U.S. Department of Agriculture
Soil Conservation Service
Engineering

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COMPUTER-AIDED DESIGN AND DRAFTING (CADD) STANDARDS

CADD Standards

Table of Contents

PREFACE

This technical release was prepared by a committee appointed by the Director of the Engineering Division on May 7, 1987. The committee consisted of the following SCS personnel: Paul Monville, West NTC, chairman; Kenneth Carpenter, Northeast NTC; Gordon Goldman, Indiana; Bill Goon, Washington, D.C.; Wayne Johnson, Texas; Jack Land, West NTC; and Ronald Nulton, South NTC. Robert Pasley, Assistant Director for Engineering Technology Development (Retired); David Ralston, National Design Engineer; and Scott Snover, Head, Design Unit, Engineering Division, participated in the committee meetings and reviews.

A draft of this technical release, dated February 23, 1988, was sent to all state conservation engineers, heads of engineering staff at NTC's, and the Engineering Division of NHQ, for review and comment. Consideration was made of all comments received, and appropriate comments were incorporated in the final technical release. The committee commends the effort made by the respondents and acknowledges that their input has been of significant value to the preparation of this technical release.

The Design Sections/Units of the NTC's will accept additional comments concerning the TR from their respective states and forward them to the Design Unit, Engineering Division, for use in future revisions.

CADD Standards

Introduction. This Technical Release provides guidelines for the organization and format of electronic data files, data entry, and output associated with computer-aided drafting and integrally related design. It supplements policy, criteria, and standards found in the following documents.

1. The National Engineering Manual Part 541, Drafting, (210-541) which furnishes Soil Conservation Service policy for the drafting of engineering drawings.

2. The General Manual Part 408, Records, (120-408) which gives policy for the storage of electronic records.

3. The National Engineering Handbook, Section 6, Chapter 4.4, which provides criteria for detailing reinforced concrete structures.

4. The Engineering Field Manual, Chapter 5, Part 3, which furnishes guidance for drawings and drafting.

In providing CADD standards, the following subjects are addressed:

a. Line Thickness and Pen Sizes.
b. Levels.
c. Text.
d. Symbols.
e. Macros.
f. Sheet Sizes and Title Blocks.
g. Standard Detail Drawing Identification.
h. File Transfer.
i. Drawing Records.

The sections concerning line thickness and pen sizes, levels, text, symbols, and sheet sizes provide recommendations for computer-aided design and drafting techniques. The sections concerning macros, National Standard Detail Drawing identification, file transfer, and drawing records provide recommendations for record keeping.

The General Manual recommends paper printouts for records if it is possible or practical to make them. However, electronic records of drawings are usable in the production of drawings for similar structures. Electronic records are, in these cases, considered more practical to maintain than the paper printout.

The establishment of macro and drawing records, as described in this Technical Release, provides an opportunity to build a data base of macros and drawings that can be made available to SCS CADD operators. The Design Unit, National Headquarters office, will serve as the contact for an inventory of record information for the SCS.

Tips based on the experience of SCS CADD users have been included on selected subjects that may be helpful to CADD programmers and operators.

Drawings produced by CADD methods may be manually revised. In these cases, it is essential that corresponding changes be made to the drawings file and that this file be kept current.

Line Thickness and Pen Sizes. The American Standards Association recommends three line widths for finished drawings: thin for section, center, extension, and dimension lines; medium for hidden lines; and thick for visible outlines, cutting-plane, and short break lines. The finished CADD drawings should follow this convention.

The following available pen sizes are recommended for making thin, medium, and thick lines:

Line Thickness	Equivalent Pen Sizes		
	Metric	English	Leroy
Thin (0.3 ± 0.1 mm.)	.25 mm.*	.010 in.	3x0
	.30 mm.	.012 in.	00
	.35 mm.*	.014 in.	0
Medium (0.5 ± 0.1 mm.)	.50 mm.*	.020 in.	1
	.60 mm.	.024 in.	2
Thick (0.7 ± 0.1 mm.)	.70 mm.*	.028 in.	2-1/2

* Commercially available disposable pen sizes.

Variation from these pen sizes may be used on occasion to emphasize a feature or add special effects to a drawing.

Tips on the selection of pens:

1. The desired line width may be obtained by selecting the appropriate pen size or by using multiple adjacent passes with a finer pen.

2. Generally, using the thickest pen size for a particular line width is desirable to minimize pen tip wear and decrease plotting time.

Levels. The processes used with CADD for developing working drawings often involve the use of levels or layers and are analogous to the transparent overlays used in conventional drafting. They enable the drafter to keep various features of the drawing separated to facilitate later use. Building a drawing in levels will allow the drafter easily to use or modify portions of the drawings within other drawings or as a base for views on other drawings. Individual levels or a composite of selected levels can be transferred to a new file in preparation of new drawings. Grouping similar information on the same level makes future revisions easier and facilitates reviews and/or checking.

It is recommended that the following level assignments, as applicable, be used to provide SCS-wide consistency. Preassigned levels aid in modifying

drawings. This is especially true if the modification must be done by someone other than the original drafter or some time after the original drawing is made. In the case of some drawings, especially simple ones, or some drawing systems, using multiple levels may not be efficient. For this reason, level 1 is assigned the option of including any or all drawing items. In many cases a combination of level 1 with other selected levels is recommended for drawings subject to repeated use.

Level 1 - Border and title block, and may include remaining drawing items.
Level 2 - Topography.
Level 3 - Survey control data.
Level 4 - Cultural features.
Level 5 - Geologic features.
Level 6 - Drawing notes.
Level 10 - Structural lines.
Level 11 - Structural dimensions.
Level 12 - Reinforcing steel with marking and spacing.
Level 13 - Grid.
Level 90 - Drawing record.
Level 91 - Miscellaneous records.
Level 100 - As-built drawing.

