

## APPENDIX C

### DRAWINGS

1. **General.** This appendix prescribes the requirements, procedures and drafting standards for the preparation and approval of drawings for military construction and/or HTRW projects. It includes drawings, other than shop drawings, prepared at all stages of design and construction.

2. **Standard Drawings.** Standard drawings are developed under the guidance and criteria issued by HQUSACE (CEMP-E). A listing of current standard drawings is available from the TECHINFO system accessed through the USACE Home Page on the Internet, <http://www.hnd.usace.army.mil>, or by direct telephone dialing the system data line at (205) 895-1826. The purpose of standard drawings is to aid in project planning and design, and to reduce the cost and time for the preparation of project drawings.

a. **Types of Drawings.** Types of standard drawings are described as follows:

(1) **Standard Design Drawings.** Standard design drawings can range in completeness from definitive or sketch level, to completed construction documents with the drawings of sufficient detail as to materials and methods of construction to serve as project construction drawings after the necessary field modifications covering site adaptations and deletion of inapplicable materials.

(a) Standard designs generally provide for site adaptation in widely separated geographical areas with design data for different climatic and seismic conditions, and building materials. Alternate wall sections, details and building elevations are included as required to illustrate

these variations.

(b) These drawings are sometimes accompanied by a standard technical guide specification.

(2) **Definitive Design Drawings.** Definitive design drawings delineate functional layouts, space allowances, special features or requirements, and the configuration of elements both horizontally and vertically. Definitive design drawings usually recommend basic building systems; materials and construction details; architectural treatments; and structural, mechanical, electrical and fire protection systems with criteria and guidance necessary for making selection. These drawings typically include floor plans, elevations and cross sections with controlling and critical dimensions, gross and net area tabulations. Definitive design drawings also address the most likely and alternative site support facilities and utility requirements for mechanical and electrical systems. These drawings are sometimes accompanied by a design analysis.

(3) **Department of the Army (DA) Facilities Standardization Program Standard Design Packages.** The drawings in these packages are normally developed to a level of design that is similar to definitive design drawings. The basic DA Standard Design Package includes both standard design drawings and design analysis. Additional requirements and information on the DA Facilities Standardization Program are contained in ER 1110-3-113 and AR 415-15.

(4) **Sketch Design Drawings.** Sketch designs are usually single-line drawings delineating functional layouts, space allowances

and the basic features of a facility type. These drawings typically include plans, and elevations and cross sections with controlling dimensions and area tabulations.

**(5) Design Guide Drawings.** Design guides are published and issued in printed form with both narrative and graphic data to describe the functional layout, space allowance and special features of a facility type. Design guides typically include drawings delineating individual space requirements, and drawings showing the organization of spaces into alternative facility layouts and designs. These designs are usually illustrated further by plans, and elevations and cross sections with controlling dimensions and area tabulations. Perspective sketches may be included to illustrate recommended interior designs and exterior design treatments. Drawings are reduced to manual size for publication.

**(6) Project Design Drawings from the CADD Library.** These drawings are completed facility specific project documents available for site adapt use to reduce cost and time for the preparation of project drawings.

**b. Modification of Standard Drawings.** The design agency responsible for the development of a project design is authorized to modify standard drawings, except those drawings contained in the DA Facilities Standardization Program standard design packages, to meet local siting, foundation, topographic, climatic and seismic conditions, energy and utility availability, and life cycle cost. Criteria and waiver request procedures for DA Facilities Standardization Program designs are governed under ER 1110-3-113, and DAIM-FDR memorandum, 7 Oct 95, SUBJECT: Request for Waivers from the Use of DA Standard Design and Space Planning Criteria.

**(1) Modifications.** Modifications to standard drawings are authorized to avoid

unnecessary construction features or costs, to correct errors, and to adapt the drawings to local materials and methods of construction, metric measurements (when originally prepared in IP unit measurement), or CADD techniques.

**(2) Directed Modifications.** Other modifications may be directed by HQUSACE (CEMP-E) in AEI or design directives. Modifications and changes may be promulgated through Engineer Technical Letters (ETL) or revisions to guide specifications.

