

CHAPTER A-10

DRAWINGS

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CHAPTER A-10

DRAWINGS

10.1 GENERAL.

10.1.1 Purpose and Scope. This chapter sets forth criteria and standards to enable designers and drafters to prepare a clear, uniform set of design drawings and illustrations. Unless specifically noted in the A-E's scope of work, the standards for drawing presentation contained in this chapter shall be used in the preparation of all drawings required in a contract. Drawings shall be prepared with the expectation that the construction will be able to construct the facility without any additional assistance and/or without the necessity for modifications to correct design deficiencies. Drawing submittals shall also be detailed to the extent that an accurate cost estimate can be prepared and shop drawings can be checked. Special consideration has also been given to the reproduction processes, and plotting equipment. If Building Information Modeling (BIM) is required, Chapter A-16, Building Information Modeling sets forth criteria and standards for preparation of a complete and functional BIM model.

10.2 **APPLICABLE PUBLICATIONS.** The publication listed below, hereinafter referred to by basic designation only, shall be used when preparing drawings. In each case, the most current edition existing at the beginning of the design shall be used.

A/E/C CAD Standard Release 4.0 Available on Internet at <https://cadbim.usace.army.mil/CAD>

10.3 COMPUTER AIDED DESIGN (CAD).

10.3.1 CAD Requirements. The following CAD file requirements will apply:

- a. The design drawing files shall be created using guidance provided herein. The CAD Details Library provided by the CAD/GIS Technology Center should be used as much as practicable. The A/E/C CAD Standard Release 4.0 is provided by the CAD/BIM Center to set forth standards that will provide a consistent and compatible platform for CAD system use Corps-wide. The establishment of a uniform CAD platform will provide a means for rapid, accurate transfer and integration of virtually all project-related information throughout the life cycle of any building project or facility master plan. Savannah District, along with most other COE districts, has chosen to make Bentley MicroStation and related products, the CAD system of record. All translations from other systems to assure compatibility must be the task of the A-E firm and not of Savannah District personnel.
- b. As a **minimum** each drawing in a design shall have an electronic file copy. Only **one** drawing should occupy an electronic file. With very few exceptions, all drawings will be plotted black and white.
- c. A key plan should be displayed on each plotted drawing that depicts topographic information or plans that are broken due to size and scale.
- d. The **electronic files** should be saved with the composite drawing (drawing as it is to be plotted) in View 1.
- e. All referenced files are to be attached without drive or directories (**no paths**). All reference files must be in the same directory as the sheet file on CD deliverables. **BOUND DGN Files are unacceptable. DGN files should be delivered UNBOUND with all reference files in tact to include the border reference.**

- f. The electronic file naming convention begins with 3-digits provided by the CAD Engineering Section referred to as the Project Code. Several Project Codes may make up a complex project. Also the site drawings will be furnished a different Project Code. This Project Code is provided within the Specific Instructions provided at the beginning of any design effort for Savannah District. The CAD Engineering Section is the proponent of this action.
- g. The files making up the Electronic Bid Set (EBS) are CAL files. The electronic file is named for the numeric sheet number of the drawing. (Example 001.cal, 002.cal, ... 123.cal.). Please note that a placeholder precedes the single digit numbers to enable their consecutive alignment. Furnish spreadsheet or text file containing list of all CAL files, plate, sheet & drawing titles.
- h. The **electronic file name** should be displayed on each drawing, and on the Index in the space labeled "dgn file".
- i. Civil site drawing CADD files:
 - 1. Civil site drawing CADD files shall use the seed files available from the Savannah District Engineering Criteria web site - <http://en.sas.usace.army.mil/enWeb/>
 - 2. All drawing elements shall reside on appropriately named levels, in accordance with the 4.0 A/E/C/ CADD standard.
 - 3. All polygons shall be cleaned and free of duplicate vertexes and self-intersections.
 - 4. On the civil site plans, label all existing structures with a building number, even when they are scheduled for demolition.
 - 5. On the civil site plans, all streets shall be labeled with the street name.
 - 6. All site plans are to be displayed with North to the top of the sheet. No rotation is acceptable.
 - 7. All site drawings will have exactly the same match lines.
 - 8. Pertinent survey information must be present on the existing topography; datum, date, survey method, and surveyor name.
 - 9. The **site layout plan** needs to clearly identify the construction limits of the project. The resulting CADD file will be a singular file depicting the **project site layout** with a closed polygon depicting the construction limits. The construction limits polygon will reside on an individual layer named **C-PROP-CONS** per the 4.0 A/E/C CADD standard AIA format with the Level/Layer Description of **Construction limits/controls, staging area**. Depiction by symbology alone is not acceptable. The construction limits should include all areas of expected disturbance – grading, clearing, erosion control, utilities, etc.

