

5. Drafting Guidelines

- 5.1. CADD File Requirements
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Bridge plans sheets should be similar in appearance, content, and style. Follow the standards in this chapter for any plan set containing a bridge design.

Submit completed bridge designs to the Bridge Section in AutoCAD format in addition to generating hard copy plan sheets for the contract.

5.1. CADD File Requirements

Prepare and submit all drawing files in latest release of AutoCAD. Use the bridge number as the file name. For revised plans, use the bridge number followed by an “R” in the file name. All reference files that are part of the finished plan sheet must be merged into a master file. Do not use reference (xREF) files; therefore, detach all reference files after merging needed files and details. Purge all elements that are not part of the final plan sheet and remove all elements that do not reside within the boundaries of the sheet border.

5.1.1. Design File

The global origin, in all Bridge Section AutoCAD drawings, is defined as X,Y=0,0 in the lower left corner of the design plane.

US Working Units

The AutoCAD format for US working units is the following:

- Set Master Units to decimal feet (ft).
- Make all drawings to scale in model space at 1=1.

Metric Working Units

The AutoCAD format for metric working units is the following:

- Set Master Units to millimeters (mm).
- Label elevations and stationing in meters.
- Make all drawings to scale in model space at 1=1.

5.1.2. Layer Assignment

Use layer assignments shown in Table 5-1. If additional layers are needed, use a layer name that clearly conveys the content of the layer; do not create obscure abbreviations.

**Table 5-1
Layer Assignments**

Layer Name	Color	Layer Content
PEN1	White	Existing Structure Lines, Utilities
PEN2	Yellow	North Arrow, Reinforcement, Note Text
PEN3	Green	Main Object Lines, Title Text
PEN4	Blue	Items to stand out, Sheet Border
PEN5	Cyan	Dimension Lines, Centerlines
PEN6	Magenta	Hatching, Existing Reinforcing Steel
V_PORT	Red	View Ports, All Items not being printed

5.1.3. Linetypes

Use the linetypes shown in Table 5-2 to distinguish the type of object being drafted. Use a global line scale (AutoCAD command “ltscale”) of 0.5. Individual settings of linetype scale are acceptable if needed.

5.1.4. Text

Present all text as left justified, except titles are center justified. When one line is not sufficient for text, use

multiline text (AutoCAD command “mtext”) to ensure the proper spacing between lines.

Normal Text

Use the following AutoCAD setting for normal text in the drawings:

- Font = Simp1 (obliquing = 22)
- Text Height = 0.13 x Scale of Detail

**Table 5-2
Standard Linetypes**

Functional Application	Layer	Linetype
Centerlines	PEN5	Center, Center2
Existing Structures	PEN1	Hidden, Hidden2
Drawings – Object lines	PEN3	Continuous
Drawings – Reinforcement	PEN2	Continuous
Ordinary High Water	PEN1	Phantom2
Utilities	PEN1	<i>Specific to Type of Utility</i>
Hidden Lines	PEN1	Hidden, Hidden2
Dimensioning	PEN5	Continuous
Text – Normal	PEN2	Continuous
Text – Headings, etc.	PEN3	Continuous

Text for Headings, Titles, Views, etc.

To format view titles use all capital letters, center-justified and underlined with two lines. Extend the lower line one character past the title on each end; make the upper line the same length as the title. Place the bar scale under the title without crowding. Use the following AutoCAD settings for text in titles and headings:

- Font = Leroy (obliquing = 0)
- Text Height = 0.1563 (*Paper Space* only)

5.1.5. Dimensioning

Use PEN5 (cyan) on all dimension lines, leader lines, and centerlines. Use curved leader lines for arrowed notes. Keep the use of “S” shaped leader lines to a minimum. Do not put text or dimensions in the body of detail. For stacked dimensions between extension lines, separate the dimension lines a distance of two times the text height. For stacked dimensions between extension lines with text placed both above and below a dimension line, separate the dimension lines a distance of three times the text height. Provide a consistent distance between dimension lines throughout the plan.

Metric Dimensioning

Use millimeters only for all dimensions on metric plan sets. Use meters for elevations and stations.

5.1.6. Hatching

Use layer PEN6, magenta for hatching. Use hatching patterns for riprap, earth, existing structures, and other items, as needed. Do not hatch concrete.

5.1.7. Title Blocks and Borders

Use the Bridge Section standard title block for all bridge and structures drawings. See Chapter 6 for more information about title blocks, borders, and sheet organization.