**(3) Deviations.** Modifications that cause deviations from functional and operational requirements, space criteria or cause significant increases in cost shall be avoided. Deviations to the functional and operational requirements contained in DA Facilities Standardization Program standard design drawings are unauthorized.

**c. Deficiency Reports and Recommendations.** HQUSACE (CEMP-EA) will be promptly informed of any errors or omissions in DA Standard Designs, including drawings. Under the provisions in ER 1110-345-100, ENG Form 3078 may be used for this purpose or the deficiency may be reported directly to HQUSACE (CEMP-EA), Washington, DC 20314-1000.

### **3. Project Drawings.**

**a. Concept Design Drawings.** Concept designs are used to define the functional, technical, and architectural and engineering aspects of a project, and to help verify project costs in order to provide a firm basis upon which to initiate the final project design. Completion of concept design drawings, together with a design analysis, outline specifications and cost estimate, normally represents about one-third of the total design effort. Concept designs will be prepared in accordance with AR 415-15, utilizing the

project requirements documents and applicable standard drawings.

(1) When standard design drawings are used, the drawings for the new project will include appropriate sheets from those drawings modified to depict site adaptations and other essential requirements. Duplication will be avoided except as required for clarity.

(2) Concept design drawings will generally include the following information:

(a) Project site plan showing existing and proposed buildings, roads, parking, landscape planting masses, contours, and the utilities in the immediate vicinity of the project.

(b) Building floor plans, cross sections and elevations showing the functional layout, space configuration and form, and building system characteristics, to include the required properties and/or performance of the construction materials and methods.

(c) Design details of exterior and interior elements; schedule of windows, doors, and finishes and colors; details related to architectural, structural, mechanical, electrical and fire protection systems; and energy usage and other special requirements.

(d) Foundation plans and details showing geotechnical investigation results, boring data, subsurface soil classification, allowable soil bearing capacity, ground water elevations, etc.

**b. Final Design Drawings.** Final design drawings will be prepared from the approved concept designs. When standard design drawings are used, additional sheets will be incorporated as appropriate. Final design drawings together with a complete design analysis, construction specifications, and a cost estimate covering all technical, architectural and engineering details will form the basis for

construction contracting. The drawings will be sufficient in detail to provide for fair and competitive bids from contractors, and to provide for the construction of the project without additional drawings, except for shop drawings or as may be required to deal with unforeseen conditions encountered during construction.

**c. Shop Drawings.** These are drawings submitted by a contractor, manufacturer, vendor or others, which show in detail the proposed fabrication and assembly of specific building components or which show the installation details (i.e., form, fit and attachment) of materials or equipment. Preparation, approval and transmittal of shop drawings are outside the scope of this regulation.

**d. As-built Drawings.** As-built drawings will be prepared as part of the completion records transferred to the using service upon completion of the project. The contract drawings will be revised and corrected to indicate the actual construction of the project, including all change orders. Site plans, building plans, cross sections and elevations, schedules and all other portions of the drawings to include the location of mechanical services, utility lines and outlets, will be revised to provide a clear understanding of the project, as built. As-built drawings, together with as-built construction specifications, final shop drawings and the design analysis will be furnished to the using service in accordance with ER 415-345-38.

**4. Drawing Preparation.** Drawings will be prepared so as to clearly and adequately delineate the work to be accomplished.

**a. Quality.** Because of the number of copies of drawings normally required for a project, most drawings are reduced to half-size for reproduction. Original drawings and details; therefore, must be of adequate size, and be

clear and sharp, so that the use of half-size reproducible will result in legible and easy to read copies.

**b. Drafting Standards and Practices.**

Format and organization, control data blocks, drawing conventions, schedules and standard details will conform to the requirements and guidance contained in paragraph 5 of this appendix.

**c. Codification.** Drawing sheets will be assigned a drawing code in accordance with the guidance contained in paragraph 10 of this appendix.

