

PART 541 - DRAFTING

SUBPART A - DRAWINGS

541.00 General.

(a) Engineering designs are documented and presented to the owner and contractor in several forms. One of the forms used is the construction drawing. The drawing provides details on location, shape, and size that are more readily documented through this format than by other means.

(b) Drawings express to the landowner, contractor, and general public the quality of engineering services being provided by NRCS. Therefore, to provide the best image possible, drawings are to be clear, legible, accurate, and complete. They are also to display quality in organization and format.

(c) Engineering drawings in NRCS shall be uniform in format to facilitate exchange of a drawing's basic content. The basic content consists of the sheet size, margins, scale, line thickness, and symbols. Detail recommendations for computer-aided drawings are contained in Technical Release No. 73.

(d) The arrangement of views, tables, details, and notes on drawings is to be in accordance with standard NRCS drafting conventions; the most frequent consist of orthographic projections for structural elements and, for earthwork, views of the plan, profile, and cross section. Geologic mapping conventions are to be used for geological work. Symbols and abbreviations used are to be identified.

(e) Sufficient views, dimensions, and symbols for the various kinds of construction materials are to be included to fully describe the work. Terminology in descriptions is to be consistent with that contained in the specifications; therefore, the draftsman as well as the engineer is to be very familiar with the specifications.

(f) Standard details are to be used to the maximum extent possible to provide efficiency, but not to the extent of resulting in a poor quality drawing. To insure uniformity, modifications made to any drawing are to be uniform with the original line thickness, line styles, text fonts, text sizes, scale, etc.

(g) Standards of drafting within the industry are to be used to the maximum extent possible. Some of the available reference standards are:

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(1) The American Concrete Institute (ACI) Detailing Manual. This consists of three parts (1) ACI Standard: Details and Detailing of Concrete Reinforcement (ACI 315), (2) ACI Standard: Manual of Engineering and Placing Drawings for Reinforced Concrete Structures (ACI 315R), and (3) supporting reference data.

(2) The American Institute of Steel Construction (AISC) Manual of Steel Construction. This includes steel member shape designations, dimensions, and properties. Included is a brief discussion on the content of drawings and the responsibility of its owner. Standard welding symbols are displayed.

(3) The American National Standards for drafting practices (ANSI Y14.1 through Y14.5) published by the American Society of Mechanical Engineers.

541.01 Media and technique.

(a) Drawings are to be prepared on the media appropriate to the purpose. For smaller jobs requiring the use of only a couple of sheets, use of the drawings is limited to the owner and contractor, and the time for completion of the planned work is within the year, paper is the most appropriate. For larger projects the use of paper may also be appropriate. However, for standard details and for standard detail drawings that require repetitive use of the drawings to make copies and that will be retained for use over a period of several years, a medium more durable than paper such as vellum or polyester film should be used. Polyester film is the most stable against shrinking and stretching with changes in humidity and should be used when distortions in the drawings are unacceptable.

(b) All lines and letters must be clear, sharp, and dense to ensure clear copies of both contact prints and one-half scale reductions. Letters are to be single stroke types. Lettering may be written freehand, by use of lettering guides, typed, or by computer-driven printers or plotters.

541.02 Sheet size.

Drawings are to be prepared on sheet sizes appropriate to provide for a neat and uncluttered appearance. For small jobs involving a limited land area, number of features, and number of details a small sheet size is adequate. Paper forms are provided and stocked by NRCS with a preprinted border, title

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block, and background guidelines (i.e., profile and cross section) in a size of 10-1/2 inches by 15 inches. For larger projects involving extensive land area and a large number of features and details, sheet sizes in the range of 21 inches by 30 inches to 24 inches by 36 inches should be used. Paper forms are provided and stocked by NRCS with a preprinted border, title block, and background guidelines (i.e., grid, profile, and cross section) in a size of 21 inches by 30 inches. The standard NRCS sheet sizes and their respective designations B, D, E, L, and N are shown in 541.20. Sheet sizes B and D are not stocked by NRCS as a standard form.

541.03 Title blocks.

Each sheet in a set of construction drawings is to have a title block to identify the originator and contents of the drawing. The format and arrangement of a title block on a drawing will vary according to the origin of the design. The title block is to be for that agency or organization preparing the design and, in turn, drafting the drawing. The NRCS title blocks shown in 541.21 are to be used on the drawings drafted by NRCS, based on an NRCS design. The title block normally used by a consulting firm or sponsoring agency should be placed on a drawing prepared by that firm or organization when they also have done the design. The number and arrangement of supplementary approval blocks will vary according to the local and state requirements.

541.04 Cover sheet.

Each set of construction drawings consisting of more than five sheets is to have a cover sheet showing the name and location of the project; the names of the sponsoring agencies, or owners; an index of the drawings; space for approval signatures; and, if appropriate, the seal of the engineer. If space permits, it may also include the location map and such general notes and design data as may apply to the drawings.