All sheets will show the name of the person responsible for designing, drafting, and checking that sheet. The Professional Engineer Seal provided by the Alaska State Board of Registration for Architects, Engineers and Land Surveyors is placed in the title block of the drawings only when the entire set of drawings is complete and the bridge engineer is ready to sign the drawings.

5.1.8. Plotting

Use the files “Bridgehalf.ctb” and “Bridgefull.ctb” for plotting. By using these files, the proper plotter setting are automatically configured. The “Bridgehalf.ctb” settings are used for half-size plots (e.g. 11” x 17” size). The “Bridgefull.ctb” settings are used for full-size plots (e.g. 22” x 34”). The newest version of these files is available upon request from the Bridge Section.

Final sheets should be readable when plotted at both full-size and half-size. Review the plotted sheet in addition to the screen views to verify quality before submitting a set of drawings.

5.2. Drafting Standards

Effective drafting requires care and attention to detail. In addition to the requirements of this section, use the following general guidelines to enhance the effectiveness of drafted material:

1. Do not crowd sheets with so many drawings that clarity is compromised. Provide enough empty space around details to distinguish between adjacent details. Use additional sheets instead of crowding too many details onto one sheet.
2. Balance the empty space of plan sheets to avoid having one crowded and another mostly empty.
3. Label the Working Line (e.g. Φ Brg., Φ Roadway, Φ Layout Line) consistently throughout the plans.
4. Tie dimensions to Working Points.
5. Keep abutments, piers, superstructure, etc., details together.

5.2.1. Scales

Draw all details to scale. Use a standard scale and the maximum scale practical. Use bar scales as much as practical. Place the bar scale under the title of the detail, both of which are centered below the detail.

Use only the following scales in drawings:

1. US Scales

Architectural: 3"=1'-0", 1 1/2"=1'-0", 1"=1'-0", 1/8"=1'-0", 1/4"=1'-0", 3/16"=1'-0", 1/2"=1'-0", 1/16"=1'-0"

Engineers: 1"=10'-0", 1"=20'-0", 1"=30'-0", 1"=40'-0", 1"=50'-0"

2. Metric Scales

1=10, 1=20, 1=25, 1=40, 1=50, 1=75, 1=100, 1=125, 1=150, 1=200, 1=250, 1=300

5.2.2. Details and Notes

When drafting details and notes adhere to the following:

1. Do not mix a detail between *Paper Space* and *Model Space*.
2. Place a period at end of each sentence in the general notes. For arrowed notes use a period

only if the note contains more than one sentence.

3. In general notes capitalize only the titles of books and manuals. For arrowed notes capitalize the first word of the note and nouns referring to bridge components.
4. Use "No Scale" as shown. Do not use "Not to Scale", "NTS", or other variations.
5. Use "Dwg. No." instead of "Sheet No." Do not use the number symbol "#" unless there is not enough room to write "No."
6. Do not use spaces when using symbols (i.e. 2'-0"±, 2'-0"∅). When labeling steel shapes do not use spaces or dimension symbols except for the length (i.e. W24x76, L6x6x3/4x2'-6").
7. If a plan sheet contains numerous variable dimensions and other data, especially for framing plans and beams, use tables to keep data in order.
8. Use active voice in all notes.
9. Verify that the details are applicable and are to scale when copying details from other plans.
10. Use large-scale corner details on skewed bridges.
11. Leave extra lines in the "Summary of Quantities" and "Reinforcing Steel Schedule" tables for additions.
12. Label girder center lines "Girder A, Girder B, etc." on the Framing Plan and other drawings. Label the girders from left to right looking ahead on station.
13. Cross-reference plan sheets by sheet title, not by sheet number.
14. Use extra details for uncommon work, but avoid unnecessary repetition of dimensions, details and/or notes. Do not double dimension.
15. When showing an existing bridge or structure on a plan sheet provide a hidden linetype to outline the relevant position.

- 16. Use isometric views sparingly and only when necessary for clarity.
- 17. Number all detail notes. Place all notes together on the bottom right hand side of the sheet. Do not enlarge details, such as bar bends, just to fill up space.

5.2.3. Symbols

Some commonly used symbols and the equivalent AutoCAD “Simpl” command code are shown in Table 5-3. Symbols can only be created in text mode; they must be copied into “mtext”.

**Table 5-3
Common AutoCAD Symbols**

Symbol	Code
+/-	%%P
⌀	%%130
⊥	%%133
∅	%%C
° (degrees)	%%D
_ (underline)	%%U (at the start and end of word)
1/16	%%201
1/8	%%202
3/16	%%203
1/4	%%204
Additional fractions in increments of 1/16	%%204 +1 for each subsequent increment of 1/16

5.2.4. Abbreviations

Use abbreviations consistent with those from previous plans. Show a list of abbreviations applicable to the project on the SITE PLAN sheet. Table 5-4 gives a sample list of abbreviations.

