Washington State Department of Enterprise Services

Administrative Services Policy No. *13.10.3*

Computer Aided Design (CAD) Project Drawings

Applies To:	Department of Enterprise Services employees
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	RCW 39.10
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Approved By:	/s/
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Purpose

The purpose of this policy is to ensure that computer aided design (CAD) record drawings are provided for all projects and delivered in a form that provides a usable electronic record of the project.

CAD drawings must meet the guidelines detailed in the technical requirements in this policy. E&AS Project Managers, client agency facility staff and consultants cannot be expected to convert or use CAD drawings that do not meet these guidelines.

Definitions

AIA means The American Institute of Architects

AutoCAD means computer aided design software marketed by AutoDesk Inc.

CAD means computer aided design program. This includes but is not limited to Autodesk AutoCAD Arch, AutoCAD MEP, and AutoCad Revit.

Entity means an object drawn within the CAD file.

Layer means a technical methodology for organizing entity or object within a CAD file. Typically similar objects will be placed into a common layer, examples may include layers for room names, room numbers, walls, doors etc..

XREF means a technical methodology for referencing one drawing into another. Typically this is used to embed common background drawings such as a floor plan into multiple drawings. Properly used, this allows consultants to work from the most current version of a floorplan throughout the design and construction document process.

ZIP means a compressed file format that allows multiple documents to be stored and distributed as a single ".zip" file.

Policy

A. All record drawings for public works construction shall be created using a computer aided design (CAD) program.

Assistant Program Managers may waive this requirement when CAD record drawings are impractical or inappropriate.

This requirement may be waived by the Project Manager for portions of a drawing set such as standard details, manufacturers catalog sheets, shop drawings and other drawings not typically produced by CAD. Plan views of drawing sets will always be required in CAD.

B. CAD record drawing files that are provided by E&AS for use on a project must be field verified in critical areas for dimensional accuracy and completeness.

Record drawings may not represent an accurate as-built condition. They should be treated as any other document from a past project and be field verified.

C. Drawings will meet the following technical requirements:

1. Authoring Software and Building Information Modeling (BIM)

A/E firms may author files using CAD or BIM software with advanced features, including Autodesk AutoCAD Arch, AutoCAD MEP, AutoCad Revit, third party add-on products or other vendor CAD applications. Authoring software shall be limited to versions that are currently supported by the software vendor and supported operating systems.

2. **AutoCAD files.**

   CAD files submitted to DES shall be exported to a file format approved by DES and the Client Agency. A/E firms may choose provide files in more advanced or recent software but must also provide files in the approved format. Copies of drawings shall also be provided in Portable Document Format (PDF).

3. **Drawings will utilize AIA CAD Layer Guidelines.**

   Use the standards provided in <u>AIA CAD Layer Guidelines; Recommended Designations for Architecture, Engineering, and Facility Management Computer Aided Design</u> published by The American Institute of Architects Press.

   The Project Manager may approve alternate layer standards in cases where a consultant's CAD system cannot reasonably be adapted to the AIA guidelines or in cases where the client agency's facility management system requires an alternate standard. In these cases, a layer conversion table showing comparable AIA layers shall be provided as part of the project "readme.txt" documentation on the delivery disks.

4. **Drawings will be in MS Windows compatible, AutoCAD DWG format, release 2014.**

   Many CAD systems use UNIX or Apple based operating systems. When drawings from these systems are delivered, they shall be converted at the source to MS Windows file format.

   Engineering and Architectural Services uses AutoCAD 2014 Arch DWG format for review, editing and archiving drawings. DXF format is not acceptable.

5. **Drawings will be in uncompressed or in "zip" compression format.**

   The industry-wide standard for compression is the "ZIP" archive file format. Delivery of uncompressed files is preferable whenever possible.

6. **Drawings delivery media.**

   Use PC compatible USB flash memory, CD-Rom or DVD-ROM disks to deliver drawings. Internet based file delivery may be acceptable provided the delivery service meets the security requirement of the DES. Media shall be labeled with state project number and title and date of issuance. The Project Manual shall be included with drawing files on the provided media.

7. **Drawing files will be purged of all unused layers, blocks, line types and font styles.**

   Extraneous layers create confusion when record drawings are used for facility management. Unused blocks, line types and font styles add unwanted size to drawing files.

8. **Script files will be provided for layer control if drawings are stacked.**

   Provide AutoCAD script file(s) when a drawing file is stacked (i.e. the file contains layers that must be turned on or off to provide views of more than one "drawing sheet".) Describe the appropriate script file(s) in the "Readme.txt" file so that reviewers will know which script to use to obtain the desired view.

9. **Fonts, specialty menus and embedded reference files or background drawings will be provided with delivery package.**

   All fonts, specialty menus and XREF,(reference or background drawings) files that are used in the drawing files must be included with the delivery disk(s). If possible, use only standard AutoCAD fonts and menus. When the delivery disk(s) are created, they shall be tested for completeness at the source.

10. **Font, menu and XREF addresses will be relative to delivery disk.**

    On the delivery disk(s), the directory that contains the project files shall also contain the related fonts, menus and XREF files. The drawing references to these files shall be relative to this same directory, not to an "absolute" directory on the original system.

11. **All CAD drawing files shall be created at "ONE-TO-ONE" scale (in "World Coordinates").**

    When details are plotted on the same "drawing sheet" with a base plan at a different scale, use AutoCAD's Paper Space or create the details as separate drawing files and insert them on the "drawing sheet" as XREF files with appropriate scale factors. In the latter case, the separate XREF drawing files shall be created at one-to one-scale.