541.05 Geographical reference.

Construction drawings for all dams that are significant for reasons of public safety (see 520.21) and major engineering works are to contain structure reference lines and right-of-way limits referenced to fixed and readily identifiable geographical points. Smaller jobs are to include at least a simple location map containing readily identifiable landmarks.

541.06 Orientation of views.

The views required on the drawings are to be oriented in the following manner:

(a) Maps should be drawn with the north toward the top of the sheet. If this orientation is not feasible, the map should be drawn with north toward the left. A north arrow is to be provided.

(b) Layout drawings of reservoirs and spillways are to be drawn so that the direction of streamflow is from left to right or bottom to top of the sheet. Arrows should indicate the direction of flow and the north direction.

(c) Elevations, sections, and plan views for earth dams, reservoirs, and spillways are to be drawn as follows:

(1) Sections representing surfaces essentially parallel to the direction of the streamflow are to be drawn so that the upstream end of the sections are on the left-hand side, so that flow is from left to right.

(2) Plan views are to be drawn so that flow is toward the right side or top of the sheet.

(3) Elevations and sections representing surfaces essentially normal to streamflow are to be drawn so that they are viewed from upstream (observer looking downstream). If the purpose of the section would be violated by such an orientation, it may be changed if the true aspect of the section is indicated on the drawings by section identification or if the position of the viewer is stated in the title of the view (for example, "Looking Upstream").

(d) Except for drainage structures, structure reference lines parallel to the direction of streamflow are to be stationed so that the station numbers increase in a downstream direction. Reference lines for drainage structures may be stationed so that the station numbers increase in an upstream direction if the drainage channel is similarly stationed. Structure reference lines normal to the direction of streamflow are to be stationed from left to right as viewed in the direction of increasing stations.

(e) Flood and irrigation channels are to be stationed so the station numbers increase in the downstream direction. If drainage channels form a part of the multiple-purpose complex of channels, they are to be stationed in the same way as flood

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and irrigation channels; otherwise, they may be stationed in an upstream direction. For all channels, profiles are to be drawn so that the stations increase from left to right and cross sections are to be drawn as though viewed in the direction of increasing stations.

541.07 Detailing.

Detailing of structural drawings is to conform to ACI 315 and the AISC Manual of Steel Construction. Structural details for concrete structures may be shown on the layout drawings if the structure has a simple system of reinforcing and the structural details and layout dimensions of the structure and appurtenances can be shown on the same drawings without confusion. The drawings will be so prepared that all dimensions and sizes of materials and appurtenances may be determined without reference to the specifications. Construction drawings are to include structural details as described in ACI 315 Part B.

541.08 Scale.

Scales of drawings must be carefully selected to insure clarity of details. The manner of reproducing copies must be fully considered in setting the scales to be used. The minimum scale of structural layout sheets will be 1/4 inch equals 1 foot. Except for simple reinforcing systems, the minimum scale for structural detail will be 3/8 inch equals 1 foot. If possible, drawings that may be copied at reduced size should have graphic scales and be drawn to a minimum scale of 1/2 inch equals one foot. When drawings lacking graphic scales must be copied at reduced size, each reduced sheet must bear a prominent warning note that the drawing is of reduced size and the indicated scales are not accurate. Care must be taken to insure that such notes are not copied on contact prints of the original drawing.

541.09 Notes.

Notes on the drawings are to be limited to those required for complete and accurate interpretation of the drawings and those required to supplement and the contract specifications. Except for standard notes (such as General Notes, Structural Notes, and Design Data) that generally apply to all drawings within a set, each note is to be placed on the sheet to which it directly applies.

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SUBPART B - EXHIBITS

541.20 Standard size sheets

(a) Standard size for NRCS stocked preprinted drafting media

STRUCTURAL DESIGN: STANDARD DRAWING SIZES AND TITLE BLOCKS

Size L
Use Type A Title Block

Size N
Use Type A Title Block
(See Notes 3 and 4, below, for exceptional)

Size E
Use Type E Title Block or Types D and E Title Blocks

Reserve this space for revision record. See sheet 4 of 4 for content.

