

APPENDIX 1
COMPUTER AIDED DRAFTING AND
FACILITIES MANAGEMENT STANDARDS 2011-2012

1.01 GENERAL

A. RELATED DOCUMENTS

1. The General Provisions of the Contract including General and Supplementary Conditions, Specification Sections and Contract Documents of Division 1, and other related sections apply to work in this section. Consult them for further instructions and be governed by their requirements.

B. WORK INCLUDED IN THIS SECTION

1. Computer Aided Drawing standards for construction (CAD)
2. All required documentation for CAD office
3. Required submittal media and format
4. Building Information Modeling (BIM) submittal standards

C. SECTION INTENT

1. The University of Colorado at Boulder is actively pursuing a program of computerized construction related documents and Computer Integrated Facilities Management (CIFM). In general terms, this section describes the requirements for CAD related drawings, the required accompanying documentation, and the form and format of the electronic data.

The intent of these standards is two-fold; first, to not jeopardize the efficiency of the consultant's internal drawing development methods by imposing overly ambitious CAD standards; and second, to provide a set of documents that are consistent with the needs of the University of Colorado for both Facilities Management and future construction.

1.02 CAD DRAWING PRODUCTION

A. FILE FORMAT AND SETUP

1. FILES PROVIDED BY CAD DEPT.

- a. The CAD Office shall provide consultants with a CD or .zip file containing all necessary base drawings, building numbers and codes, etc. at the beginning of each project upon request.

2. ELECTRONIC FILE FORMAT

- a. Facility documentation drawings and construction project drawings must be submitted to the CAD Office in full compliance with AutoCAD software (file extension = .DWG).
- b. Projects designed as a Revit model must be submitted to the CAD Office

in the “.rvt” format.

- c. The University of Colorado shall not accept any drawings in the Drawing Interchange Format (DXF) or any other format than .DWG. If any drawing translators are used prior to submittal, the results of such translations shall be 100% complete. It is the responsibility of the Consultant to cross-check translated drawings for errors and omissions. This includes DWG files exported from BIM software (including but not limited to Revit, ArchiCAD, Vector Works, etc.)
- d. Files names must include the sheet name. Examples: A100.dwg, P205, AF902.
- e. All Record Set/Close-Out Set of files should only contain one drawing sheet per file. Example: A100.dwg should only contain the drawing sheet A100 (RFIs, etc. can be included in the same file). Sheets A1.02, A1.02, A1.03, etc. should all be separate files.

3. TEXT

- a. Text size must be legible and appropriate to the graphic information presented and the intended plotted scale of the drawing. Text must be in all upper case letters throughout a drawing.
- b. Text usually should not touch other graphic objects, and must be placed with enough space around it to be legible when the drawing is plotted and reproduced.

4. TITLE BLOCKS

- a. The title block should be placed in paper space, with its insertion point inserted at a coordinate location of (0,0,0), and at a scale of 1:1. Depending on the purpose of the drawing, facility documentation or construction, the drawing’s title block should contain certain essential information that the CAD Office needs, to store and retrieve each drawing in its library.
 - i. Project Information:
 - (a) Project Number - assigned by the UCB Facilities Management Dept.
 - (b) Firm Name - representing the drawing author
 - (c) Building Name - specify only if the project name does not include this information already, and the project is building specific
 - ii. Drawing Information:

- a) Drawing Title - indicating the drawing content, e.g. floor plan, section, detail, etc.
- b) UCB Project Number – all sheets
- c) Drawing Number
- d) Date of Drawing - original drawing date including significant revision dates
- e) Drawing Scale - representing the intended plot scale of the drawing with title block
- f) North Arrow
- g) Electronic File Name

5. MODEL SPACE AND PAPER SPACE

- a. The CAD Office requires that each CAD file submitted as a project deliverable contain only one title block in paper space which references the building model contained in model space. Additional models related to the same building are allowed and shall be shown through the use of multiple viewports in paper space.
- b. In addition:
 - i. Draw all model space objects at full scale (1:1), and to scale.
 - ii. Label scaled details with the appropriate scale on the detail title in model space.
 - iii. Show detail through viewport zoomed to the appropriate scale in paper space.
 - iv. Do not place or draw model-related blocks, tags and objects in paper space.

