

MINNESOTA DEPARTMENT OF TRANSPORTATION

Bridge Office

Summary of Recommended Drafting Standards

Mn/DOT BRIDGE OFFICE

Summary of Recommended Drafting Standards

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DESIGN FILE

The global origin (*preset in the Bridge Final Design Seed File*¹) in all Mn/DOT Bridge Final Design MicroStation™ 2d files, is defined as GO=0,0 with XY=0,0 in the lower left corner of the design plane.

WORKING UNITS

MicroStation™ format mu:su:pu - master, sub, and positional units.

Set variable MS_CUSTOMUNITDEF = MNDOT_units.def¹

- Bridge Preliminary Design:
Master units shall be Survey Feet
Sub units shall be Survey Feet
mu:su:pu = 1:1:1000
1 foot with 1 sub units and 1000 positional units
- Bridge Final Design – New and Rehabilitation Plans
(*preset in the Bridge Final Design Seed File*¹):
Master units shall be Survey Feet
Sub units shall be Survey Inches
mu:su:pu = 1:12:1600
1 foot with 12 sub units and 1600 positional units

**DRAFTING
STANDARDS**

The Mn/DOT Bridge Office has adopted the following standards/practices to be used when drafting plan sheets.

All sheets, excluding survey sheets, shall show the initials of the person responsible for design, drafting, and checking for that sheet.

Final sheets (11" x 17") should be readable. Review the sheet, not the view on the screen.

Do not crowd sheets. Use additional sheets instead.

Use sheets efficiently; make use of open spaces for special details. Balance plan sheets to avoid having one crowded and another empty.

Label the Working Line throughout the plan. Tie dimensions to Working Points.

When copying details from other plans, make sure details are applicable and are to scale.

Make sure details, data, and other information, which may be given on more than one plan sheet, agree between plan sheets.

The order of plan sheets provides contract information: GPE, Schedule of Quantities and Transverse Section, Bridge Layout, substructures, superstructures, Standard sheets, B-Details, and Bridge Survey. In general, plan sheets are placed in the order a bridge is constructed, from the footings up.

LEVEL STRUCTURE

(preset in the Bridge Final Design Seed File ¹)

Level "BR" is the Bridge Final Design default.

Number	Name	Description
9000	BR	Bridge BRX
9001	1	WT=1 BRX
9002	2	WT=2 BRX
9003	3	WT=3 BRX
9004	4	WT=4 BRX
9005	5	WT=5 BRX
9006	SHT1	Sheet 1 BRX
9007	Border	Iplot Organizer Plot Shape BRX
9008	Line	General level BRX
9009	STD	Levels for standards BRX
9010	CLR	Center line roadway BRX
9011	CL	Center line BRX
9012	GL	Gutter line BRX
9013	WL	Working Line BRX
9014	Txt	Text placement BRX
9015	WP	Working Point BRX
9016	Dim	Dimensions BRX
9017	AbtFtg	Abutment Footing BRX
9018	AbtFtgRein	Abutment Footing Reinforcement BRX
9019	AbtConc	Abutment Concrete BRX
9020	AbtBar	Abutment Reinforcement BRX
9021	AbtDim	Abutment Text and Dimensions BRX
9022	AbtPile	Abutment Piles BRX
9023	AbtCL	Abutment Center line BRX
9024	AbtBrg	Abutment Bearing line BRX
9025	AbtConcHid	Abutment Concrete Hidden BRX
9026	AbtPad	Abutment Pad BRX
9027	Abt2	Abutment Weight 2 lines- Break Lines-etc. BRX
9028	PierFtg	Pier Footing BRX
9029	PierFtgRein	Pier Footing Reinforcement BRX
9030	PConc	Pier Concrete BRX
9031	Pbar	Pier Reinforcement BRX
9032	PDim	Pier Text and Dimensions BRX
9033	PPile	Pier Piles BRX
9034	PCL	Pier Center line BRX
9035	PBrg	Pier Bearing line BRX
9036	PConcHid	Pier Concrete Hidden BRX
9037	PPad	Pier Pad Concrete BRX
9038	P2	Pier Weight 2 lines- Break Lines-etc. BRX
9039	BmL	Beam Lines BRX
9040	DkConc	Deck Concrete BRX
9041	DkReinf	Deck Reinforcement BRX
9042	DkDim	Deck Text and Dimensions BRX