Notes:

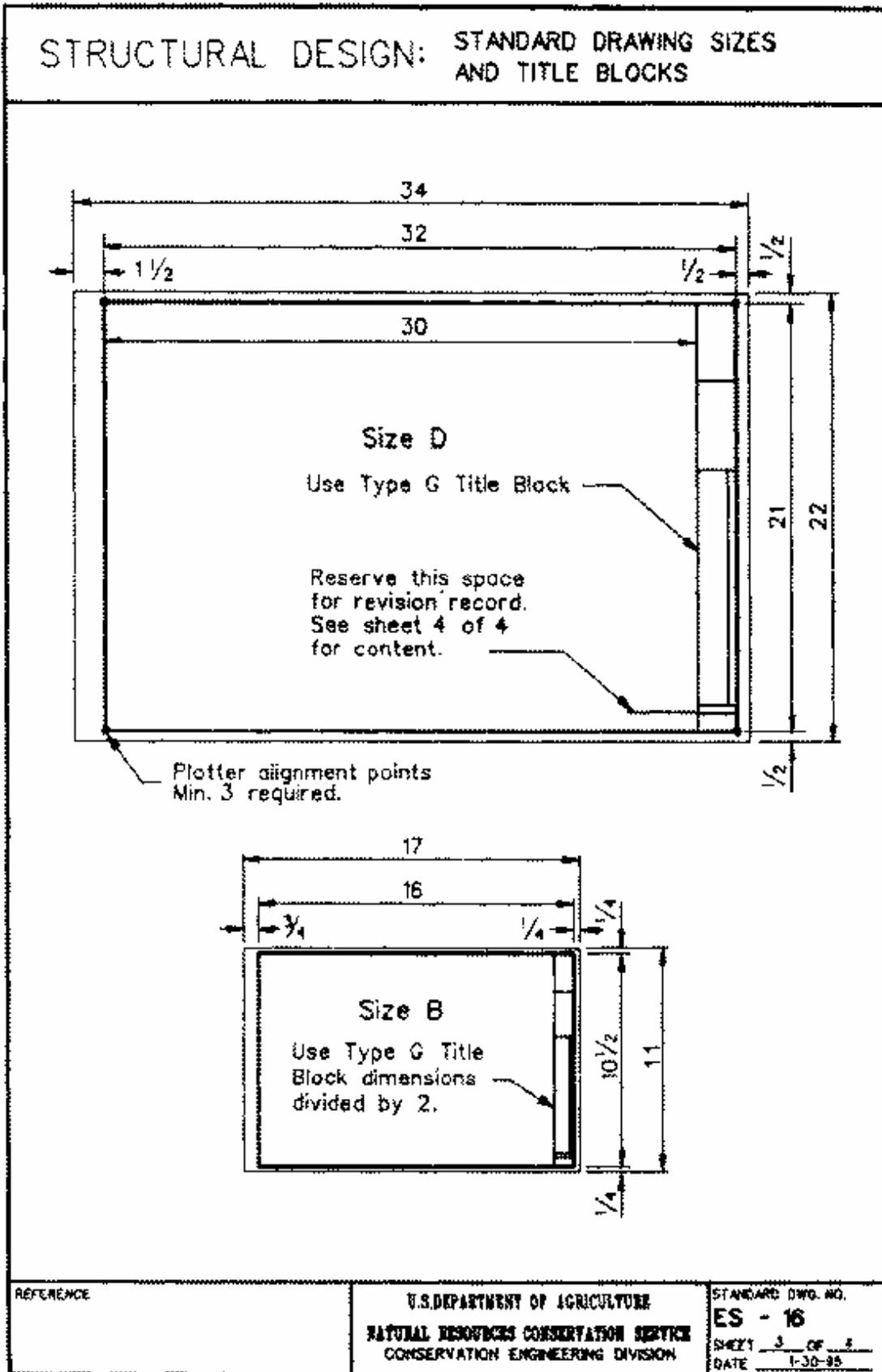
- All drawings shall be one of the sizes on this sheet or sheet 3 of 4, and shall have a border and trim lines as shown.
- Standard size typewritten material placed on size B, size L and N drawings shall not have a linear reduction greater than 1 to 0.75 in the final form.
- Size L and Size N drawings 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.
- Size N drawings prepared for a purpose other than inclusion in National Technical Material may use the type F Title Block.
- All size D and size E drawings shall be prepared to accept a linear reduction of 1 to 0.5.
- Type E Title Blocks shall be used on all size E drawings. Type G Title Blocks shall be used on all size D drawings.
- 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.
- As shown on the 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.

REFERENCE	U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION ENGINEERING DIVISION	STANDARD DWG. NO. ES - 16 SHEET <u>1</u> of <u>4</u> DATE <u>1-30-89</u>
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541.20 (b)

(b) Alternate sheet size for CADD drawings



(210-V-NEM, Amend. 20, January 1995)

SUBPART B - EXHIBITS

541.21 Standard sheet sizes

(a) Title block for NRCS stocked preprinted drafting media

STRUCTURAL DESIGN: STANDARD DRAWING SIZES AND TITLE BLOCKS																													
<p>Type A</p> <p>The title block used at the top and bottom of this sheet is Type A. For Type A Title Block, enter name of office preparing the drawing in center block at bottom of page.</p>																													
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541.21(b)

(b) Title block for alternate sheet sizes for CADD drawings