10.3.2 CAD Deliverables. The requirements of the CAD drawing **deliverables** are itemized as follows:

- a. As a minimum each drawing represented in a design should have an electronic file. The acceptable software is Bentley Corp. MicroStation (.DGN). Any supporting resource files, pen tables, plot drivers, cell and font libraries must also be furnished to the Savannah District with the electronic files. All work should be completed using default settings with no specialized font or line styles. All resource files furnished by the A/E/C CAD Center are considered default. **BOUND DGN Files are unacceptable. DGN files should be delivered UNBOUND with all reference files in tact to include the border reference.**
- b. A text file or spreadsheet listing each electronic file name, drawing plate no., drawing sheet no. and drawing title should be included with the electronic drawing files and submitted in hard copy form. The electronic media used for delivery should be CD-ROM created with a drive adhering to **ISO 9660**.

c. Furnish CAL files of all drawings at each submittal stage.

10.3.3 CAD Standards. The A-E shall comply with the A/E/C CAD Standard from The CAD/BIM Center. The web site for the standard is <https://cadbim.usace.army.mil/CAD> .

10.4. **SUBMITTAL REQUIREMENTS.** The arrangement by drawing discipline is given in Exhibit A-10-10 of this manual. Specific technical requirements for these submittals may be found in the individual chapters of the respective technical disciplines. Electronic files should be submitted for technical adequacy review at each submittal stage. Submit all the CAD drawing files with a hard copy submittal to the Project Manager. CAD drawing files must be submitted in MicroStation DGN, and CAL Type 1 format. Only one set of the CAD files is required. Each electronic drawing submittal package must display a label with:

Base name
Project name
CAD # _____
Design submittal phase
Firm Name

10.5 **FINAL (100 PERCENT) DESIGN SUBMITTAL REQUIREMENTS.** The drawing guidance given in this chapter is applicable to the Final (100 Percent) Design submittal. Additionally, it should be noted that all title block information (titles, numbering, category code, solicitation no, etc.) must be complete in the Final (100%) Design submittal. Specific technical requirements for this submittal may be found in the individual chapters of the respective technical disciplines. This submittal shall include **all** electronic files necessary to display every drawing for the design. CAD drawing files must be submitted in MicroStation .DGN, **and** CAL Type 1 format. A hard copy plot of each drawing must also be submitted to the Project Manager. Only one set of the CAD files is required. Each electronic drawing submittal package must display a label with:

Base name
Project name
CAD # _____
Design submittal phase
Firm Name

10.6 **CORRECTED FINAL DESIGN SUBMITTAL REQUIREMENTS.**

10.6.1 Notice. Corrected Final submittals are not considered a normal design level and are required only when Final submittals must be revised or corrected due to error or omission.

10.6.2 General. The drawing guidance given in this chapter is applicable to the Corrected Final Design submittal. This submittal shall include **all** electronic files necessary to display every drawing for the design. CAD drawing files must be submitted in MicroStation .DGN, **and** CAL Type 1 format. A hard copy plot of each drawing must also be submitted to the Project Manager. Only one set of the CAD files is required. Each electronic drawing submittal package must display a label with:

Base name
Project name
FY, Line Item
CAD # _____
Design submittal phase
Firm Name

10.7 **MATERIALS.**

10.7.1 Drawing Media. Drawings shall be plotted on bond paper, English Inch Pound Unit Projects drawing size D (22" x 34" overall) or Metric Unit project drawing size A1 (841 x 594). Savannah District CAD Engineering Section provides these borders, title blocks, and zoning to A/E's. A new border sheet file should be obtained each time a new project is begun due to changes in border requirements.

10.7.2 Other Media. There are various electronic files available from Savannah District, CAD Engineering Section. The A-E should request CD-ROM with files through the Project Manager, or ask for the current Web page where they can be found. Formats available on CD are the following:

- a. Border Sheets
- b. Cover Sheet (for jobs with more than 50 drawings)
- a. Combination Cover/Index Sheet (for jobs with 50 or less drawings)
- b. Index of Drawings (for use with Cover Sheet)
- c. Location Plans (not all Installations have electronic files)

10.7.3 General Requirements.

10.7.3.1 All drawings will be prepared electronically with software compatible and approved by Savannah District, unless a special waiver has been obtained from Project Management. Color plotting is not acceptable for contract drawings.