LEVEL STRUCTURE (continued)*(preset in the Bridge Final Design Seed File ¹)*

Number	Name	Description
9043	RailConc	Railing Concrete-Median Concrete BRX
9044	RailBar	Railing Reinforcement BRX
9045	RailDim	Railing Text and Dimensions BRX
9046	Exp	Expansion Device Deck plan view BRX
9047	Dk2	Deck Weight 2 lines- Break Lines-etc. BRX
9048	Swk	Sidewalk BRX
9049	SS	Structural Steel BRX
9050	Prelim	Preliminary BRX
9051	PrelimCL	Preliminary Centerline BRX
9052	SubStruct	Substructures BRX
9053	Util	Utilities & Conduit BRX
9054	ExpJT	Expansion Joint BRX
9055	Working	Working Line BRX
9056	Pattern	Patterning
9057	ClFacBM	Centerline Fascia Beams BRX
9059	Profile	Profile Grade BRX
9058	ClIntBms	Centerline Interior Beams BRX
9060	BMDet	Beam Details BRX
9061	SlopeP	Slope Paving BRX
9062	GutterCurb	Gutter and Curb Under Bridge BRX
9063	CLRdwyU	Centerline Roadways Under Structure BRX
9064	Diaph	Diaphragms
9066	PointInfo	Point Information BRX
9067	VC	Vertical Curve BRX
9068	TempMB	Temporary Median Barrier BRX
9069	CoorInfo	Coordinate Information BRX
9070	Pile	Pile
9071	InpBridgeFtg	Inplace Bridge Footing
9072	InpGroundLines	Inplace Ground Lines
9080	BmCl	Beam Centerline
9099	Z1	1-BREAK Z
9100	InpBrSupRein	Inplace Bridge Superstructure Rein. BRX
9101	InpBrSup	Inplace Bridge Superstructure. BRX
9102	InpSub	Inplace Substructures BRX
9103	InpFtg	Inplace Footings BRX
9104	InpPile	Inplace Piling BRX
9106	InpExpJT	Inplace Expansion Jts BRX
9109	InpUtil	Inplace Utilities & Conduit BRX
9112	InpCLBeam	Inplace Centerline Beams BRX
9200	OHSign	Overhead Sign BRX
9300	DkGray	Filled Shape - dark Gray
9301	Gray	Filled Shape - gray
9302	LtGray	Filled Shape - light gray
9303	LtGrayNo	No Boundary Filled Shaped - light gray

SYMBOLGY *

Weight=WT Line Style=LC (linecode)

Centerlines	WT=2	LC=4
Inplace Structure *	WT=2	LC=2
Drawings – Object lines	WT=3 or 4	LC=0
Drawings - Reinforcement	WT=2 or 3	LC=0
Utilities	WT=3 or 4	LC=0
Hidden lines *	WT=2	LC=2
Dimensioning	WT=2	LC=0
Text – Normal	WT=3	n/a
Text – Headings, etc.	WT=5	n/a

* Symbolgy may be adjusted for clarity.

SCALES – GENERAL

Use a standard scale. Use maximum scale practical for clarity. Avoid using scales smaller than $\frac{3}{8}"$.

STANDARD SCALES

3":1', 1 $\frac{1}{2}$ ":1', 1":1', $\frac{1}{2}$ ":1', $\frac{3}{8}$ ":1', $\frac{1}{4}$ ":1', $\frac{3}{16}$ ":1', $\frac{1}{8}$ ":1', $\frac{3}{32}$ ":1', $\frac{1}{16}$ ":1', 1":10', 1":15', 1":20', 1":25', 1":30', 1":40', 1":50'

PATTERNING

WT=0

Suggested Pattern Delta: PD=TX

Use a 45° angle for cross-hatching.

REINFORCEMENT

WT=2

Detail reinforcement with one line not two lines.

For crowded drawings, do not show every rebar. Label representative rebars.

