

Central Michigan University
Facilities Management
CAD Standards

1.0.0 OVERVIEW

This standard pertains to the use, production and submittal of electronic CAD information to the Plant Engineering and Planning Office at Central Michigan University. This standard has been developed to provide direction to consultants performing work for CMU. Consultants shall contact the Plant Engineering and Planning Office for the most current release of this document prior to the commencement of any work. This information is also available on the Facilities Management Web page at www.fmgmt.cmich.edu. It should be noted that the most efficient and effective use of CAD is not necessarily the initial generation of the drawing file, but the capability to easily modify and reuse the file in the future. Therefore, there will be no restriction by the provider on the ownership of the files including the distribution of CAD files or parts thereof at Central Michigan University's discretion. By establishing and adhering to a common set of standards, CMU can achieve significant benefits including a layering and file naming standard based on the U.S. National CAD Standard, AIA Layer Guidelines, and the Uniform Drawing System. It is important to note that these standards, as with any office standards are constantly being revised and updated to keep up with changing technology and construction practices.

2.0.0 USER RESPONSIBILITY

Adherence to the standards and procedures contained herein is essential to preserving a consistent and standardized character in the drawings maintained by CMU and in increasing the efficient use of project time and management. Modifications to the standards and procedures in this manual may be necessary for specific situations. Proposed modifications and or deviations from this standard must be approved in writing by the CAD Manager. **Do not make arbitrary changes without prior approval.** Internal change recommendations to this manual should be directed to the CAD Manager in writing detailing:

- Why the current procedure is not adequate
- What the proposed modification or addition should be
- How it would improve the existing standards and procedures
- Use of the CAD Standard Modification form in Appendix A is required

3.0.0 GENERAL REQUIREMENTS

3.0.1 RECORD Drawing Building Set

1) CD in AutoCAD format. **No other formats will be accepted.**

Contact the CAD Manager for the most current version used by Central Michigan University.

2) Other software may be used in the production of CAD files for Central Michigan University; however, it is the consultant's responsibility to ensure **COMPLETE** AutoCAD compatibility and data integrity. CAD drawings must be identical to hard copy versions submitted.

3) A complete list of layers for each drawing and descriptions of each layer, as well as color, line type, line weight and text styles shall be part of submittal of record information. A hard copy and electronic matrix format is recommended.

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4.0.0 MEDIA

4.0.1 MEDIA TYPES and COMPRESSION

Electronic data shall be submitted to Central Michigan University on CD, 2 copies required. Preliminary submittals at 90% review are also required to be submitted to the university project manager via CD, 2 copies required. Project Manager is required to distribute one copy to the CAD Manager who will transfer the files onto the server. The files will be copied to the appropriate titled project folder.

4.0.2 REQUIRED DOCUMENTATION

The electronic data deliverable package will be submitted on accepted media and accompanied by a hardcopy description of the submittal. The package will include:

- A hard copy on mylar identical to the electronic file, for maximum reproducibility.
- An electronic file of **Final Record Drawings**

4.0.3 MEDIA LABELLING

All media submitted to the University is to be labeled as follows:

CENTRAL MICHIGAN UNIVERSITY	<i>Example</i>
Date	<i>Jan 1, 2005</i>
Facility Building Code	<i>MU</i>
Facility Name	<i>Music Building</i>
Central Michigan University CMU Proj #	<i>CMU-2005.16</i>
Project Title	<i>Music Building Construction Plans</i>
Discipline Folder	<i>Mechanical</i>
Filename(s) on disk	<i>List by Title and drawing number</i>

4.0.4 FILE DESCRIPTION

Each submittal is to be accompanied by a letter of transmittal that identifies the media, quantity, status and description of its contents including file names.

5.0.0 REQUIRED DATA

5.0.1. FILE TYPES

The files which will be included in any submittal will fall into the following three categories.