5.2.5. Retrofit, Rehabilitation, and Staged Construction

On projects with staged construction, clearly indicate how the bridge construction is to be coordinated with staging, especially for complex projects. When drafting removal items, clearly indicate removal limits. Use a straight line to show a saw cut.

On retrofit and rehabilitation projects, denote elevations and dimensions taken from the as-built plans with a ± symbol. The ± symbol indicates approximate dimension. Require the contractor to verify these dimensions, elevations, etc. in the field if necessary, before using them on new work. Include this note under the General Notes of all rehabilitation projects:

“Existing stations, elevations and dimensions are based on as-built plans and those plans may not show

existing dimensions and conditions. Where dimensions of the proposed work depend on the existing bridge dimensions, field-verify the controlling dimension and adjust proposed dimensions of the work to fit existing conditions.”

On subsequent sheets of all rehabilitation projects use the following note:

“Verify controlling field dimensions before ordering or fabricating any material.”

5.2.6. Detailing Reinforcing Steel for Concrete

The following standards apply to drafting reinforcing steel in concrete:

1. Use layer PEN2 (yellow) to draw reinforcing steel.
2. Detail reinforcement with one line not two lines.
3. For crowded views, do not show every reinforcing steel bar. Point to the first and last bar.

Table 5.4
List of Common Abbreviations

☉	= Centerline	F	= fixed bearing
Ⓟ	= Plate	f.f.	= far face
&	= and	Hwy.	= highway
@	= at	Jt.	= joint
∅	= diameter	ksf	= kips per square foot
±	= plus or minus	Lt.	= left
A/C	= asphalt concrete	max.	= maximum
Approx.	= approximate	min.	= minimum
Abut.	= Abutment	n.a.	= not applicable
Bot.	= bottom	n.f.	= near face
Br.	= bridge	No.	= number
Btwn.	= between	o.c.	= on center
Brg.	= bearing	OHW	= ordinary high water
C.I.P.	= cast in place	psi	= pounds per square inch
CJP	= complete joint penetration	ROW	= right of way
Clr.	= clear, clearance	Rt.	= right
Dia.	= diameter	S.I.P.	= stay in place
DHW	= design high water	spc.	= space, spaces
Dwg.	= drawing	Sta.	= station
Elev.	= elevation	Symm.	= symmetric
e.f.	= each face	Typ.	= typical
E	= expansion bearing	UT	= ultrasonic testing

- When showing reinforcing steel sections, use an oversized circle (AutoCAD command “donut” with inside diameter = 0).
- On a skewed bridge with skew angle greater than 20 degrees, detail main reinforcing steel spacing in the deck slab along edges of the slab. Do not detail spacing normal to the reinforcing steel, as this tends to increase the actual spacing beyond design spacing. Show and dimension a radius only on nonstandard bends.
- Do not show reinforcement in details with scales less than 3/8”=1’-0”.
- Use the reinforcing steel identification convention shown in Figure 5-1. Start the numerical sequence at “01” with no gaps in the numerical order. For example, the first #4 reinforcing bar for an abutment would be labeled “A401”.

Provide a reinforcing schedule (bar list) on all sheets containing reinforcing steel. However, if two or more sheets are needed for one bridge component (e.g. PIER and PIER DETAILS) show the reinforcing schedule on the first sheet only. Use actual reinforcing steel shapes in the reinforcing steel schedule.

5.2.7. Drafting Quality Control

Drawings should be thoroughly reviewed by the drafter as well as the bridge engineer at each stage of development.

Verify that details, data, and other information, which may be given on more than one plan sheet, agree on all locations of the plan sheet(s). Avoid double dimensioning as much as practical.

Carefully check plans for errors and spelling. Errors on Preliminary Plans could possibly be carried through the entire final plan stage without being

discovered, and major last-minute revisions might then be necessary, resulting in disrupted schedules.

Verify that pay item numbers and descriptions in the Estimate of Quantities Table have the exact wording and spelling as the pay items in the DOT&PF *Standard Specifications for Highway Construction* and relevant standard modifications and special provisions.

Read a plan from a contractor's perspective to determine if the plan contains all the necessary information and data needed to construct the bridge. Verifying material quantities is often a good way to check for completeness of a plan sheet. If the quantities cannot be calculated then more information is required on the plans.