**d. Metrication.** The criteria and requirements for the application of metric measurements in drawings were addressed in paragraph 4 of this regulation. The following ANSI and ASTM standards will be used in the preparation of drawings:

(1) American National Standards Institute. 28 October 1992. "American National Standard for Metric Practice," ANSI/IEEE 268-1992, IEEE Standards Coordinating Committee 14 on Quantities, Units, and Letter Symbols, New York.

(2) American Society for Testing and Materials. 1991. "Standard Practice for the Use of Metric (SI) Units in Building Design and Construction," ASTM E 621-84 (Reapproved 1991), Committee E-6 on Performance of Building Construction, Philadelphia, PA.

(3) American Society for Testing and Materials. 1992. "Standard Practice for the Use of the International System of Units (SI) (the Modernized Metric System)," ASTM E 380-92, Committee E-43 on Metric Practice, Philadelphia, PA.

**e. Computer-Aided Design and Drafting (CADD).** Commercially available CADD systems

have demonstrated significant potential for improving the efficiency and quality of drawing production. Standards for USACE CADD application are contained in Tri-Service CADD/GIS Technology Centers Architectural, Engineering and Construction (A/E/C) CADD Standards available at Internet site <http://mr2.wes.army.mil>. Those criteria that meet the quality requirement in the paragraph above are acceptable for use in preparing project and other drawings. Manually prepared drawings will also follow the general guidance in this manual as it applies to general drafting standards.

**5. Drafting Standards and Practices.**

**a. Format and Organization.**

(1) Concept and final design drawings, and drawings for standard and definitive designs, will be prepared on standard A1 metric size sheets, 594 mm x 841 mm (23.39 inches x 33.11 inches); an American National Standards Institute (ANSI) "D" equivalent sheet.

(2) When preparing large maps, i.e., installation master plans and drawings for Civil Works projects, the standard A0 metric sheets; 841 mm x 1189 mm (33.1 inches x 46 inches) should be used; an ANSI "E" equivalent sheet.

(3) When preparing half-size drawings for inclusion to booklets such as "Design Analysis," the standard A3 metric sheet; 297 mm x 420 mm (11.7 inches x 16.5 inches) should be used; an ANSI "B" equivalent sheet, that conveniently folds in to the standard A4 metric size; 210 mm x 297 mm (8.3 inches x 11.7 inches), an ANSI "A" equivalent sheet.

(4) The sheet layout, including the standard title and information blocks, for drawings are provided at Figure C-1 and Figure C-2 which depict expanded views of the title, revision and other information blocks on the

standard sheet.

**b. Cover Sheet.**

(1) Project drawings will have a cover sheet or sheets with the project name, project location, design agency logo and identification, project number and fiscal year. Applicable file numbers will be included as appropriate. The overall sheet layout of title and other information blocks shall follow the theme in Figure C-1 and Figure C-2.

(2) Cover sheets for in-house work shall comply with the requirements of ER 1110-1-8152, paragraph 6 concerning signatures, and will include the following statement:

“This project was designed by the (name of district) District of the U.S. Army Corps of Engineers. The initials or signatures and registration designations of individuals appear on these projects documents within the scope of their employment as required by ER 1110-1-8152.”

**c. Index Sheets.** Project drawings, and drawings for standard and definitive designs, will have an index sheet or sheets. The index sheet or sheets will identify by reference number, date and title, each of the other sheets in the set of drawings, and indicate the total number of sheets in each design discipline group. The overall sheet layout of title and other information blocks shall follow the theme in Figure C-1 and Figure C-2.

**d. Legend Sheets.** A legend sheet or sheets should follow the index sheet or sheets, or may be combined with the index sheet or sheets. The legend sheet or sheets will include definitions of abbreviations used; legends for materials, mechanical and electrical symbols; a graphic illustration of details and cross section reference indicators; and other information as required for that particular set of drawings. The

overall sheet layout of title and other information blocks shall follow the theme in Figure C-1 and Figure C-2

**e. Drawing Sheets.** Drawing sheets will follow the cover, index and legend sheets in order of the following design discipline groups: civil to include the site design; architectural to include interior design; structural; mechanical; electrical; and others. The architectural drawings should normally show plans, elevations, cross sections and details in that order. The overall sheet layout of title and other information blocks shall follow the theme in Figure C-1 and Figure C-2.