When showing rebar sections, the circle shall appear on the final print (11x17) as a diameter of $\frac{1}{32}"$. To accomplish this, the radius of the circle shall be $\frac{1}{4}$ the normal text size (e.g., TX=0.3333 therefore the radius=0.0833).

On bar bend details, show and dimension a radius only on nonstandard bends.

Use actual rebar shapes in the Bill of Reinforcement.

With stage construction, use separate columns for each stage in the Bill of Reinforcement and Summary of Quantities.

DIMENSIONING – GENERAL

All dimension lines, witness lines, leader lines, vertical lines in text nodes, and center lines shall be WT=2.

Do not use curved leader lines.

The distance between dimension lines shall be equal to three- or four-times the TX. When text is placed both above and below a dimension line, the distance between dimension lines shall be four-times the TX. Distance between dimension lines shall be consistent throughout the plan.

Round dimensions to the nearest $\frac{1}{8}$ of an inch.

TEXT - GENERAL

Text Size=TX Text Height=TH Text Width=TW

Multiple lines of text (text node) shall have a leader line connecting to a vertical line. Text nodes should be left justified, when possible, with the vertical line to the left of the text node. Do not right-justify unless space on the sheet is an issue (or if drafting is being done on a standard drawing/drafting aid). When a text node is right justified the vertical line is to the right of the text node. Lines of text in a text node should be as equal in length as possible.

TEXT – NORMAL

Font=21

WT=3

TX= $\frac{1}{3}$ the Active Scale (e.g., AS=1 therefore TX=0.3333)

Line Spacing= $\frac{2}{3}$ the Text Height (e.g., TH=0.3333, therefore
LS=0.2222)

TEXT – HEADINGS, TITLES, VIEWS, etc.

Font=21

WT=5

TX= $\frac{1}{2}$ the normal text size (e.g., $0.3333 \times 1.5 = 0.5$)

Line Spacing= $\frac{2}{3}$ the Text Height (e.g., TH=0.5, therefore LS=0.3333)

Format: Center-justified and underlined with one line (Underline Spacing=67%).

DETAILS AND NOTES

On rehabilitation projects: If elevations given in a rehab plan are taken off the original plan make sure to note this in the rehab plan. Require the contractor to verify these elevations, in field if necessary, before using them on new work.

When it appears that plan notes, such as procedure descriptions, specifications, etc., will become excessively wordy it is best to relegate these notes to the special provisions.

On the Bridge Layout plan sheet, if elevation drops vary along a substructure unit, it is desirable to give the values of these variables. Total values should be given, in both inches and decimals of a foot, to two places.

Use Bill of Reinforcement for all but very minor reinforced concrete work.

On projects with staged construction, use generous drawings to clearly indicate how the bridge construction is to be coordinated with staging, especially for complex projects. Keep structure units together.

On rehabilitation projects, clearly indicate cut lines and extent of all removals. If there is a saw cut, detail the saw cut with a straight line (suggested symbology: WT=5 LC=7).

On a skewed bridge, detail main rebar spacing in the deck slab along edges of the slab. Do not detail spacing normal to the rebar, as this tends to increase the actual spacing beyond design spacing.

If a plan sheet contains numerous variable dimensions and other data, especially for framing plans and beams, make use of tables to keep this data in order.

On skewed bridges, and for other complex corners, large-scale corner details are required.

For bridges with numerous footings, and curved alignment, a separate foundation layout drawing is recommended.

For abutments, and other complex drawings, use different views and sections to separate dimensions and reinforcement.

Leave extra lines in the Summary of Quantities and Bill of Reinforcement for additions. Also, leave extra space in the list of notes.

Never reference bar bend details by letter to generic shapes.

For simple beam spans, prestressed girders, etc., dimension beam spacing at pier cap along centerline of the pier(s). Supplemental dimensions along centerline of bearing should be used for curved and flared structures.

On the Framing Plan, show bearing type beside each bearing point instead of using lines and arrows, which tend to clutter the drawing.

BEAM NOTATION on Prestressed Concrete Beam projects: Label beam lines "B1, B2, B3, etc." on the Framing Plan. If necessary, give each beam a unique number.