10.7.3.2 Excessive patterning should be avoided. Associative patterning or hatching should be used for area patterns and line styles should be used in lieu of linear patterns. The use of multiple line placements to depict line width is not advised. Shading should be used sparingly. Any characteristic that is dependant on plotting software should be avoided. The drawings become the property of the users and each have different plot configurations.

10.8 DRAWING PREPARATION.

10.8.1 Drafting Standards. All line work, text, symbolizing, and other aspects of drafting shall be accomplished in accordance with standard drafting practices. Consistency is essential throughout the drawing set, from one discipline to the next the drawing appearance (text size, font, case, line weight consistency, etc) should be constant. Complete legends of symbols and lists of abbreviations shall be included on the drawings for all submittals so that their meanings are clear. Key plans and match lines should also be used.

10.8.2 Half-size Reduction. Particular care shall be exercised to insure that all work is prepared for half-size printing. Congested areas should be enlarged to a suitable scale. For any sheet or part of a sheet not meeting this standard, the designer will be required to promptly re-scale and resubmit, at no additional expense to the Government, a new drawing which is completely readable when reduced half size.

10.8.3 Drawings Incorporating Photographs. Certain project drawings (e.g., operations and maintenance work, rehab projects, etc.) may be best portrayed by use of digital or scanned photographic images of the actual buildings or aerial photographic site plans. This method may be used only if the text and line work is placed on a separate level from the basic photograph. (The border and title block should be a reference file to the photograph.) Also, those portions of the photograph, which lie beneath the text and/or line work, must be removed in order to ensure clarity and readability of the composite drawing.

10.8.4 Line Weights. Line weights are illustrated in the A/E/C CAD Standards. Additionally, special care should be taken to distinguish between new and existing work. Line weights for new work shall be heavier than for existing work where they both occur on the same drawing. Only the line weight variations can effectively distinguish between new and existing work on the full-size prints. Scale and space permitting, a separation of three line weights will be used to distinguish new from existing.

10.8.5 Text. Text shall appear to be single stroke commercial Gothic style, all capitals. Minimum height and width shall be 1/8" inch. The recommended MicroStation fonts are 1 and 3. Font 3 is particularly well suited for tables and rows of numerals. Generally only **one** font should be used on an entire set of drawings. This font will vary only in size and line weight. True type fonts are allowed but care should be exercised to have the same fonts used throughout the drawing set.

10.9 DRAWING FORMATS.

10.9.1 General. All projects shall have a cover and an index sheet or a combination thereof. If Savannah District is providing the soil borings, reserve some space on the index plates for the soil boring sheets. Refer to table EXHIBIT A-10-10 for discipline organization per discipline designator.

10.9.2 Title Blocks. Exhibits A-10-1 through A-10-3, filled-in title blocks as indicated below:

Exhibit A-10-1	A-E Title Block Title, Plate & Sheet (English)
Exhibit A-10-2	A-E Title Block Category Code, Solicitation No, & Miscellaneous Info
Exhibit A-10-3	Sample Revision Block

PROJECT NAME PROJECT LOCATION	72 MAN BARRACKS FIRST FLOOR PLAN
PLATE REFERENCE NUMBER A-101 SHEET 20	

Exhibit A-10-1 TITLE BLOCK & PLATE NUMBER

U. S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS SAVANNAH DISTRICT		DESIGNED BY:		DATE:
		DWN BY:	CKD BY:	SOLICITATION NO.:
AE FIRM NAME AND ADDRESS		SUBMITTED BY:		CONTRACT NO.:
		FILE NAME:		CATEGORY CODE:
		SIZE:	PLOT SCALE:	PLOT DATE:

Exhibit A-10-2
 A/E TITLE BLOCK
 CATEGORY CODE,
 SOLICITATION NUMBER, MISC INFORMATION

10.9.3 Numbering System. The explanations given below refer to numbering required in title blocks.

10.9.3.1 The Solicitation Number is a unique, alpha-numeric number set which denotes the specific construction bid solicitation. Due to Government contracting requirements, this number is not available until final or corrected final design submittal. Plan to add this number to all drawings under SOLICITATION NO. in the title block prior to your last submittal. The Solicitation Number should also be placed on the Cover Sheet.