**f. Supplemental Drawing Sheets.** When it is required that any drawing sheet for a specific project be redrawn and/or new drawing sheets added, such as in the preparation of as-built drawings or contract modifications, the redrawn or new drawing sheets will be consecutively numbered to follow the last drawing sheet of the design discipline group. The basic sheet that is replaced or supplemented by a supplemental drawing sheet will be retained in its original position with a note in the revision block indicating the sheet number where the changed conditions are shown.

**6. Control Data Blocks.**

**a. Title Blocks.** Except for the cover sheet, title blocks will be placed on each individual drawing sheet in the space inside the right hand margin of the drawing sheet, as indicated in Figure C-1, to identify the name of the project, the project number and fiscal year, and the installation where the project is located. Title block data will also include the title of the drawing on the sheet, the sheet reference number, the drawing code assigned in accordance with paragraph 10 of this appendix, applicable local file numbers, and the approval date of the drawing sheet. Local design agency standards may be used for recording in the title

blocks of individual drawing sheets, the names or initials of the person or persons responsible for the design, drawing and checking of each drawing sheet, and for overall review and approval in accordance with ER 1110-1-8152 . However, the local design agency standard shall comply with the sheet size standards in the appendix, and the standard configuration at Figures C-1 and C-2.

**b. Authentication Blocks.** Authentication blocks will be placed on the index sheet or sheets to the left of the title block. Authentication blocks will provide spaces for the signatures of those individuals responsible for the preparation, review and approval of the drawings. Approval is required for both technical and functional adequacy. Space will also be provided to indicate the date of approval next to the signature. Use of authentication blocks on other drawing sheets will be at the discretion of the design agency responsible for the design.

**c. Revision Blocks.** Except for the cover sheet, revision blocks will be placed on each drawing sheet above the title block to describe any revision made to the drawings, to indicate the number and date of the revision, and the initials of the official approving the revision; see Figure C-1.

**7. Drawing Conventions.** Methods used for drawing, lettering, dimensioning and cross-referencing must be economical and assure legibility when drawing sheets are reduced to half-size sheets. Lettering styles and sizes should be standardized within a set of drawings regardless of the design discipline involved.

**a. Symbols.** Symbols used in the preparation of civil, architectural, structural, mechanical, electrical and other drawings will reflect usage, for example, established by the American National Standards Institute (ANSI) standards or generally accepted professional

standards.

**b. Abbreviations.** Abbreviations will reflect common usage.

**c. Scales.** Graphic scales will be provided on drawings to allow for measured scaling. Project drawings, standard and definitive designs will generally be drawn to the scales indicated in Table C-1.

<b>Table C-1</b>		
<b>Drawing Scales</b>		
Type	SI Metric	Inch-Pound (IP), Customary Equivalent
Site Plan	1:250 /1	(1" = 25')
	1:200	(1/16" = 1'-0")
Floor Plan	1:50 /2	(1/4" = 1'-0")
	1:100	(1/8" = 1'-0")
	1:200	(1/16" = 1'-0")
Roof Plan	1:200	(1/16" = 1'-0")
Exterior	1:10	(1" or 1-1/2" =1'-0")
Elevation	1:100	(1/8" = 1'-0")
	1:200	(1/16" = 1'-0")
Interior	1:50	(1/4" = 1'-0")
Elevation	1:100	(1/8" = 1'-0")
Boring	1:10	(1" or 1-1/2" = 1'-0")
Logs	1:100	(1/8" = 1'-0")
	1:200	(1/16" = 1'-0")
Cross- Section	1:50	(1/4" = 1'-0")
	1:100	(1/8" = 1'-0")
	1:200	(1/16" = 1'-0")
Wall Section	1:20	(1/2" or 3/4" = 1'-0")
Stair Detail	1:10	(1" or 1-1/2" = 1'-0")

**Table C-1**  
**Drawing Scales,** Continued

Type	SI Metric	Inch-Pound (IP) Customary Equivalent
Details	1:5	(3" = 1'-0")
	1:10	(1" or 1-1/2" = 1'-0")

/1 May be necessary for landscape plans

/2 May be used for partial floor plans

**d. Keys.** All cross-referencing conventions, symbols and abbreviations will be keyed, and shown on the legend and other drawing sheets as appropriate.