6. EXTERNAL REFERENCE FILES (XREFs)

- a. Drawings containing x-refs shall be prepared for submittal to the CAD Office by using the e-transmit command within AutoCAD. See 1.02.A.11.a.v.
- b. There shall not be any nested xrefs (a drawing xreffed into another drawing that is xreffed into another drawing, etc.). DWG files will be rejected and a request for resubmittal will be sent to the offending party.
- c. Any and all unused xrefs shall be purged/detached by the consultant prior to submittal to the CAD Office.
- d. All xref files must be named clearly as an xref file. Example: xref – A100 details.dwg, Site Photo 1 xref.jpg, etc.

7. DIMENSIONS

- a. 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 overriding the actual dimensions is NOT acceptable in submittals to the CAD Dept.

8. FILL AND HATCH PATTERNS

- a. Limit excessive use of hatch patterns to avoid unnecessarily large files.
- b. Prior to exporting a BIM file to a .dwg file, all shadows, high-detail settings, textures, etc. must be turned off.

9. AUTOCAD DRAWING SUPPORT FILES

- a. Drawings created using non-standard AutoCAD fonts, linetypes and hatch patterns can result in content discrepancies in the delivered drawing set. To ensure the integrity of the drawing set, and minimize potential problems:
 - i. Use the e-transmit command within AutoCAD. See 1.02.A.11.a.v.
 - ii. Postscript fonts shall not be used.

10. STANDARD SHEET SIZES AND FORMATS

- a. All sheet sizes are to be limited to five standard formats. Required sheet size is specific to each project and is under the discretion of the University. They are as follows:
 - i. A Sized Plot 8 1/2" x 11"
 - ii. B Sized Plot 11" x 17"
 - iii. D Sized Plot 24" x 36" (preferred format)
 - iv. E1 Sized Plot 30" x 42"
 - v. E Sized Plot 36" x 48"

11. CAD FILE TRANSMITTAL

- a. The content of electronic drawings must match the delivered original hard copy set. To ensure the integrity of the electronic drawing set upon delivery to The CAD Dept.:
 - i. Ensure the drawings adhere to the guidelines presented in this document.
 - ii. Include a transmittal sheet (electronic and hard copy) with all submittals indicating the CAD Office project number, project name and complete listing of all materials submitted, including filenames and sheet numbers for each item included in the

submittal. File names shall contain the sheet number they represent. This ensures the completeness of the drawing set and assists in archival procedures.

- iii. Electronic data deliverables (.DWG and PDF format) are required at all submittal stages.
- iv. Submit AutoCAD files (See section 2.A.2.a.) and other electronic format files on CD-ROM formatted for Windows.
- v. The CAD Office requires using the e-transmit command within AutoCAD for all drawing transmittals. Individual drawings or multiple drawings may be zipped together with the e-transmit command. Transmittal options within the e-transmit command shall be set to “place all files in one folder” and “include fonts”. X-referenced and CTB files will be included in the e-transmit file.
 1. The zip file should be named with the Project number, Project Description and Submittal Phase of the files included in the zip file.
- vi. Include hard copy prints per UCB Facilities Management Division Standards (<http://www.colorado.edu/facilitiesmanagement/pdc/cad/index.html>)
- vii. The Project Manager (PM) shall withhold final payment until all closeout documents have been received from all parties. Refer to <http://www.colorado.edu/facilitiesmanagement/pdc/construction/documents/CloseoutProcess10-26-05.pdf> for complete information.

12. CD-ROM LABELING

- a. All CDs are to be labeled as follows:
 - i. DATE: The date when the submittal was delivered to the campus for final acceptance.
 - ii. PROJECT: Title of the project and PR #.
 - iii. SUBMITTAL: Project submittal phase (i.e. 50% schematic etc.)
 - iv. BLDG NUMBERS: Building number identified by the campus specific to the project.
 - v. COMPANY: Name of consultant to the campus.