BEAM NOTATION on Steel Beam projects: Label beam lines "B1, B2, B3, etc." on the Framing Plan. Give each beam a unique number.

Limit the use of sheet numbers to reference other plan sheets. Check carefully when, and if, sheet numbers change. Cross-referencing plan sheets to details is recommended.

Avoid labeling sections the same on each structural unit in a plan.

Use extra details for uncommon work.

Avoid unnecessary repetition of details and notes.

BRIDGE REPLACEMENT - When showing the old bridge on a plan sheet only a dashed outline is necessary to show relevant position.

Dimensions to a precision of $\frac{1}{16}$ " are never necessary for concrete work.

Use perspective views for clarity.

Label and dimension rebar splices.

Modify Standard Figures and Standard B-Details whenever standard details are not applicable.

Delete all redundant details on Standard Figures and Standard B-Details; modify others as necessary. Add "MODIFIED" by the Figure (or B-Detail) number or delete the number.

FOOTNOTES, SUBNOTES, ETC.: List general notes first, followed by numbered specific detail notes. Numbered specific detail notes should be circled and referenced to the detail to which they apply. Place all notes together on the right hand side of the plan sheet.

Do not enlarge details, such as bar bends, just to fill up space.

Pile design loads, and notes pertaining to a particular substructure, should be grouped together on the same plan sheet as the substructure's footing plan view.

Use the words "will" and "shall" correctly. "Will" refers to the portion of work to be performed by the owner (Mn/DOT). "Shall" refers to the portion of work to be performed by the Contractor. "Shall" may be thought of as a directive to the Contractor.

Use leading zeros on special pay items.

STANDARD DRAWINGS

Standard drawings are defined as drawings that can stand alone, requiring little or no modification. Any drawing that is considered quite standard, but still requires major modification shall be defined as a drafting aid.

- Review current standard drawings to eliminate old details and details that do not meet the definition of a standard.
- Group details that require more modification into a book of Drafting Aids. Drafting Aids serve as a guideline for details drawn separately on a plan sheet, or as detail sheets to be modified to fit a specific plan condition.
- Create a new standard drawing from details/cells that have been used, without modification, over a specified number of usages.

Review present standard drawings for existence of errors, agreement with other standards, construction feasibility, standard detailing practice, etc.

Develop a commentary for all standard drawings, details/cells and drafting aids, giving directions for use or modification, tabular information, and revision history.

Develop a cross-reference system to indicate other standard drawings, details/cells, or drafting aids that may be affected by approved changes to notes or details.

B-Details may be incorporated as an integral part of a plan (e.g., bearing details and splice details).

PRELIMINARY PLANS

Give as much design criteria as possible. This includes traffic counts, design speeds, etc.

For critical clearances, give computed dimensions from known points, such as roadway surface above to surface at clearance point below. The designer can calculate the assumed depth of structure to obtain the approximate clearances for the plans.

Carefully check plans for errors. 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.

See Section 2 of the Mn/DOT LRFD Bridge Design Manual for more information on Preliminary Plans.

FINAL PLANS

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.

PLAN SHEET ORDER

Below is a model for the order of plan sheets for a typical new structure. Placement variations of plan sheets will occur when project size and complexity are factors. In general, plan sheets are placed in the order a bridge is constructed, from the footings up.

Title Sheet	Use when a bridge is let separately from grading, or when work is being completed at different locations.
GPE	General Plan and Elevation
Schedule of Quantities and Transverse Section	Schedule of Quantities, Transverse Section, Construction Notes and other Miscellaneous Notes
Staging Plan	Show staging for removals and construction.
Bridge Layout	Show Working Point Layout, stool and beam heights, simple superelevation charts, etc.