In some cases, it may be desirable to use additional levels to provide a more detailed separation of items or for items not included in the above list. Examples of these items are land ownership, soils, hydrologic characteristics (RCN), utilities, additional local use, existing contours, finished contours, point data, and fixed improvements. Levels 14 through 89 are available for these additional items, as are those levels above 91 for software having a greater number of levels available. For larger jobs, where consecutive levels are desired, the upper levels may be used in place of the designated levels. However, these deviations should be noted on the drawing record.

Tips on the use of levels:

1. Displaying only levels that are currently being worked on will reduce the use of display memory and increase the speed of computer operations.

2. Level 91 should be used consistently to contain significant notes and comments by the survey note keeper, designer, checker, or drafter. This may help to eliminate the need to keep paper check prints with notes on them.

3. Where color is available, levels can be color-coordinated for easy identification and modification of drawing objects.

Text. All text that may be photographically reduced in size should have 0.06 inch minimum height after reduction. Titles should be all capitals, with 0.09 inch minimum height after reduction. Titles include those for title blocks, plan and elevation views, sections, and details. Line widths for titles should be thick. Slant or vertical lettering used should be consistent throughout the drawing.

Tips on choosing size and style of lettering:

1. To improve the appearance of plans, make an effort to use the same size and style of lettering in all drawings in a set.

2. If letter sizes and style chosen are compatible with Leroy Lettering Guide sizes and styles, minor corrections on the finished drawings may be made easily by hand to avoid the need to replot the entire drawing.

3. A prepared chart or a macro is helpful for providing the required size text of 0.06 and 0.09 inch minimum on the sheets that have been reduced.

Symbols. A symbol is a group of drawing entities (lines, arcs, notes, etc.) combined to make a unique part of a drawing and saved for efficient repetitive use in more than one drawing. Symbols are saved in a separate file as part of a symbol library. Symbols can easily be placed anywhere in a drawing with the option of scale and rotation modification parameters. Symbols created should conform to existing standards, such as Soil Conservation Service National Map Symbol Handbook, Title 170, Part 601; the latest edition of Engineering Drawing and Graphic Technology, by French and Veirck; and the American Welding Society, where applicable. Frequently-used standard details and the SCS logo are types of drawing items that may be repeatedly used with ease as a symbol.

Symbols should be created at the 1:1 inch scale (1 inch equals 1 inch) for consistency and to facilitate recalling for placement on the drawings.

Macros. A macro is a stored sequence of keystrokes or commands that can be automatically executed to perform a computer operation (a mini-algorithm). Once created, a macro can be used within any drawing to repeat the operation. The benefits of using macros include saving time by using fewer keystrokes, providing consistency between drawings, and increasing productivity. Macros combine common programming functions with graphic functions.

A macro can be created in a variety of ways and still produce the same results. In order to promote consistency, a form has been prepared for use in documenting the macro. A blank macro record form is provided in appendix B (figures 1 and 2). Copies are to be made either electronically or on paper, as needed for each macro developed. A completed example record is provided in appendix B for guidance in preparing the form. (See figures 3, 4, and 5.) Completing this record form makes it easier to understand the potential application of an existing macro to a particular job.

The format for documentation also allows the creation of a data base, retrievable through the use of keywords and titles, to keep track of and share macros that are developed. A copy of the completed macro form should be sent to the Design Unit, NHQ. In addition, the macro title and abstract will be entered into the bulletin board established and operated by the Design Unit to provide an informational exchange point for CADD operators. The Design Unit will provide macro file names, access, and other needed instructions. Suggested keywords, upon which the data base will be established and which will be included in the record form, are given in appendix C. This list of

keywords may be expanded by the user to include other familiar terms. Each CADD operator may add to the macro file data base and select from it macros which will enhance his or her operation. Each CADD operator should, in turn, contact the respective macro developer to make the necessary arrangements to obtain copies of the macro. If operations and file space permit, the macro file may be loaded on the bulletin board for both uploading and downloading the macro algorithm.

Tips on the use of macros:

1. Macros can be used to develop tablet overlays, providing a very convenient way of executing drawing functions from a digitizing tablet.

2. Menus used by CADD software can also be customized to suit individual needs through the use of macros.

3. Macros can be written using prompts for input that establish accepted ranges for the input values and provide error messages if the values fall out of that range.

4. One powerful application of macros is the development of standard drawings with variable dimensions. These dimensions can be entered through a macro that then modifies the standard to the specified dimensions.

5. Macros can be written with any common text editor and incorporated into the CADD software for execution.

6. Subroutines within the macro should be indented equally at the beginning and the exit of the subroutine in order to separate them from other sections of the macro.

7. If any operation in the macro assumes a default value in performing a calculation, a "Print" statement should be added illustrating the existence and value of that default to the macro user.

8. If the macro prompts the user for an alphabetical character, such as (Y) for yes or (N) for no, the program should be written to accept both lower and upper case letters; i.e., (Y) or (y), (N) or (n).

9. "Error messages" or "beeps" should be used frequently to indicate invalid input by the macro user.

Sheet Sizes and Title Blocks. The limitations of some plotters require the use of sheet sizes other than E. Computer-generated drawings may be prepared on industry standard D (22"x34") or B (11"x17") size sheets. Border locations for these sheet sizes should be as given in ES-16, sheet 3 of 4, in appendix D and NEH Section 6. If industry architectural standard D (24"x36") size sheets are used, the border dimensions shall be 21" x 32" as given in ES-16, sheet 3 of 4. Dimensions of the type G title block for use with the D size drawing are given on ES-16, sheet 4 of 4, in appendix D and NEH Section 6. The Design Unit, National Headquarters office, has electronic CADD file copies of the D

size plan sheet with border and type G title block for distribution. Each office is responsible for supplying mylar and paper stock for the preparation of computer-generated drawings in accordance with the above requirements.