- vi. CR-ROM Number: Label as CD-ROM x of y. When only a single CD is used for the submittal, label as CD-ROM 1 of 1

13. SOFTWARE AND SOFTWARE LICENSES

- a. The CAD Office requires that the delivered CAD files be usable without any additional software licenses or installation

B. FM CAD DEPARTMENT PROCEEDURES

1. START-UP INFORMATION

- a. Key Plan - Shall be either a building footprint or a site plan with the project area noted. Key plans shown shall be for the purpose of locating sheet specific information within the project area.
- b. Current Room Numbers – Only the most current room numbers shall be used on project documentation. These numbers may be obtained from the floor plan drawings maintained by the CAD Office.
 - i. Room numbers are subject to change after review by the CAD Office New floor plan drawings and modifications to existing floor plan drawings require room number assignments by the Capital Assets and Space Planning (CASP) Department. The CAD Office will obtain new room numbers and forward this information to the consultant for incorporation into the revised floor plans. Subsequent changes to the floor plans will require this process to be repeated.

2. REQUESTING CAD DATA FROM THE CAD DEPT.

- a. Consultants may request copies of existing CAD data for University facilities. CAD Data is provided for the convenience of the recipient only. This data has been gathered from a variety of sources and it may or may not conform to University of Colorado at Boulder standards. The data may be incomplete, or may not accurately reflect current facility conditions. The CAD Office makes no representation as to the data's completeness or accuracy. Consultants should also acknowledge that CAD data appears to be extremely accurate because it has been generated with a computer, and that the accurate appearance of drawings does not guarantee that they truly represent existing conditions. CAD data submitted by consultants to the CAD Office must be accurate and must conform to the current CAD standards, even if reference data provided by the CAD Office was inaccurate or did not conform to the standards.

- b. The FM CAD Office will not research and/or compile the necessary drawings needed for a specific project. It is the responsibility of the project manager or consultant to come in and choose the appropriate information and request copies from the FM CAD Office.
- c. Acquisition of Site Map Data: All rights reserved. Map data provided by Facilities Management CAD Office is intended for the sole use of the contractor to satisfy obligations to the University of Colorado construction contracts. The map information may include copyright Electronic Spatial Data from Boulder County and/or the City of Boulder and may not be copied, duplicated, or redistributed in any way, in whole or in part, without expressed written consent by Boulder County and/or City of Boulder. Agreement of "Electronic Data Limitations and Conditions of Use" must be entered into by and between the University of Colorado and consultant prior to release of above mentioned electronic data.
- d. The FM CAD Office will not provide CAD files or copies of design documents to sub-consultants or contractors working on the same or another related project. This information is the property of the design firm until the project is complete and record documents are submitted to the FM CAD Office.

3. SUBMITTAL REQUIREMENTS

- a. All submittal documentation forwarded to the CAD Office shall be submitted in a timely fashion, coinciding with the needs of the project and the CAD Office staff. The delivery of submittal documentation during various project stages shall be timed appropriately to ensure that the CAD Office ultimately receives the most accurate information available.
- b. Ensure that the Facilities Management Project Number is located on all drawing sheets (including the cover sheet) and all other submitted documentation, i.e. Specifications and Operations and Maintenance Manuals. The FM project number should be located in the title block of all drawings, and in the header or footer of Specifications and Operations and Maintenance Manuals, and any other submitted items.
- c. The following documentation shall be delivered to the CAD Office at the following project milestones:
 - i. Review sets (SD, DD, 1-100%):

- a) The CAD Office requires a complete set of documents as specified in the standard CU Architect/Engineer Contract including:
 - 1) AutoCAD drawings in electronic format (.DWG and .PDF)
 - 2) Architectural Floor plans, site/civil drawings and irrigation plans needed in DWG format.
 - 3) Complete packaged needed in PDF format
 - 4) Building Information Models (BIM) in Revit format (.rvt) (projects with a construction budget over \$2 million)
 - 5) Specifications - submit electronically in PDF format as one document, OCR searchable, bookmarked according to CSI standards