12. **Ensure two-dimensional entities lie in proper elevation planes.**

    When mixing 3D and 2D drafting in one drawing file, ensure that lines/entities that are designed to be in the same plane actually do lie in the same plane. With CAD, it is too easy to "snap" to entities in the wrong elevation plane. When viewed from a 3D viewpoint, lines that appear to be correct in plan view may actually connect points on two different elevations. This is especially true when a CAD drawing contains "stacked" floor plans, each drawn at a different elevation.

13. **Colors "by layer", not by entity.**

    Entity colors shall be "By Layer", not by entity. Since plotted line weights are tied to color, this will allow easy adjustment of plotted line weights.

    In the case that this requirement may not apply when advanced BIM software is used to author the files, the exported files shall include the appropriate pen weight standards.

14. **Colors coordinate with plotter pen weight standards.**

    If layer colors are associated with line weights. A pen table showing layer color vs. pen weight shall be included in the "Readme.txt" file. Pen tables should be provided for the primary consultant as well as any sub-consultants.

15. **"Object snap" will be used to ensure drawings are accurate.**

    Lines and entities that are designed to meet or intersect shall be "snapped" to ensure accurate connections and relationships. Future use of a CAD drawing is compromised when lines/entities that appear to meet are off by a small, unpredictable amount. Small errors caused by failure to "snap" objects significantly complicate dimension checks and alignments.

16. **Dimensions will be made associative.**

Make dimensions associative: i.e., the dimensions shown on the drawing shall relate directly and electronically to the actual dimension of the CAD coordinates of the dimensioned entity. For example: if a CAD line actually measures 20' 1-5/8" but is dimensioned as 20' 1-1/2", the CAD dimension is NOT associative. The 1/8" difference between "actual" and "dimensioned" can confuse dimension checks and complicate use of the file in future applications.

17. **Site plans, building plans and the plans for specific disciplines shall all have the same origin.**

The insertion base in AutoCAD shall be at coordinates 0,0,0. Plan view drawing origins shall be chosen such that drawings for each discipline or building system can be overlaid exactly with the base plan drawing.

18. **Ensure text and blocks are not "exploded" during conversion.**

Some CAD systems convert to DWG format by "exploding" text and blocks into lines and arcs. Ensure that text in the delivered file reads as a text entity in AutoCAD. Also ensure that entities that are supposed to be blocks (blocks are entities that are grouped into one unit) remain as blocks during the conversion process. Poor conversion could remove all of the "intelligence" of the original drawing file.

19. **Coordinate equipment and component naming with facility staff.**

Naming of components and equipment, especially the use of abbreviations, shall be coordinated with the facility staff. Use of standardized equipment and component data sheets is encouraged. Final coordination of CAD record drawings with Operations and Maintenance manuals and with the facility maintenance system is required.

20. **The project shall be documented with a "README.TXT" file included on the delivery media.**

A "Readme.txt" file that contains important information about the project and the associated computer files shall be included with the drawing and project files on the delivery media. This text file shall contain all of the information that a future E&AS or facilities staff member will need to view, read, analyze, plot or print the project files.

At a minimum, the "Readme.txt" file should contain the following:

Project information:

- Project number, title, and brief description
- Client agency, facility, and building
- Consultant and sub-consultant contact person(s), E&AS Project Manager, and client agency contact person
- Contractor and subcontractor contact person(s)
- Detailed description of project
- Explanation of relationship between drawings and relevant XREF files.

Files listing:

- Compressed files (ZIP). Include a list of all file names compressed within a single ZIP file.

- Drawing files, including brief description of each. When used, include a list of associated XREF drawing files, special font or menu files, and "script" files used for layering control.
- Script files, including a description and where and when they are to be used.
- XREF drawing files, including brief description and those drawings with which they are associated.
- Font shape files, for non-standard fonts including a brief description of the character type of the font.
- Specifications files, if included. Include description of word processor version used.
- SourceView bid pack files, if included. Include brief description of each associated file.
- SourceView reader. Include the self-installing (free) reader on the disk(s) if needed.
- WEB index (HTML), if included. Include listing of connected web sites and manufacturers' web pages.
- WEB files (HTML), if included. Include brief description of each file or O&M manual.
- O&M manual files, if included. Include brief description of file and a description of word processor version or file reader required (if not in HTML).
- File reader software (free), if required to read O&M manuals. Include installation instructions.

Pen Weight Table:

- As needed, pen table showing layer color vs. pen weight.

Layer naming schedule:

- Layer names, including brief description of each (not required if using AIA Layer Guidelines).
- Script files used to control display of layers in composite or stacked drawings, including description of what each script is designed to display.
- Conversion table relating drawing layers to the AIA equivalent (if layering is not by AIA Layer Guidelines). If the facility requires special layering definitions, then the conversion table must define each layer used in the drawings and how it relates to the facility's definition.

Block naming schedule:

- Block names related to specific facility equipment as requested by facility staff. Include matching of block names to Client Agency's facility management software, it required.
- Layers used within blocks, if not on layer zero (0).

Coordinate schedule:

- Geographic coordinates for the insertion point, origin (0,0,0), for each drawing file, if relevant. Include description of the geographic coordinate system used (i.e. State Plane, Latitude and Longitude, local reference).

21. Disks will be tested at the source prior to distribution.

After the delivery disks are created, they shall be tested at the source prior to distribution. Only those who have created the drawing files know how to fix any problems. The disks should be downloaded to a test directory on a Windows PC-compatible computer running AutoCAD 2014, or later, software. Each drawing file should be opened and reviewed. All applicable script files should be run. The A/E firm is responsible for verifying that the submitted files are free of software viruses.

History

Amended:

- 9/29/15 – High level change summary. E&AS no longer uses pen weights.

Need a copy of a prior version of this policy? E-mail jack.zeigler@des.wa.gov