10.9.3.2 The Category Code Number, reflecting Army and Air Force criteria, defines facility classification category code, and the sequence for that type facility. This unique seven-digit number set should be added to the border sheet where indicated. This number will be furnished within the Specific Instructions for CAD.

10.9.3.3 The Plate Number assigned to each drawing is defined in the A/E/C CAD Standard. The Sheet Number is a sequence number placed consecutively within each drawing set. The total number of drawings in the set, noted thus: SHEET 1 OF XXX, will be indicated **only** on the first sheet in the set. The single sheet number will be placed on the following sheets in sequence. This will facilitate later revisions. **NEVER RENUMBER SHEETS AFTER FINAL SUBMITTAL.** If you need to add sheets, simply add a suffix to the sheet number. Example, adding a drawing between sheets 21 and 22. This sheet number would be 21A. The same applies to the CAL files. **DO NOT RENUMBER AFTER FINAL SUBMISSION.**

10.10 **DRAWING REVISIONS.** In general, the designer/drafter may be involved in revisions to drawings during solicitation and during construction. Revisions during solicitations are referred to as **amendments**. Revisions during construction are referred to as **contract modifications or modifications**. The methods and procedures for reflecting these changes on drawings are described below and the notation is illustrated in Exhibit A-10-3.

10.10.1 Amendment Drawings for Solicitations. **All amendment revisions to drawings are made by issuing revised drawing(s).** Use the first available space in the revision block and identify it as Revision 1 (teardrop), or the next sequentially higher number for that drawing. Thus, the revision (teardrop) numbers for a given amendment may vary from drawing to drawing and will not necessarily match the amendment number itself. All revised drawings will be annotated by symbol (teardrop) on the drawing at the point of revision and will carry a revision number, which will be shown in the column headed "Symbol" in the revision block of the drawing. A brief description "**REVISED IN ACCORDANCE WITH AMENDMENT 000#**" will be entered under "Description" in the drawing revision block. Revisions to drawings for Task Orders will be as explained for Solicitations with the exception in the Description. The description will read "**REVISED IN ACCORDANCE WITH RFP LETTER_R#**". Drawings added or deleted in a Task Order will be as described below, with only the revision block text referring to **RFP LETTER_R#**.

10.10.2 Added Drawings. For sheets to be added by amendment, the revision block will be annotated "**SHEET ADDED BY AMENDMENT 000#**" at the "Description", no teardrop should be placed in the symbol area. Added sheet titles and other information will be a revision to the Index of Drawings sheet.

10.10.3 Deleted Drawings. For sheets to be deleted by amendment, the revision block will not be tear dropped and the words "**SHEET DELETED BY AMENDMENT 000#**" will be entered under "Description" and the revision block initialed and dated. Sheets deleted by amendment will be shown as "Deleted" on the Index of Drawings sheet and noted as a revision to the Index of Drawings.

10.10.4 Modification Drawings. Modifications to construction contracts are high priority items and shall be acted upon without delay. Timely preparation of contract documents to accompany the modification package will prevent undue delay in construction schedules. Upon receipt of design requirements for a proposed modification, the A-E will proceed with preparation of the necessary changes or additions. Construction Division will forward the completed package to the Project Manager for finalization and subsequent implementation. Modifications to the construction contract may be accomplished by application of one or more methods available to the A-E. Formulating a clear, concise, and accurate modification package cannot be overemphasized. A method of modifying the contract documents is to revise an existing drawing. Care should be taken to conform to the existing drafting style already present on the drawing files. Acceptable terminology which should appear in the revision block "**REVISED IN ACCORDANCE WITH MCB ##-##-**". Each modification should be properly tear dropped, described, dated, and initialed by the A-E firm. Occasionally a modification requires preparation of one or more new sheets because of the magnitude of the change. For sheets to be added by modification, the revision block will **not** be tear dropped and the words "**SHEET ADDED BY MODIFICATION #**" will be entered under "Description" and the revision block initialed. Care should be exercised in assigning sheet and plate numbers to new drawings. For example, if a new sheet is to be inserted between existing Sheets 19 and 20, the proper identification would be Sheet 19A. All drawings added by modification should be noted on the Index of Drawings.

10.11 **SPECIFIC INSTRUCTIONS.** Exceptions to these guidelines or additional guidance relative to a specific job may be provided in the Specific Instructions to A-E for that job.