All drawings of a set should be prepared on the same size sheets. E size drawings collated with D size sheets are to be reproduced on D size sheets with the excess margin to the top and left and the title block in the lower right corner.

Standard Detail Drawing Identification. Digitized National Standard Detail Drawings (NSDD) can be stored on computer storage media. They should be identified by filenames based on the existing engineering standard (ES) drawing numbers, as outlined in Design Note 18, Group A - Schedules of National Standard Detail Drawings. If the ES number exceeds eight characters, the maximum filename size most computers allow, parts of the ES number should be used as a subdirectory name. The following table provides the recommended subdirectory names and filenames for the existing NSDD.

Standard Detail Drawing	Engineering Standard No.	Standard Detail Drawing No.	Sub-directory Name	Filename
Type B Drop Spillways	ES-94	ES-2FFK-LLB	None	BFFK-LLS
Standard Covered Risers	ES-169	ES-30DD-$[NN]_{ih}[NN]_{is}$ $^{E}_{R}$	CR3000	$^{E}_{R}$ SDD$[NN]_{ih}[NN]_{is}$
Standard Open Risers	ES-180	ES-31DD-$[NN]_{ih}[NN]_{is}$ $^{E}_{R}$	OR3100	$^{E}_{R}$ SDD$[NN]_{ih}[NN]_{is}$
Standard Baffle Risers	ES-231	ES-32DD-$[NN]_{ih}[NN]_{is}$ $^{E}_{R}$	BR3200	$^{E}_{R}$ SDD$[NN]_{is}[NN]_{is}$
Standard Impact Basins	ES-186	ES-4WWW	None	ES-4WWWS
Standard Conduit Details	ES-195	ES-6 $^{1}_{2}$ DD- $^{C}_{B}$ $^{E}_{R}$	None	ES-6 $^{1}_{2}$ - $^{C}_{B}$ $^{E}_{R}$

K = code number from 1 to 8 for total depth of weir h. See ES-94.
S = sheet number.

Tips for storing and retrieving of original drawings:

1. If possible, all master drawings should be placed in a read only directory to protect the originals from accidental change or erasure.

2. All master drawings should be backed up and protected.

File Transfer. File transfer between different CADD software may be accomplished through the use of available CADD conversion programs.

File transfer between similar software can be done by sending disks or by phone line digital transmission. Phone line digital transmission of large drawings requires considerable time to complete and requires a communication software that supports binary file transfer in an error free mode. File sharing can be accomplished only when versions of the CADD software involved are compatible.

Scanning may be an alternative to digitizing hard copies of drawings for transfer to electronic files. However, scanned files may require considerable cleanup before they are suitable for use. Therefore, determine the cost of obtaining a high-quality final product by the scanning operation, including cleanup, before deciding to proceed.

Drawing Records. A record should be maintained for each drawing containing information on how the drawing was developed. This record will allow others to make use of the drawings more easily, since they will not have to figure out how the drawings were created. It will also aid operators in the office creating the drawing should they have to use it some time after it was done, or if more than one operator works on the file.

A blank record form is provided in appendix B (figure 6). Copies are to be made as needed for each CADD file developed. Copies may be either in electronic form and stored as part of the drawing or on paper. A completed example record is provided for guidance in completing the form (appendix B, figure 7).

As shown in the section on levels, the drawing record should be developed and stored on level 90 of the drawing. It is also recommended that the completed record be filed in a data base to allow searches and sorting of all drawings.

Records for drawings that may have application for other jobs at other locations may be shared through a bulletin board to be established by the Design Unit, National Headquarters. Copies of drawings themselves, including supporting documentation, will be obtained from the originating office.

APPENDIX A

GLOSSARY

GLOSSARY

Algorithm	≡	A series of program instruction lines designed to solve a specific problem.
ASCII	≡	American National Standard Code for Information Interchange. An ASCII file is a text file that uses ASCII codes to represent each character.
Attribute	≡	One of the characteristics that is assigned to every item. Examples of attributes are: pen number, level, dash type, etc.
Binary	≡	A number system that uses 2 as its base and thus contains only the digits 0 and 1.
CADD	≡	See computer-aided design and drafting.
Command file	≡	Text/data file containing a series of program instructions that have been collected for use by the operating system to perform a particular operation.
Computer-Aided Design and Drafting	≡	A method of using computer-generated graphics technology to support engineers, architects, and other design professionals and technicians in the generation of engineering and construction drawings, design computations, and other design documents.
Cultural feature	≡	Manmade.
Data base	≡	Information organized and stored in the computer, generally through use of a data base software.
Digitizing tablet	≡	An electronic graphics tablet used as an input device. The on-screen cursor movement is controlled by manipulating a stylus about the surface of the tablet.
Directory	≡	The name (grouping) of a collection of files stored on a floppy disk or a hard disk.
Disk	≡	A magnetic storage medium that can contain data such as the drafting program, workfile, and drawings. A floppy disk (sometimes called a diskette) is a small portable disk that has a limited amount of storage space, whereas a hard disk (sometimes called a Winchester or fixed disk) is a sealed unit that can store large amounts of data.
Disk drive	≡	A mechanism that receives one disk to record and read electronic data.