**e. Revisions.** Conventions for describing revisions will include marking of the area of the drawing sheet revised so that the area can be easily located.

## 7. Schedules.

**a. Window Schedules.** A tabular schedule of windows will also be included on the drawings. Each type of window will be assigned a number preceded by the letter "W." An elevation drawing of each type of window will be provided along with pertinent details. Every window will be clearly indicated by type on the elevation drawings.

**b. Door Schedules.** A tabular schedule of doors will be included on the drawings. Every door will be assigned a separate number and this number will be clearly indicated on the plans. Door numbers should be as nearly consecutive as possible, by floor, beginning with the principal building entrance area and progressing counter-clockwise through the plan. An elevation drawing of each type of door, identified by an upper case letter will indicate the material of which the door is made and other pertinent details. Details of each type of

door frame will be shown and each type will be identified.

**c. Finish and Color Schedules.** A tabular schedule of interior finishes and colors will be included on the drawings. Finish and color schedules should identify by room number the finish materials and colors to be used for the floor to include the base, the walls to include any wainscoting and trim, and the ceiling. The meaning of the abbreviations used in naming the materials and finishes will appear on the legend sheet or on the same sheet as the schedules.

**8. Standard Details.** The classification and type of standard details on drawings will conform as "CLASS 40" listed in Table C-2. When sequence numbers for standard details, i.e., DET 40-06-04 is Lighting Fixtures, are established; the sequence numbers are obtained from the U.S. Army Engineering and Support Center, Huntsville (CEHNC-ED-ES), telephone (205) 895-1402.

**Table C-2**  
**Class 40 - Standard Details**

Type No.	Type of Detail
01	Architectural Details
02	Structural Details
03	Heating Details
04	Equipment Layouts & Details
05	Legends, Notes, Schedules, and Symbols
06	Electrical Details
07	Water System Details
08	Sanitary Sewer Details
09	Gas System Details
10	Field Survey Details
11	Athletic Equipment Details
12	Railroad Details
13	Plumbing details
14	Air Conditioning Details
15	Fire Protection Details
16	Fence Details
17	Pavement, Curb and Sidewalk Repair Details

**Table C-2**  
**Class 40 - Standard Detail, Continued**

Type No.	Type of Detail
18	Storage Racks, Grounds & Equipment Details
19	Tent Frame Details
20	Storm Water Details
21	Standard Component Layouts and Details
22	Kitchen Equipment Layouts and Details
23	Overhead Carrier System Details
24	Aircraft Arresting Barrier Details

**9. Area Computations and Room Numbering.**

**a. Area Computations.** Gross area of buildings and net area breakdowns for each floor will be provided on plans and computed in accordance with the method specified in AR 415-17, AEI Design Criteria.

**b. Room Numbering.** Every room will be assigned a separate number and this number will be clearly indicated on the plans. Room numbers will generally be assigned as shown in Table C-3. Room numbers should be as nearly consecutive as possible, beginning with the principal entry area and progressing counter-clockwise through the plan. Spaces added by revision should be given the number of the primary or nearest room followed by the letter "A," or if more than one additional space "B."

**Table C-3**  
**Room Numbering**

Floor	Numbering Sequence
Basement	01 through 99
First	100 through 199
Second	200 through 299

**10. Drawing Codification.** Drawings will be assigned a drawing code consisting of a letter prefix and three numerical parts as follows:

**a. Prefixes.** Letter prefixes will be used to differentiate between the various types of drawings, and between drawings prepared for Army, Air Force, and other projects as shown Table C-4.

**Table C-4**  
**Drawing Prefixes**

Drawing other	Type	Army Prefix	Air Force Prefix	
Project Drawings	Concept	C	AC	XC
	Final	F	AF	XF
	As-Built	AS-BLT	AS-BLT	AS-
BLT				
Standard Drawings	Standard	STD	AW	XW
	Definitive Design	DEF	AD	XD
	Sketch Design	SK	ASK	XSK
	Design Guide	DG	-	-

**b. Class Number.** The first numerical part of the drawing code is a class number based on the first three digits of the facility category codes given in AR 415-28, and for Air Force projects obtain the information from the project Air Force command.

