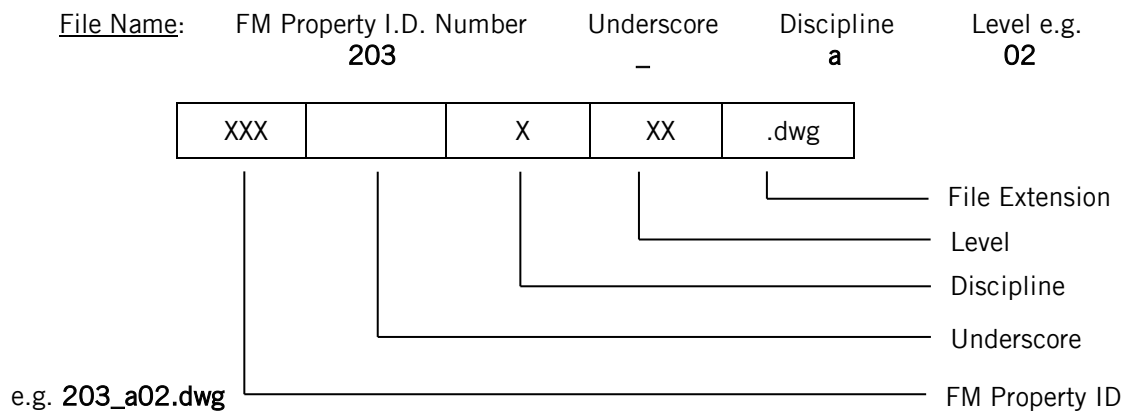
D. Plotting

- 1. AutoCAD files must be set up for plotting in the paper space environment. There must be one file created for each plot. The paper space environment is for arranging viewports on a sheet border. Plotting is done in paper space at a plot factor of 1=1". (The model space environment is a "working" environment and this will be the environment maintained for the Life-Cycle documents. This is where you will xref-overlay your background information and create your working drawing complete with dimensions, notes, etc...)
- 2. Consultant shall provide "CTB" plot style with CAD files.

CAD File Naming Convention

The University of Alabama will be managing three distinct types of CAD and other graphic files. These are: FM Life Cycle Files, Model Files and Sheet Files.

The FM Life-Cycle files will be CAD files for all disciplines of current floor and site plan information. The original file and updates will be made from information extracted from the Model Files after field verification of "As-Built" conditions.



It is important to note that neither Model File Names nor Sheet File Names include property or project information and that only the FM Life Cycle Files have unique file Names related to a specific property. Therefore, all files must be submitted separately and within a folder or directory set up specific for the project or building.

Audit & Quality Assurance Procedure

A. Audit and Quality Assurance Procedures

1. The objective of these audit and quality assurance procedures is to ensure:
 - a. The accuracy of submitted CAD documentation as to the inclusion of significant features relative to field conditions;
 - b. The dimensional accuracy of submitted CAD documentation relative to field conditions; and,
 - c. Compliance of submitted CAD documentation with the standards and guidelines described in this document.
2. The procedures specified rely on the involvement and assistance of the project manager in a visual audit of the submitted CAD documentation and a measurement audit of the documentation relative to field conditions.

B. Feature Audit

1. The project manager will by visual inspection of the CAD documentation ensure the presence, accurate location and approximate dimensional accuracy of the features listed below relative to field conditions of the property:
 - a. Doors
 - b. Windows
 - c. Walls (Exterior and Interior)
 - d. Columns
 - e. Stairs and Ramps
 - f. Any other general floor-plan layout items specific to a property
2. Any obvious omissions or errors will be noted. Systematic errors in terms of completeness, location and approximate dimensional accuracy of features will be deemed a failure of the submitted CAD documentation to meet prescribed standards and guidelines.

C. Results of Audit

1. The consultant is expected to submit the documentation in accordance with the Basic Requirements & Deliverables section (Section 2) of this document.
2. After the field and CAD audits have been completed the submitted CAD documentation will either be accepted or rejected for revision and re-submission based on the criteria noted above.
3. Should the submission of CAD documentation be rejected, the consultant shall, at its expense, correct any omissions and/or errors and return the documentation to The University of Alabama within ten (10) business days.

- End -