Disk file	=	A named collection of data stored on a disk. The system uses disk files to store text and graphical information.
Display monitor	=	The television-like screen on which graphics and/or text is displayed, in color or monochrome.
Downloading	=	Transfer of electronic data file from a remote system to a local system.
Drawing file	=	A drawing stored in electronic form on a disk under a unique name.
File	=	A separate, distinct collection of data (such as a drawing) stored under a single assigned name for access.
Filename	=	A specific, unique name given to a file in order to identify it.
Floppy disk	=	See disk.
Graphics tablet	=	See digitizing tablet.
Grids	=	Dotted lines along the X and Y axes that aid precise drawing. The spacing of the grid lines and the number of dots between lines may be independently adjusted.
Interactive	=	Two-way immediate communication between computer and data entry.
Keyword	=	The entry in the first field of all system commands. The keyword tells the system the kind of activity to be carried out.
Layers	=	See levels.
Levels	=	One of an item's attributes. The items assigned to a particular level are analogous to an overlay in a manual drawing.
Library	=	A collection of symbols stored in a grid pattern on a disk by an assigned name. Each symbol in the library can be recalled to the display screen by placing the digitizing stylus on the appropriate overlay square.
Macro	=	A short sequence of keystroke or commands grouped together directing the computer to perform an operation automatically. Macros are often used in conjunction with a particular drawing or file operation. A series of macros can be collected into a command file.

Menu	≡	A list of choices displayed on the monitor for interactive data entry.
Output	≡	The information transfer from the computer to some external device, such as a plotter or disk drive.
Overlay	≡	A plotted drawing placed on a graphics tablet from which macros, library symbols and menu commands can be visually selected.
Parameter	≡	A variable that determines the characteristics of a system. For example, the properties of objects, such as color, line style, etc., are parameters.
Plotter	≡	A device that reproduces on paper or other medium an inked image of the drawing on the display screen, using an electronically-controlled pen or pens.
Program	≡	A set of instructions that tells the computer how to accomplish a given task. They usually are stored on a magnetic disk. Collectively, programs are called software.
Scale	≡	To size an object, group of objects, or drawing. Scaling can be done by X-Y distance, a multiplying factor, or by the size of a window drawn on the screen.
Scanner	≡	A device that reads data from a hard copy and automatically transmits the information into the computer.
Software	≡	See program.
Stylus	≡	The object used with a digitizer to control cursor movement across the display screen.
Subdirectory	≡	A directory within a directory.
Symbol	≡	A collection of combined items, such as lines, circles, and text, that make up a complex figure saved in a special disk file called a symbol library.
Uploading	≡	Transfer of electronic data file from a local system to a remote system.
Workfile	≡	A temporary storage area, kept on a disk or in the computer memory, which keeps a running record of the work as it proceeds. Drawings are saved from the workfile to a drawing file and retrieved from the drawing file to the workfile.

Workgroup	≡	See workset.
Workset	≡	A collection of combined items, such as lines, circles, and text that are grouped and named for the purpose of moving, copying, or editing within a drawing.

APPENDIX B

FIGURES

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Figure 1
Sheet _ of _

CADD MACRO RECORD

Title:	Keywords:
Programmer:	
State:	
Date:	
Phone No.: FTS	Criteria:
COMM	
Software/Vers.:	

Abstract

Required Input Data

Instructions for Use

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
23.
24.

Figure 2
Sheet _ of _

Line No.	Macro Program Lines	Comments

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Figure 3
Sheet 1 of 3

CADD MACRO RECORD

Title: SECTION.LSP Programmer: J. Light State: WNTC Date: 1/13/88 Phone No.: FTS 423 - 2854 COMM (503) 221 - 2854 Software/ Vers.: AutoCAD Release 9	Keywords: concrete, channel, chute, cross section, rectangular Criteria: TR-50

Abstract

Draws cross section of concrete channel given input of height, width, floor and wall thickness, and footing width.

Required Input Data

Height, Width, Floor Thickness, Wall Thickness, and Footing Width.

Instructions for Use

1. @ command line, type (load "section")
2. @ command line, type section
3. Select center line invert with coordinates or with cursor
4. Enter height. ft.
5. Enter wall thickness. in.
6. Enter floor thickness. in.
7. Enter width of channel. ft.
8. Enter footing width. ft.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
23.
24.

Figure 4
Sheet 2 of 3

Line No.	Macro Program Lines	Comments
1.		Convert angle in degrees
2.	(defun dtr (a)	to radians
3.	(*pi (/ a 180.0)	
4.	(	
5.	;	
6.		Acquire information for
7.	(defun csu ()	concrete cross section
8.	(setq sp (get point "/nStart point of section: (center line on invert elev) "))	input variables
9.	(setq ht (getdist "/nHeight of wall above floor: "))	
10.	(setq wt (getdist "/nWall thickness "))	
11.	(setq ft (getdist "/nFloor thickness: "))	
12.	(setq wd (getdist "/nWidth of Channel: "))	
13.	(setq fw (getdist "/nWidth of Footing "))	
14.		
15.	(setq hw (*0.5 wd))	
16.	)	
17.	;	
18.		Drawing routine
19.	(defun drawout ()	
20.	(command "pline"	
21.	(setq p (polar sp (dtr 0) hw))	
22.	(setq p (polar p (dtr 90) ht))	
23.	(setq p (polar p (dtr 0) wt))	
24.	(setq p (polar p (dtr 270) ht))	
25.	(setq p (polar p (dtr 0) fw))	
26.	(setq p (polar p (dtr 270) ft))	
27.	(setq p (polar p (dtr 180) fw))	
28.	(setq p (polar p (dtr 180) wt))	
29.	(setq p (polar p (dtr 180) wd))	
30.	(setq p (polar p (dtr 180) wt))	
31.	(setq p (polar p (dtr 180) fw))	
32.	(setq p (polar p (dtr 90) ft))	
33.	(setq p (polar p (dtr 0) fw))	
34.	(setq p (polar p (dtr 90) ht)0	
35.	(setq p (polar p (dtr 0) wt))	
36.	(setq p (polar p (dtr 270) ht))	
37.	(setq p (polar p (dtr 0) hw))	
38.	"close"	
39.	"redraw"	
40.	)	
41.	)	
42.		
43.	;	Execute command, calling

Figure 5
Sheet 3 of 3

Line No.	Macro Program Lines	Comments
44.		constituent functions
45.	(defun c:SECTION ()	
46.	(csu)	
47.	(drawout)	
48.	)	

FIGURE 6

ENGINEERING DRAWING CADD RECORD SHEET

Software

____

Drawing Filename

____

User No.