5.0.1.1 Text Files

The only types of text files to be included in the deliverables are File Descriptions and Specifications unless otherwise directed by Central Michigan University. File descriptions will be in ASCII file format and will have the extension TXT. Specifications may be submitted in Microsoft Word (DOC) or Adobe Acrobat (PDF). ***No other formats will be accepted.***

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5.0.1.2 Drawing Files

The only types of drawing files to be included in the deliverables will be in AutoCAD and will have the DWG extension. ***DXF files will not be accepted.***

5.0.1.3 Raster Files

The only types of raster or image files that will be accepted are TIFF, JPG, BMP or WMF.

5.0.2 FILE INFORMATION

All information included in hard copy submittals is to be included in electronic data deliverables.

- If blocks are used in the documents, then they are to be consistent throughout. For example, if fixture “A” is a block, then all locations where fixture “A” is shown shall be of the same block.
- Any reference files or block files pertinent to the content of the master file are required data and are to be included in the File Description.

5.0.2.1 File Format

All submittals shall be clearly and systematically organized and incorporate standard and acceptable drafting practices. All submittals to Central Michigan University shall have colors set by layer, not by entity. Graphic elements representing a physical component of the project (i.e., lines indicating a wall or a block indicating a light fixture) shall be shown only one time in the submittals. If additional references to the object are needed in additional drawing files they shall be shown via an external reference of the original file.

5.0.2.2 File Size and Organization

It is the responsibility of the consultant to organize drawing information coherently and-maintain reasonable file sizes. Major contributors to excessive file sizes are unreferenced blocks, redundant line work and hatches. Files **must be purged** before submittal to remove unnecessary data and reduce file size.

5.0.2.3 Copy and Compression Format

Files requiring less than one disk for transmittal will be written to a CD-R disk and be properly labeled.

5.0.2.4 Externally Referenced Files

When submitting the electronic AutoCAD drawings, A/E’s **must bind all externally referenced drawings. Drawings submitted without x-refs bound will be rejected.**

5.0.2.5 Document File Format

There shall be one drawing file, saved in a plot-ready format, corresponding to each hard copy submittal sheet. Document files shall be formatted utilizing paper space. Plotting should take place from paper space at a scale of 1 = 1.

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5.0.2.6 File Naming

All files included in the electronic data deliverable package will conform to the file naming convention that is based on Uniform Drawing System published by CSI. Alternative file naming conventions may be utilized only with prior written approval of a detailed alternative. Approval of alternate naming conventions is solely at the discretion of the CAD Manager.

Similar name guidelines have been defined for both Model and Sheet file types. The first character is the discipline code designator, then a hyphen.

5.0.2.6a Model file name example: ___ 101

This applies to both file types and must be one of the following:

- A Architecture
- C Civil
- E Electrical
- F Fire Protection
- G General
- H Hazardous material
- I Interiors
- K Kitchen Equipment
- L Landscape
- M Mechanical
- P Plumbing
- Q Equipment
- R Resource
- S Structure
- T Communications
- X Other disciplines
- U Utilities Infrastructure
- Z Contractor/Shop drawings

5.0.2.6b Sheet File Names

The remaining characters following the File Type will be the Sheet File Name. These are numeric and indicate the sheet sequence number. Central Michigan University requires a numeric sequence by organizing the sheets by type of information found on the sheet.

The following is how the sheets shall be numbered:

- 000 LL Lower Level
- 100 First Floor
- 200 Second Floor
- 300 Third Floor
- 400 Fourth Floor (if needed)
- 500 Fifth Floor (if needed)
- 600 Exterior Elevations, Building Sections, Wall Sections

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700 Interiors General

800 Reflected Ceiling Plans

900 Interiors Specific

Basements, Sub-Basements, Mezzanines will be labeled B, SB or M after the letter/3 digit number. For example the basement below the lower level will be labeled A000B. The subbasement in the same building would be A000SB.

For large buildings where the floor plans have to be split a letter designating north south east or west will be used after the 3 digit number: A100N, A100S, A101N, A101S etc. The sheets within a specific grouping will be labeled numerically; for example M200, M201, M202, M203, and so on.