**c. Type Number.** The second numerical part of the drawing code is a type number based on the last two digits of the facility category codes given in AR 415-28 for Army projects, and the last three digits given Air Force Command for an Air Force project.

**d. Sequence Number.** The third numerical part of the drawing code is a chronological



sequence number to indicate succeeding numbers of drawings for a particular class and type of building or structure prepared within a particular design agency.

(1) Sequence numbers for project drawings will be assigned by the design agency responsible for the project and follow the criteria in this appendix. The first sequence number will be 01 after implementation of the coding system herein.

(2) Sequence numbers for standard drawings will be assigned by HQUSACE (CEMP-EA).

**e. Examples.** The following subparagraphs show how prefixes and numbers are combined to form a complete drawing code:

(1) To establish the drawing code for a training facility; the class number is 171, training buildings. If the facility is for the Army and for general instruction, the type number is 20; if the facility is for the Air Force and for pilot training, the type number is 213. Assuming this coding is the first design for this type of facility by the design agency since implementation of the coding system herein, the sequence number is 01.

(2) For the above example, the drawing code at the concept design stage becomes C-171-20-01 for an Army project and AC 171-213-01 for an Air Force project. A sequence number once assigned, is henceforth fixed for that particular set of drawings.

(3) During the development of drawings from the concept to final design stage, the numbers are retained but the prefix is changed from C to F. The drawing code at the final design stage becomes F-171-20-01 for an Army project and AF 171-213-01 for an Air Force project.

(4) In the case of an Army project standard design, the drawing code is STD 171-20-01, or AW 171-213-01 for an Air Force project. These drawing codes will be assigned by HQUSACE (CEMP-EA). The drawing code assigned by the design agency in site adapting this standard to an Army project would be F-171-20-01, assuming this was the first set of drawings for this type of facility prepared by the design agency.

(5) When modifying the final drawings to reflect as-built conditions, the numbers are retained but the prefix will be changed from F to AS-BLT. The drawing code becomes AS-BLT 171-20-01 for an Army project and AS-BLT 171-113-01 for an Air Force project (confer with the project's Air Force Command).

(6) If a final project drawing is designated as a standard drawing, the basic class and type numbers are retained, but the sequence number is changed to that assigned by HQUSACE (CEMP-EA). The prefix is also changed from F to FD to indicate designation as a field design.

**11. Use of Additional SE Coding or Numbering Systems.** No changes will be made in the coding system prescribed herein without prior approval of HQUSACE (CEMP-EA). If a design agency requires a class or type number not clearly covered by the facility category codes in AR 415-28, an appropriate number will be furnished upon request to HQUSACE (CEMP-EA). All requests concerning Air Force definitive numbers and facility nomenclature should be made to the Air Force Civil Engineer Support Agency, Tyndall AFB, FL 32403-53191, and the project's Air Force Command. When a design agency requires an additional coding or numbering system to comply with an existing system, these additional codes or numbers may be included on the drawings.

**12. Review and Approval of Project Drawings.**

**a. Using Service.** Submittal of drawings to the using service for review and approval of the functional aspects of the design will be compatible with the provisions of AR 415-15 .

**b. Corps of Engineers Design Agency.** Review and approval of drawings by the design agency will be in accordance with the design verification provisions set forth in ER 1110-345-100.

**c. Headquarters, U.S. Army Corps of Engineers (HQUSACE).** Project drawings shall not be submitted to HQUSACE (CEMP-E), except as provided by specific regulations, design directive or other HQUSACE instructions. Review or approval by HQUSACE (CEMP-E), that is directed by regulation or HQUSACE (CEMP-E) instruction, will in no way relieve the design agency of its approval responsibility.