____

Sheet Size

____

Text height

____

Drafters name

____

Phone No. FTS

____

Phone No. Commercial

____

Basic drawing unit

English ☐

Metric ☐

Drawing scale

____

Drawing description

____

Drawing revisions

Drafter	Date

Worksets/Workblocks assigned

____

Title of Macro Used

____

PEN POINT AND LEVEL ASSIGNMENT

Pen/ Color	Pen size	Line style	Line width	Level	Description

Sheet of

FIGURE 7

ENGINEERING DRAWING CADD RECORD SHEET

Software	Drafters name	Drawing revisions
Plot 10 tektroid	Jack Land	Drafter Date
Drawing Filename	Phone No. FTS	Jack Land 6/27/88
Fig7	8 423 2357	
User No.	Phone No. Commercial	
User0	1 803 221 2357	Worksets/Workblocks assigned
Sheet Size	Basic drawing unit	None
8.5 x 11	English ■	
Text height	Metric □	
.1 For notes	Drawing scale	
.175 For subtitles	1"=1"	
.2 For main titles	Drawing description	Title of Macro Used
	CADD record sheet used as an example for the national TR	None

PEN POINT AND LEVEL ASSIGNMENT

Pen/ Color	Pen size	Line style	Line width	Level	Description
1	.35mm	1-S	.35mm	1	Lines & Notes
3	.7	N/A	N/A	1	Main title & Subtitle

APPENDIX C

KEYWORDS

KEYWORDS

Construction Features

- channel
- dike
- diversion
- embankment
- grouting
- irrigation canal
- irrigation line
- spillway
  - emergency spillway
  - principal spillway
- waterway

Details and Appurtenances

- anchor
- animal guard
- castings
- caulking
- cradle
  - bedding
  - pipe support blocks
  - plain concrete
  - reinforced cradle
- cribbing
  - concrete
  - steel
  - wood
- dowel bars
- drain
  - bedding
  - blanket
  - diaphragm
  - filter
  - pipe
  - trench
- drain tile
- gabion
- gate (fence)
- gate (water)
  - flap
  - radial
  - slide headgate
  - sluice

geotextile
grate
guard rail
hoist
joint
    articulation joint
    chute floor joint
    expansion and contraction joint
    joint extensibility
junction box
ladder
manhole
mulch
piezometer
piling
    concrete
    sheet
    wooden
pipe
    clay
    copper
    corrugated aluminum
    corrugated steel
    drain tile
    plastic
    reinforced concrete
    tubing
    welded steel
pipe joint
    bell-and-spigot
    rubber gasket joint
    tongue-and-groove
plaque
reinforcing steel
relief well
riprap
rock treatment
sealant
sheet pile
splice
three-edge bearing strength
thrust block
trashrack
trench
valve
waterstop
weir
welding
well
well point
well screen

Drawing Features
- bill of materials
- border
- curve data
- index
- legend
- match lines
- north arrow
- notes
- revision record
- scale
- schedule
- steel schedule
- symbols
  - concrete and wood
  - cultural features
  - sand and gravel
  - soil and rock
- table of contents
- title block

Drawing Type
- cross section
- details
- geology
- land rights
- pay limits
- plan
- profile
- rock boring
- soil boring
- structure layout
- topography

Drawing View Titles
- front elevation
- half plan
- half section
- isometric
- perspective
- plan view
- profile view
- section on centerline
- side elevation
- typical cross section

Spillway Type and Feature (whole sheets & structure component sheets)

COMPLETE STRUCTURE --
- channel side inlet
- chute
  - baffle chute
  - box inlet chute

- rock chute
- straight inlet chute
- drop inlet conduit spillway
- drop spillway
  - folded weir inlet drop spillway
  - rectangular box inlet drop spillway
  - straight drop spillway
  - trapezoidal box inlet drop spillway
- road crossing

COMPONENTS OF STRUCTURES --

- basin
  - impact basin
  - rock-lined plunge basin
  - SAF outlet
  - stilling basin
- chute channel section
- conduit
  - monolithic box conduit
  - pipe conduit
    - corrugated pipe conduit
    - reinforced concrete pipe conduit
  - slotted flume
- inlet
  - baffled top inlet
  - drop inlet
  - flared inlet
  - hood inlet
  - labyrinth weir
  - standard covered top inlet
  - straight inlet
- outlet
  - cantilever outlet
  - flip bucket
  - plain apron
  - PWD

Structures Other Than Spillways

- bridge
- bulkhead
- culvert
- fence
- floodwall
- flume
- groin
- headwall
- irrigation
  - canal headgate
  - diversion dam
  - settling basin (sediment)
  - siphon (inverted siphon)