6.0.0 DRAWING FORMATS AND GRAPHICS

Sheet borders, title block and data, consultant's stamp, logos and all other components of the master drawing sheet shall be located in paper space. All graphic representations of the project or facility and all related notes, dimensions, symbols, etc., shall be constructed in model space. All graphic entities shall be comprised of representational and geometrically accurate entities, e.g. a circle shall be represented by circle entity and not a visually equivalent collection of line segments. Items shown in a dashed line type shall be created with the LINETYPE feature and not by individual line elements.

6.0.1 AutoCAD compatibility

CAD File deliverables must be in AutoCAD format. All files delivered to Central Michigan University will be thoroughly tested for compatibility and integrity. Files delivered to Central Michigan University must be free of any copyrighted or other material whose distribution is prohibited.

6.0.2 Entities

All graphic entities shall be comprised of representational and geometrically accurate entities.

- For example, a circle shall be represented by a circle entity and not a visually equivalent collection of line segments. Items shown in a dashed line type shall be created with the "LINETYPE" feature and not by individual line elements. These characteristics are typical of files that have been converted from some other format and they will not be accepted.
- Likewise, files in which all blocks are exploded or all data is on a single layer **will not be accepted**. Good drawing technique goes a long way in AutoCAD drawings. It is expected that submittals to the university will be of the highest quality.
- The following are considered poor technique and should not be present in CAD products delivered to the University. **Redundant Lines - There should be no redundant lines**. These typically are forms of multiple line segments in the same place or two segments joined to make a single segment. This also applies to text entities.
- Redundant Blocks— Care should be taken to insure that only one insertion occurs for a block. Also make sure that the block itself only contains one copy of the image.

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- Open Intersections— One of the most important and basic tools used in CAD is object snap. By using snap, the CAD operator is sure to produce clean and closed intersections. Intersections are very important since they provide accurate snap positions and are required as part of area boundaries.
- All entities shall be colored ‘BYLAYER’ and not individually by entity. No use of Yellow is permitted. It may be desirable on-screen but is practically illegible when plotted.
- If the drawing is to be three dimensional than it should be consistently and accurately drawn as such, otherwise it is a two dimensional drawing and all ‘Z’ coordinates should be 0, 0.
- All blocks shall be created from layer “0”.
- **Nested blocks will be avoided.**
- NO information shall be stored on layer “0”.
- Blocks shall not be mirrored. Mirrored blocks cannot be exploded and their attributes cannot be edited.
- Temporary blocks used during file creation or editing shall be exploded and purged.
- Both model and **paper space** (preferred) origins shall be 0, 0.
- Drawings shall be saved with the ACAD.MNU as the current menu.
- Exterior drawings shall be created with appropriate University Control Points as their starting point.

7.0.0 DRAWING ENVIRONMENT

AutoCAD allows the choice between two drawing environments: model space and paper space. Model space is AutoCAD’s working mode for creating the model. The model is a subset of a building’s geometry and its physical components such as walls, doors, windows, columns, beams, outlets, ducts, etc. The model is *always* drawn at full scale (1:1). Paper space enables one to take the model and create a variety of views or scales for plotting. Each sheet represents one plotted drawing at full scale.

7.0.1 Paper Space

The primary drawing is to be submitted in paper space or converted from model space to paper space for As-Built submission. The features represented in paper space are scaled to fit on the sheet. The various views of the drawings are referenced. General project graphic elements such as title blocks, legends, key plans, plan titles, riser and schematic diagrams, and sheet specific notes should be drawn in paper space.

7.0.2 Model Space

The drawing or model may be created in model space. This drawing must be drawn at full scale (1:1). Any additional items that help define the model or add model data such as details, schedules or sections must also be drawn at full scale in model space. Consistency in keeping related model elements in model space along with proper layer assignments will allow the use of x-refs and the ability to keep information dynamic and updated among disciplines.

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7.0.3 Standard Coordinate System

Any drawing utilizing a coordinate system shall correspond to the North American Datum, 1983 (NAD 83), Michigan State Plane System, South Zone in international feet, for all map and plan view files.