**13. Drawing Authentication.** Approved drawings will be so designated by authentication on an index sheet or sheets that identifies by reference number, date and title, each of the other sheets in the set. This sheet or sheets will bear the signature of the appropriate officials responsible for the preparation, review and approval of the drawings. Drawings will be certified as official

and final, see ER 1110-1-8152.

**14. Modification of Project Drawings After Approval.** The design agency responsible for the project design is authorized to make modifications to the project drawings that have been approved in accordance with paragraph 12 of this appendix to correct errors, omissions and ambiguities, or to meet changes in local conditions occurring during construction.

**a. Modifications after Approval.** Modifications may be undertaken provided that the modifications are necessary or desirable to allow construction to proceed in an efficient and economical manner, and do not alter the quality of construction, general functions, appearance or scope of the project.

**b. Identifying Modifications.** Modification of project drawings will be clearly indicated and identified by date and the office authorizing the change.

**15. A-E Prepared Drawings.** A-E contractor drawings shall comply with Figure C-1 and Figure C-2, and ER 1110-1-8152, paragraph 7. A-E contractor prepared drawings shall not be signed as accepted or approved by Corps of Engineers' personnel.

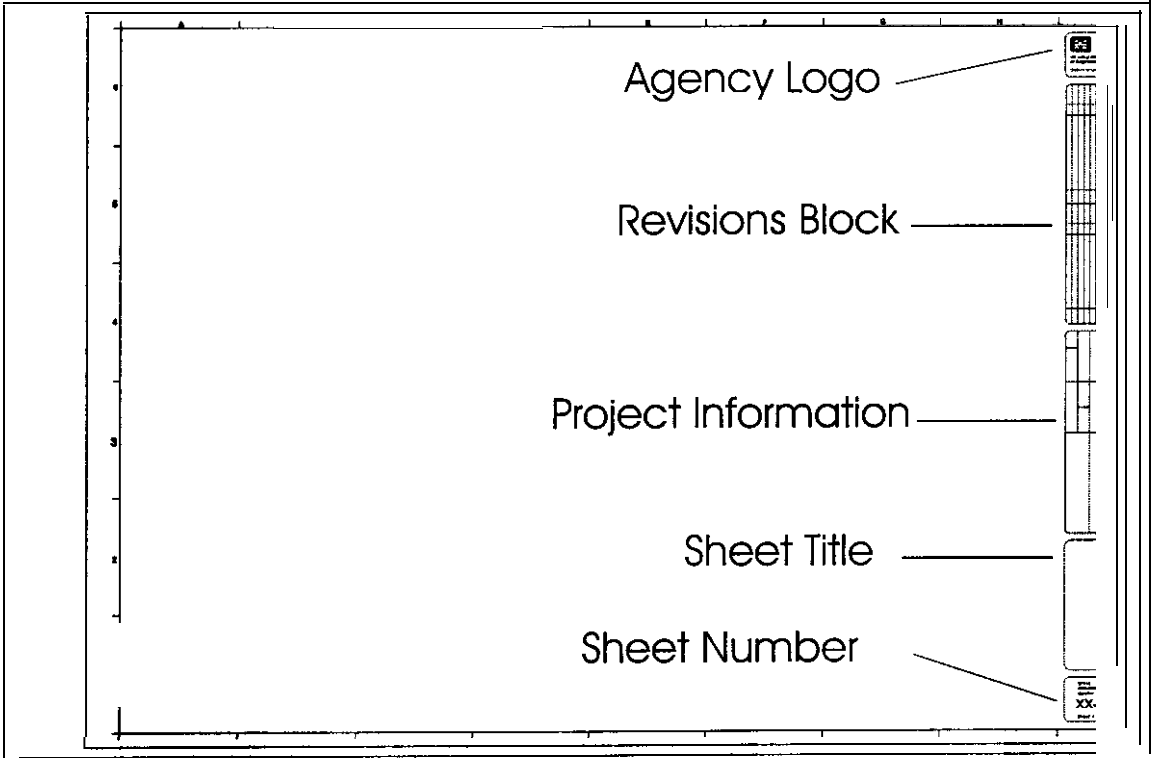


Figure C-1 Metric Sheet with Vertical Title Block