- turnout structure
- wasteway

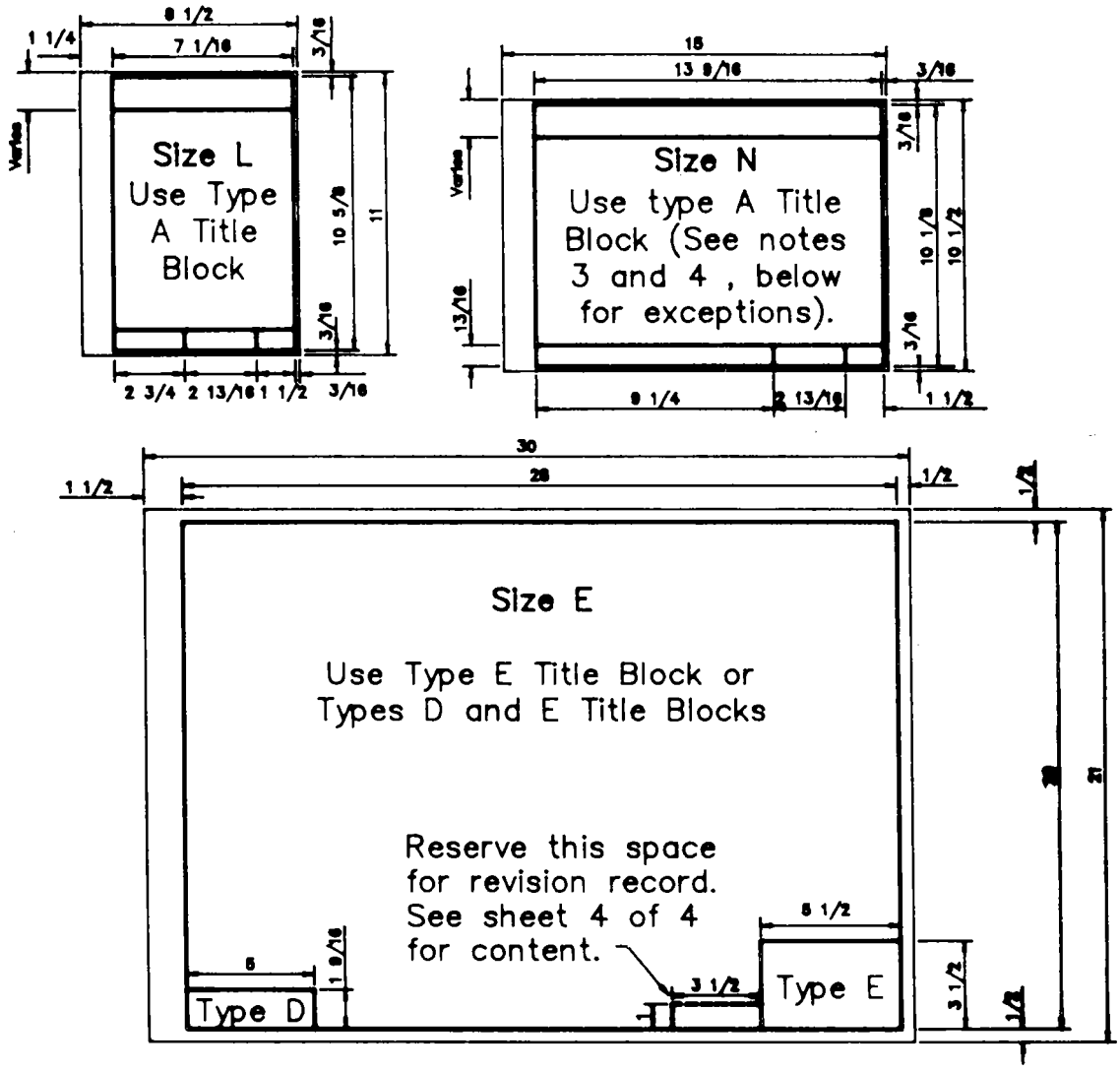
jetty
manure tank
mine
- mine shaft

pump
recreation facilities
retaining wall
road
rock chute
stream ford
terrace
waterway

APPENDIX D

ES DRAWING SIZES AND TITLE BLOCKS

STRUCTURAL DESIGN: STANDARD DRAWING SIZES AND TITLE BLOCKS



Notes:

1. All drawings shall be one of the sizes on this sheet or sheet 3 of 4 , and shall have border and trim lines as shown.
2. Standard size typewritten material placed on size B, size L and N drawings shall not have a linear reduction greater than 1 to 0.75 in the final form.
3. Size L and size N drawings prepared for inclusion in National Engineering Technical Material shall use the Type A Title Block except where a size E drawing is reduced to a size N. A Type A Title Block consists of two parts, one at the top of the sheet and the other at the bottom.
4. Size N drawings prepared for a purpose other than inclusion in National Engineering Technical Material may use the type F Title Block.
5. All size D and size E drawings shall be prepared to accept a linear reduction of 1 to 0.5.
6. Type E Title Blocks shall be used on all size E drawings. Type C Title Blocks shall be used on all size D drawings.
7. Type D and E Title Blocks shall be used on all National Standard Detail Drawings that are to be incorporated into a set of construction plans. Type D shall be placed in the lower left-hand corner and Type E in the lower right-hand corner. The Type D Title Block shall be completed by the office preparing the original standard drawing and the Type E by the office using the standard.
8. As shown on this sheet, all size E drawings shall be prepared with a 3 1/2 X 1 inch vacant space (without border lines) for recording drawing revisions.