7.0.4 Prototype Drawing Files

Prototype drawing files and symbols shall be utilized as provided by the University. These may include but not be limited to title sheets, formatted drawing files, drawing symbology and other blocks. When blocks contain attributes all relevant attribute fields are to be filled out.

8.0.0 STANDARD SHEET SIZES AND FORMATS

All sheet sizes are to be limited to four standard formats. Required sheet size is specific to each project and is under the discretion of the University. They are as follows:

- ANSI A Plot - 8 1/2" x 11"
- ANSI B Plot- 11" x 17"
- ARCH D Plot - 24" x 36" (preferred format)
- ARCH E1 Plot - 30" x 42"

9.0.0 GRAPHICS

9.0.1 Text

All text is to be created only with standard AutoCAD or standard Windows TrueType fonts. Exceptions will be made, however, **they must be approved by the CAD Manager**, and the source font files **must be** included in the root directory of any electronic deliverable or submittal. All text sizes are to plot and display in accordance with the following minimum sizes:

- Schedules — 1/8"
- Dimensions and Notes — 1/8"
- Grid Numbers — 3/16"
- Sheet Detail Title — 3/16"
- Sheet Title— 3/16"
- Sheet Number — 3/16'

9.0.2 Special Entity Requirements

Common symbols, doors, windows, equipment, and so on shall be inserted as blocks. Room numbers are very important to Central Michigan University's CAD files because they are used to provide real data throughout the University. A standard block named "RMNO" should be used and it should contain attribute data including not only associative data such as room number, area and perimeter but also the entity handle of the polyline with which it is associated. **All Record Drawing submissions will contain Central Michigan University building room numbers, not the construction or consultant's numbers. This information shall be included in the ANNO-IDEN layer within the drawing.**

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9.0.3 Dimensioning

All dimensions shown in the project submittals shall be fully associative. Dimension definition points should be located with an appropriate Object Snap (End Point, Mid Point, etc.) or otherwise located precisely on the project geometry. Manual input of dimension text or otherwise over-riding the actual dimensions is ***not acceptable*** in submittals to the university.

9.0.4 Line types

It is recommended that only standard AutoCAD line types be used. If custom or compound line types are necessary, then their definition file(s) shall have a .LIN extension and shall be included in the root directory of the files with which they are associated and be included in the root directory of any electronic deliverable or submittal.

9.0.5 Fill and Hatch Patterns

Vector fill patterns are acceptable but excessive use is discouraged as they make files unnecessarily large. In many circumstances solids may be used instead of hatches. All consultants are responsible for keeping files sizes within manageable limits.

9.06 Line Weights

Preliminary Recommendations:

Consultants are solely responsible for the production and appearance of their hard copy submittals. Consultants shall supply line weight requirements for proper printing of documentation by CMU personnel and shall provide information on included submitted CD's.

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**APPENDIX A
DEVIATION FORM**

Any proposal, by the design professional, to have any practice deviate (modifies, substitutes or deletes) from Central Michigan University's Facilities Management Plant Engineering and Planning CAD Standards must be accompanied by this form, submitted for approval, to the Plant Engineering and Planning Office to the CAD Manager in charge of final approval or the Project Manager of the specific project described below.

CMU Project #: _____
(To be filled in by University)

Project Title: _____

CSI related section: _____

CMU Standards related section: _____

New proposed practice: _____

Rationale for using new practice: _____

State operational benefits (if any) that accrue to the University as a result of the proposed deviation: _____

Estimated project cost increase or decrease: \$ _____

Failure to comply with this requirement will result in the Responsible Party, as defined in Section 00010.02 of the Design Standards, being responsible for costs associated with changes in the field, necessary to comply with CMU's Planning and Design Standards, in accordance with Section 00010.02 of the university Design Standards.

Signature & Date: Design Professional

Signature & Date of CMU Approval
Facilities Management
Plant Engineering and Planning Office
CAD Manager