**CHAPTER A-10
DRAWINGS
EXHIBITS**

Military and Civil Projects For File Name Purposes

AIWW	A
Fort Benning	N
Fort Bragg	B
Brunswick Harbor	V
Dobbins AFB	D
Donaldson AFB	O
Fort Gillem	L
Fort Gordon	G
Hartwell Dam & Lake	W
Hunter AAF	H
Fort Jackson	J
Kings Bay Naval Subbase	K
Fort McPherson	F
Moody AFB	M
Pope AFB	P
Richard B. Russell Dam & Lake	U
Robins AFB	R
Savannah River	Z
Seymour Johnson AFB	C
Fort Stewart	S
Strom W. Thurmond Dam & Lake	X
Sunny Point Military Ocean Terminal	T
Turner AFB	E
Tybee Island	Y

EXHIBIT A-10-4

Exhibit A-10-9
CHECKLIST FOR FINAL SUBMITTAL
DRAWINGS

The checklist is designed to acquaint firms with printing and storage requirements for preparation of contract documents. It is intended to serve only as a guide and does not replace detailed criteria provided elsewhere.

- __1. All work depicted on drawings should be suitable for reproduction to one-half size.
 - __2. A minimum of 1/8" height text should be used within the body of the drawing.
 - __3. All **new** work should be shown three weights heavier than existing work when both new and existing appear on the same drawing.
 - __4. Plans and model files should be checked for duplications or overprinting of features, notes, plans, sections, details.
 - __5. Titles, subtitles, title block and revision block information should be in accordance with Section A-10, Savannah District Design Manual for Military Construction.
 - __6. Titles of drawings should agree with the titles listed on the Index of Drawings.
 - __7. The total number of drawings should be shown only on the first sheet of the set.
 - __8. Signature blocks used to be required on the first set of each discipline, but with electronic bid sets signature blocks are not required.
 - __9. Drawings should be consecutively numbered in the Sheet number blocks at bottom right of each sheet.
 - __10. Site-adapted drawings must have the appropriate notation in each revision block.
 - __11. Amended or modified drawings must have the appropriate notation in each revision block, with teardrop on the sheet where the change was made. Teardrop is to have the revision number inside.
 - __12. Symboling on drawings should be in accordance with A/E/C CAD Standards.
 - __13. Coordinate the use of cross-referencing bubbles for locating sections, details and elevations.
 - __14. On the Final Design submittal, all title block numbering, (Plate No., File No., Sheet No., Category Code, Solicitation No.) should be in place.
 - __15. All final contract drawings should have the design file name on the electronic title block.
 - __16. Colored ink should not be used for plotting.
- EXHIBIT A-10-9
- __17. When a plan is cut into multiple sheets to provide a larger scale, provide a key plan showing where the individual plan is in relation to the overall site.
 - __18. All drawings should be the same size when plotted at full size. (22" x 34" for English jobs) (594 x 842 mm for Metric jobs)
 - __19. No specialized pen table or plot tables should be used to depict line styles or symboling.

__20. All drawing files must be present on the final CD and the CD should be marked either by label or pen with **Base Name, Project Name, FY, Line Item, CAD#, Submittal Phase and Firm Name.**

__21. All CAL files numbered by sheet number shall be submitted. Make sure that all CAL files have sheet numbers, solicitation numbers, category codes and dates prior to corrected final submittal. Project Manager will provide the solicitation number.

__22. Provide an excel spreadsheet or text file with CAL filename, plate number, sheet number and drawing title with the corrected final submittal.

EXHIBIT A-10-9

TYPICAL DRAWING SET BY DISCIPLINE DESIGNATOR	
DISCIPLINE	DESIGNATOR
GENERAL	G
HAZARDOUS MATERIALS	H
SURVEY/MAPPING	V
GEOTECHNICAL	B
CIVIL WORKS	W
CIVIL	C
LANDSCAPE	L
STRUCTURAL	S
ARCHITECTURAL	A
INTERIORS	I
EQUIPMENT	Q
FIRE PROTECTION	F
PLUMBING	P
PROCESS	D
MECHANICAL	M
ELECTRICAL	E
TELECOMMUNICATIONS	T
RESOURCE	R
OTHER DISCIPLINES	X
CONTRACTOR/SHOP DRAWINGS	Z
OPERATIONS	O

NOTE:
**THIS IS GUIDANCE FOR SEQUENCING
OF DRAWINGS FOR LARGE PROJECTS.
IT IS UNDERSTOOD THAT SOME OF
THE CATEGORIES LISTED MAY NOT
BE APPLICABLE TO ALL PROJECTS.**

EXHIBIT A-10-10