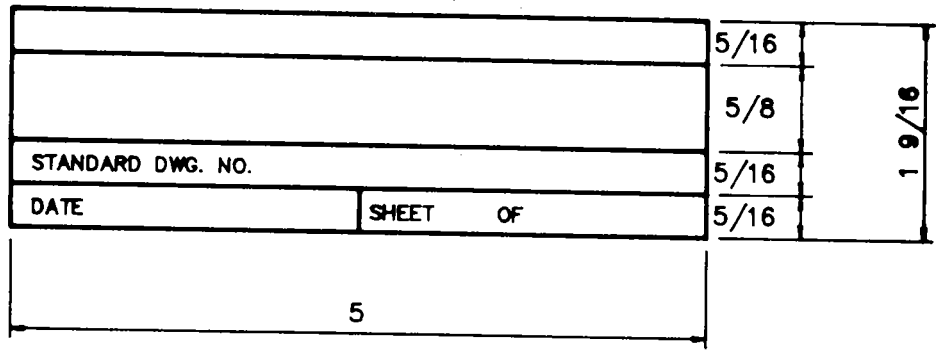
	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION – DESIGN UNIT	ES-16 SHEET 1 OF 4 DATE July 1, 1986

STRUCTURAL DESIGN: STANDARD DRAWING SIZES AND TITLE BLOCKS

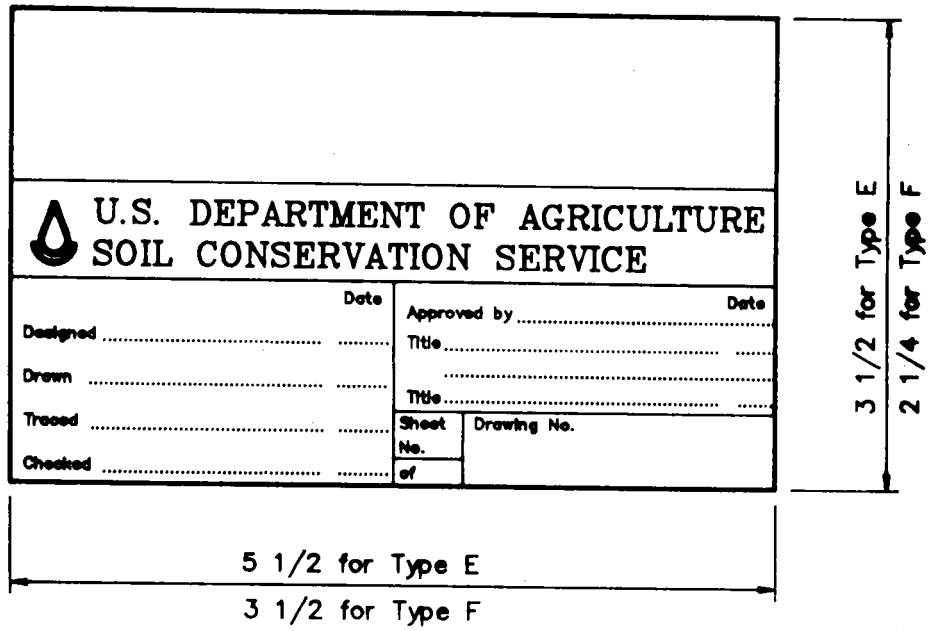
Type A

The title block used at the top and bottom of this sheet is **Type A.**

For a Type A Title Block, enter name of office preparing the drawing in center block at bottom of page.