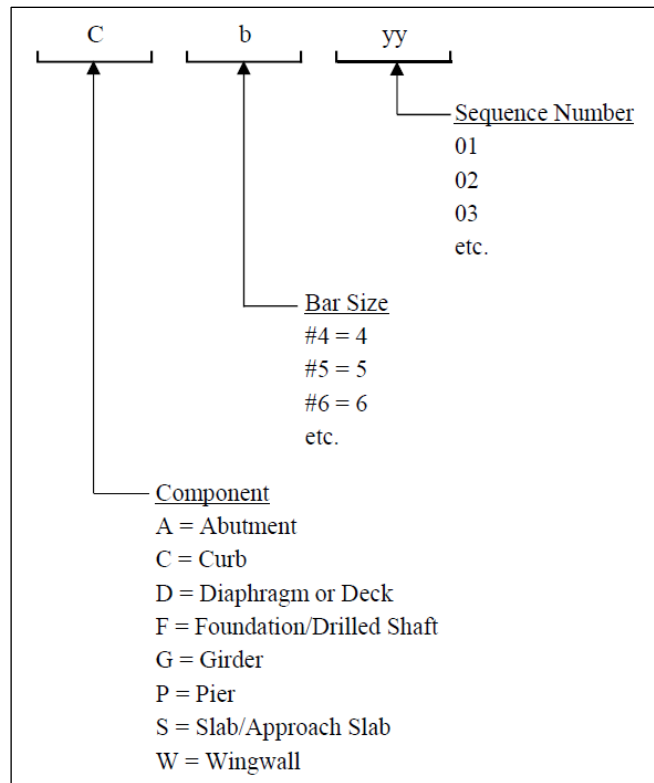


Figure 5-1
Reinforcing Bar Identification

5.3. Plan Sheets

Table 5-5 shows the order of plan sheets for a typical new structure. Variations in plan sheet titles and order can occur depending on project size and complexity. In general, plan sheets are placed in the order a bridge is constructed, from the foundation up. Plan sheets can be added or removed to accommodate the particular bridge.

5.3.1. Final Plan Sets

Plot final plan sets on mylar and have the mylars signed by the appropriate bridge engineer and checker(s). Create a digital copy in PDF format of the signed final mylar set. Increasingly, the regions are requesting that final plans be submitted in electronic format. If the mylars are not submitted to the region, store them in the vault flat file archives. Consultants must submit signed mylars to the Bridge Section along with the AutoCAD files and electronic PDF files.

**Table 5-5
Typical Plan Sheets**

Sheet Title	Sheet Contents
TITLE SHEET	Use when a bridge is let separately from roadway work, or when work is being completed at different locations.
GENERAL LAYOUT	General Plan, Elevation and Typical Section, Estimate of Quantities Table, Index to Plans.
SITE PLAN	Site Plan, General Notes, Pile or Footing Data Table, Estimate of Quantities Table (if does not fit on GENERAL LAYOUT).
RIPRAP LAYOUT	Riprap and Hydraulics information if not located on the SITE PLAN.
FOUNDATION PLAN	Footing and pile layout. Use this sheet when the SITE PLAN is too crowded.
MSE WALLS	MSE Wall layout and details. Use only with jobs that have MSE Walls.
ABUTMENTS	Abutment geometries, piles, and dowels to Working Points. Use an additional abutment sheet if abutments are not similar. Title ABUTMENT 1 and ABUTMENT X.
ABUTMENT DETAILS	Details pertaining to abutments.
WINGWALLS	Wingwall layout and details.
PIERS	Pier geometries, piles, and dowels to Working Points. Use additional pier sheets if piers are not similar. Label PIER 2 and PIER 3, etc.
PIER DETAILS	Details pertaining to piers.
TYPICAL SECTION	Typical section details, including diaphragm details.
FRAMING PLAN	Girder layout, Diaphragm spacing, Rail Post spacing, and Shear Connectors are to be labeled. May be combined with the TYPICAL SECTION Sheet.
GIRDERS	Girder geometry and reinforcing.
GIRDER DETAILS	Additional details that do not fit on girder sheet.
DECK	Deck details and reinforcing.
APPROACH SLAB	Approach slab details and reinforcing.
STEEL BRIDGE RAILING	Railing details. The sheet name should be consistent with the Item 507 description in the <i>Alaska Standard Specification for Highway Construction</i> .
UTILITIES	Utility details attached to bridge.
TEST BORING LOG AND LOCATIONS	Sheet provided by the foundation engineer with boring log information.