Removal Details	Complex removal details may be shown on a separate plan sheet. Otherwise, removal details should be included with the structure details
Abutment 1 Details	For abutment geometrics, tie corners, piles, and dowels to Working Points.
Abutment 1 Reinforcement	Abutment reinforcement follows abutment details.
Abutment 2 Details	<i>Similar to Abutment 1 Details</i>
Abutment 2 Reinforcement	<i>Similar to Abutment 1 Reinforcement</i>
Pier 1 Details	For pier geometrics, tie corners, piles, and dowels to Working Points.
Pier 1 Reinforcement	Pier reinforcement follows pier details.
Pier 2 Details	<i>Similar to Pier 1 Details</i>
Pier 2 Reinforcement	<i>Similar to Pier 1 Reinforcement</i>
Framing Plan	Include any drafting aids as needed.
Beam Details	Steel Beams and/or Prestressed Concrete Beams.
Superstructure Details	Include deck plan and any drafting aids as needed.
Corner Details	Corner details should be included with the superstructure details, or deck plan. Complex corner details may be shown on a separate plan sheet.
Superstructure Reinforcement	Include Bill of Reinforcement and Summary of Quantities
Railing	
Fencing	
Expansion Joint/Fingers	
Utilities/Conduit Systems	
Slope Paving	
Details	Standard Plan Sheets and B-Details
As-Built Bridge Data	
Superelevation	For complex superelevations include grading plan layout or line diagram, if provided on Preliminary Plan.
Bridge Survey	Show test piles and footing locations on bridge survey sheets, obtained from Preliminary Plan.

CHECKING DRAWINGS AND QUANTITIES

Make sure enough dimensions are given for constructability.

If calculating a quantity is difficult, due to incomplete information, it may be necessary to add one or more dimensions to a plan sheet.

Make computations neat and readable. Strive for continuity. These computations may be needed for future reference and the reader must be able to interpret them.

Box in, or underline, computation totals for quicker take off.

Initial, date, and put the bridge (or project) number on **every** computation sheet. The checker's initials must also be on each sheet.

Two sets of independent quantity computations are required for each pay item. A check of the original computations is **not** a check.

An independent check of the drawings is necessary also. Copying drawing files is not a check.

Arrange design and quantity computations into a neat and orderly package.

**CADD FILE
REQUIREMENTS**

All files must be submitted in MicroStation™ V8.

Use the correct file naming convention for all files.

For each plan set there shall be only one file per file naming convention; therefore, merge/copy plan sheets/details or files into one file. (Example: if you have separate files for the north and south abutment details, and/or reinforcement, combine them into one file with the "abt" file extension. If you have separate files for each pier combine them into one file with the "pir" file extension.)

All reference files that are part of the finished plan sheet must be merged into the master file. Reference files are not allowed; therefore, detach all reference files after merging needed files and details.

Remove all elements that are not part of the final plan sheet; remove all elements that do not reside within the boundaries of the sheet border.

EXCEPTION: In the GPE file, a coordinate correct General Plan View is

required and may be an additional drawing other than the drawing within the sheet border).

Sheet numbers are to be numeric. The exception is on revised plan sheets where an "R" follows the sheet number.

File Naming Convention – MicroStation™ V8

File name shall be:

"BR" + "bridge number" + "v8 designator"

(v8 designator = "_" + "file extension" + ".dgn")

Example: BR12345_abt.dgn

On Consultant created files a "C" will prefix the filename.

Example: CBR12345_abt.dgn

v8 Designator – MicroStation™ V8

NEW PLANS:

_abt.dgn	Abutment Details and Reinforcement
_det.dgn	B-Details, Standard Sheets, and As-Built Bridge Data Sheet
_exp.dgn	Expansion Device Details **
_pcb.dgn	Concrete Beam Details **
_pir.dgn	Pier Details and Reinforcement
_ral.dgn	Railing and Median Details **
_s12.dgn	General Plan and Elevation, Bridge Layout, Variable Super Charts, and Quantities
_stl.dgn	Steel: Beams, Framing Details, etc.**
_sup.dgn	Superstructure: Deck Plan, Framing Plan, Integral Diaphragm, Deck Transverse and Longitudinal Sections, and Sidewalk and Median Sheets.
_sur.dgn	Survey: Plan and Profile
_sys.dgn	Conduit Systems: Power, Lighting, Phone, Signals, etc.

** These plan sheets may be included in the "sup" file extension.

REHABILITATION PLANS:

_app.dgn	Approach Panels
_rem.dgn	Removals
_rep.dgn	Repair
_stg.dgn	Staging Plans

Resources

Resource downloads are located at:

<http://www.dot.state.mn.us/bridge/cadd/>

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