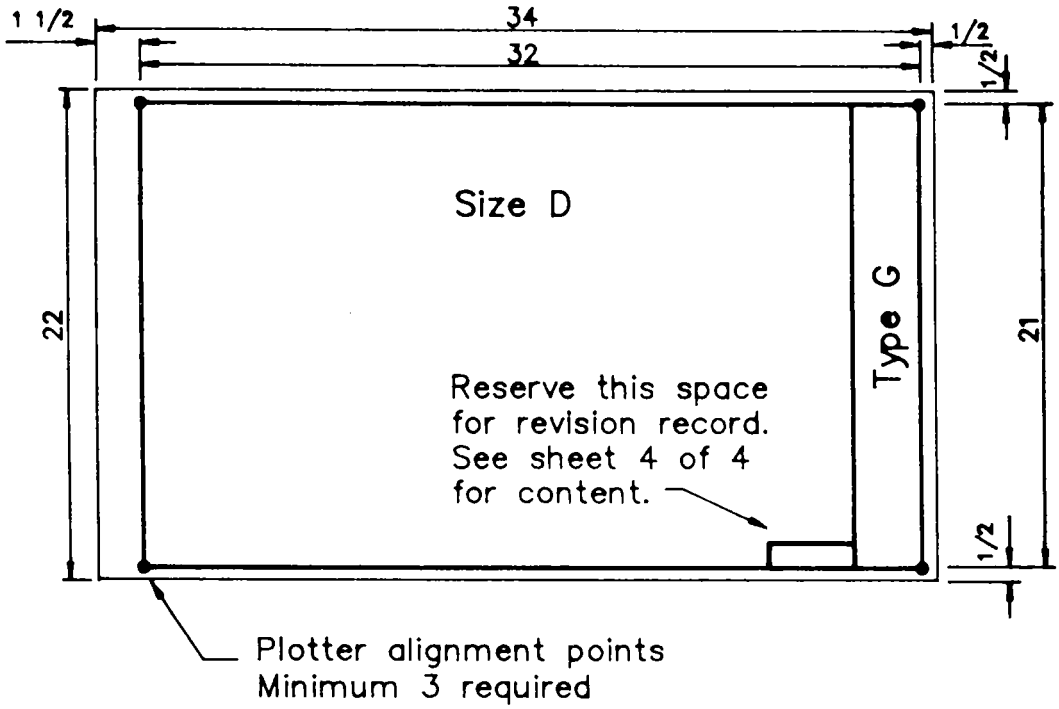
Type D

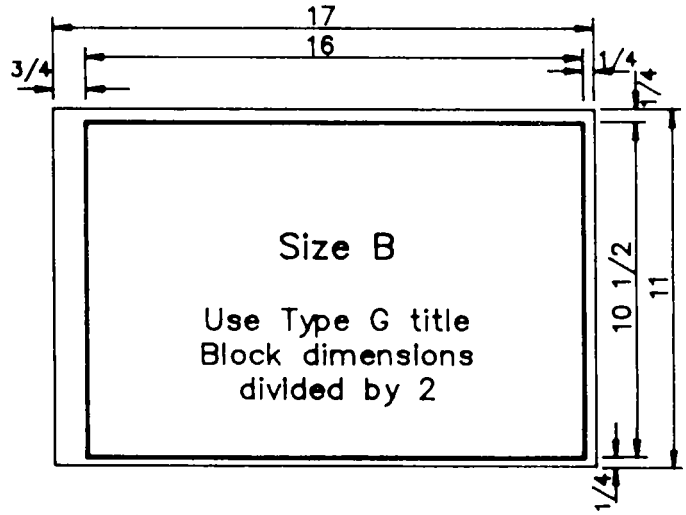


Type E and Type F

REFERENCE	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION – DESIGN UNIT	DRAWING REVISION ES-16 SHEET 2 of 4 DATE July 1, 1988

STRUCTURAL DESIGN: STANDARD DRAWING SIZES AND TITLE BLOCKS





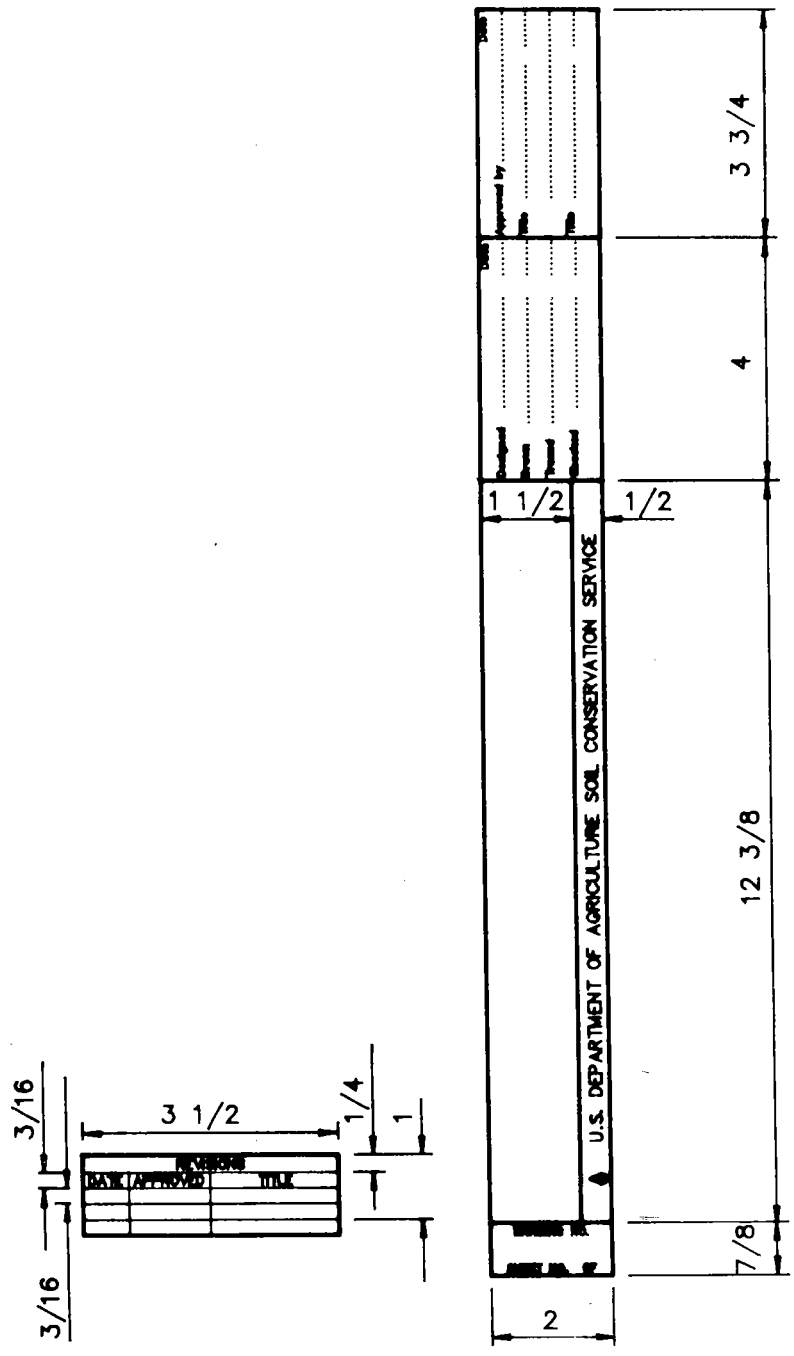
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION – DESIGN UNIT

ES-16

SHEET 3 OF 4

DATE July 1, 1988

STRUCTURAL DESIGN: STANDARD DRAWING SIZES AND TITLE BLOCKS



Revision Record

Type G

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION – DESIGN UNIT

STANDARD DWG. NO.
ES-16
SHEET 4 OF 4
DATE July 1, 1989

APPENDIX E

REFERENCES

REFERENCES

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2. PLOT 10-2D Drafting User's Manual, Tektronix Inc.

3. Microsoft GW-BASIC Programmer's Guide, 1986, Agora Resources, Inc., Lexington, MA

4. Soil Conservation Service CAD/DROPSPILL SYSTEM User's Guide, Design Unit, National Headquarters, WDC, 1985

5. VersaCAD Advanced Version 5.0, April 1986, T & W Systems, Inc., Huntington Beach, CA

6. Ven-Tel 212 Plus Operator's Manual, Ven-Tel, Inc., 1985

7. The AutoCAD Drafting Package User's Guide, Publication 106-008, Autodesk, Inc., April 9, 1985