- ii. Completion of Civil Utilities Installation:
 - a) Site Development Drawings (Survey) shall be set up using CO-HARN coordinates and the drawing units set to decimal feet. When required, the survey shall be tied to a control network provided by the CAD Office

 - b) The CAD Office requires a complete set of Site Development Drawings (Survey) as specified in the standard CU Architect/Engineer Contract including:
 - 1) AutoCAD Record Site Development Drawings (Survey) in electronic format (.DWG and .PDF and hardcopy – 1 set)
 - 2) Contractor Redlined Site Development Drawings (Survey) - Full size hard copy format (1 set)

- iii. 100% Construction Documents (final CDs not for review) i.e. Bid Set
 - a) The CAD Office requires a complete set of documents as specified in the standard CU Architect/Engineer Contract including:
 - 1) AutoCAD drawings in electronic format (.DWG and .PDF)
 - 2) Full size hard copy format (1 set) – Stamped
 - 3) Building Information Models (BIM) in Revit format (.rvt) (projects with a construction budget over \$2 million)
 - 4) Specifications - submit electronically in PDF format as one document, OCR searchable, bookmarked according to CSI standards
 - 5) Specifications - hard copy format (1 set) – Stamped

iv. Record Documents:

- a) When the project has been completed, the Consultant shall submit a complete set of record construction documents as specified in the standard CU Architect/Engineer Contract including:
- 1) AutoCAD Record drawings in electronic format (.DWG and .PDF)
 - 2) Record drawings – Hardcopy 1 set
 - 3) Revit produced projects shall include the Revit model reflecting the changes outlined in the redlined drawings.
 - 4) Redlined construction drawings (hard copy)
 - 5) Fire Systems shop drawings
 - 6) Fire Suppression (sprinkler/standpipe) system (hardcopy - 1 set, .DWG and PDF)
 - 7) Fire Detection/Alarm system (hardcopy - 1 set, .DWG and PDF)
 - 8) Specifications - submit electronically in PDF format as one document, OCR searchable, bookmarked according to CSI standards
 - 9) Operations and Maintenance Manuals – all disciplines - submit electronically in PDF format as one document, OCR searchable, bookmarked according to CSI standards

4. VALIDATION OF DELIVERED MATERIALS

- a. The CAD Office will validate the CAD data and other materials submitted by consultants. If submittals do not conform to the UCB Facilities Management CAD Standards Guidelines, the CAD Office may return the materials to the consultant. The consultant is responsible for revising the materials to make them conform to the UCB Facilities Management CAD Standards Guidelines.
- b. Use the e-transmit command within AutoCAD. See 1.02.A.11.a.v.
- c. The Project Manager (PM) shall withhold final payment until all closeout documents have been received from all parties. Refer to <http://www.colorado.edu/facilitiesmanagement/pdc/construction/documents/CloseoutProcess10-26-05.pdf> for complete information.

5. COMMUNICATION ABOUT THE CAD STANDARDS

- a. These CAD Standards will be most effective for consultants if there is communication between consultants and the University Owner's Representative. Consultants should ask questions about the CAD data standards before beginning work. Direct questions to the CAD Office. Concerns regarding the impact of the CAD standards on a particular project must be discussed with the Owner's Representative. Consultant's questions are valuable because they help the CAD Office understand the

real-world conditions of each project's design and construction process. Questions will raise issues that will result in better CAD standards.

6. SUGGESTIONS FOR THE STANDARDS

- a. The content of the manual is intended to be neither static nor all-inclusive and thus will be updated and enhanced annually as appropriate. Suggestions for improvements are encouraged so that subsequent updates reflect the needs of the University. Submit suggestions, as well as any pertinent new information, which would enhance these standards, to the CAD Office client representative.

END OF SECTION APPENDIX 6