STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

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SECRETARY

MEMORANDUM TO: Project Engineers
Project Design Engineers

FROM: G. R. Perfetti, P. E.
State Structures Engineer

DATE: February 3, 2014

SUBJECT: DISC BEARINGS

To enhance long-term performance of high-load multi-rotational (HLMR) bearings, the use of disc bearings is preferred in lieu of pot bearings. The attached Design Manual Figures 6-125 and 6-126, as well as Standard Drawing DB1 – Disc Bearing Details have been developed for detailing disc bearings. The following guidelines will be placed in the Design Manual for use during design and plan development.

When steel reinforced elastomeric bearings are not feasible, disc bearings should be used. Disc bearings shall be fixed or unidirectional expansion bearings. See standard drawing DB1 for typical plan sheet details. Components of a fixed disc bearing include a sole plate, an upper bearing plate, a polyether urethane disc, a lower bearing plate, and a masonry plate. Expansion bearings include the same components as the fixed bearings, as well as guide bars that are welded to the underside of the sole plate and friction reducing components that are positioned between the sole plate and the upper bearing plate.

All steel in disc bearings shall be AASHTO M270 Grade 50W (345W) or Grade 50 (345). The plates in the disc bearing assemblies shall be commercially blast cleaned, except for the areas with special facing, and shall be metallized in accordance with the Special Provision for Thermal Sprayed Coatings (Metallization).

Refer to Figure 6-125 for design data such as masonry plate size, anchor bolt gage, and overall bearing height. During design, use this information when computing bridge seat elevations and cap dimensions. Use the anchor bolt gage to check for conflicts with reinforcing steel in the bent cap. To facilitate proper placement of anchor bolts for expansion bearings, detail 4 inch (102 mm) grout cans in the plans.

Use standard drawing DB1 during plan development. Show the total bearing height and the dimensions of the masonry plate. In addition, detail a 1/8 inch (3 mm) preformed bearing pad under the steel masonry plate. Use the following guidelines to orient the masonry plate and other bearing components:

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- For all bridges, orient the masonry plate so that the centerline of the plate is normal to the bent cap.
- For fixed or expansion bearings on bridges with straight girders, orient the remaining bearing components parallel to the centerline of the girder.
- For fixed bearings on bridges with curved girders, orient the remaining bearing components parallel to the centerline of the girder.
- For expansion bearings on bridges with curved girders, note that curved girders expand along the chord between the nearest fixed and expansion bearings. Orient the remaining bearing components parallel to the expansion chord for each individual girder. For proper field setting of expansion bearings, include an expansion chord setting table on standard drawing DB1 showing the angle between the centerline of bearing and the expansion chord for each girder. See Figure 6-126 for an example of detailing the expansion chord setting angle.

Disc bearings are designed by the manufacturer to transmit the loads and movement specified in the plans to the substructure. When disc bearings are used, place the unfactored vertical and factored horizontal design loads on standard drawing DB1. The factored horizontal design load for disc bearings is the larger of:

- 15% of the total vertical load (DL + LL w/IM) at the service limit state, or
- 25% of the total dead load plus 12.5% of the live load with impact at the service limit state.

The disc bearing manufacturer is responsible for determining the size of the lower bearing plate, disc, upper bearing plate, and sole plate. However, the sole plate is required to extend a minimum of 1 inch (25 mm) beyond both sides of the bottom flange of the girder. Therefore, use the following guidelines to show the sole plate details on standard drawing DB1:

- When disc bearings are used for straight girders, show the length of the sole plate, but not the width or thickness.
- When disc bearings are used for curved girders, do not detail the length, width, or thickness of the sole plate. On standard drawing DB1, modify the cut-away plan to show the girder flange is skewed with respect to the sole plate and the minimum edge distance is 1" (25mm), and modify the note that accompanies the sole plate details as such:

  Dimensions "L", "W", and "T" shall be determined by the bearing manufacturer. Set dimension "L" such that the minimum edge distance to the girder flange is 1" (25mm).

- Bevel the top of the sole plate to match the final grade of the bottom flange at the location of the bearing and show the percentage slope of the top of the sole plate.

When disc bearings are detailed, place the following notes on the plans:

> ***Sole plates should be welded to girder flanges and anchor bolts should be grouted before falsework is placed.***
>
> ***At all points of support, nuts for anchor bolts shall be finger-tightened plus an additional ¼ turn. The thread of the nut and bolt shall then be burred with a sharp pointed tool.***
>
> ***When welding the sole plate to the girder, use temperature indicating wax pens, or other suitable means, to ensure that the temperature of the bearing does not exceed 250°F (121°C). Temperatures above this may damage the TFE or elastomer.***

See Sections 6.7.7 – *Sole Plate Details* and 6.8 – *Anchorage* for additional information.

Payment for disc bearings shall be shown on the Total Bill of Material at the lump sum price for "Disc Bearings."

This policy is effective for all new projects, as well as for existing projects that are in early stages of design. The Design Manual, Standard Drawings, and Project Special Provisions have been updated and are available online. The new Design Manual Figures 6-125 and 6-126 are attached and Figures 6-127 and 6-128 have been deleted.

GRP/TMG/KAW

Attachments:
- Figure 6-125 (English)
- Figure 6-125 M (Metric)
- Figure 6-126 (English)
- Figure 6-126 M (Metric)

cc:
- T. K. Koch, P. E.
- B. C. Hanks, P. E.
- E. B. Nelson, P. E.
- H. A. Black, P. E.
- C. A. Peoples, P. E.
- R. A. Hancock, P. E., Attn: State Bridge Construction Engineer
- J. V. Barbour, P. E.
- E. E. Dubin, P. E., FHWA
- Division Bridge Program Managers

Fixed Disc Bearings						
① Vertical Load (kips)	Masonry Plate Width (in.)	Anchor Bolt Gage (in.)	Masonry Plate Thickness (in.)	Sole Plate Thickness (in.)	UBP + LBP + Disc Ht. (in.)	see note ②
300	19 1/2	13 1/2	3/4	7/8	3 5/8	5 3/8
400	21	15	3/4	7/8	3 5/8	5 3/8
500	22 1/2	16 1/2	3/4	1	3 5/8	5 1/2
600	24 1/2	18 1/2	1	1	4 1/8	6 1/4
700	26 1/2	20 1/2	1	1	4 1/4	6 3/8
800	28 1/2	22 1/2	1	1	4 7/8	7
900	30	24	1	1	5 1/8	7 1/4
1000	32	26	1 1/4	1	5 1/4	7 5/8

Expansion Disc Bearings						
① Vertical Load (kips)	Masonry Plate Width (in.)	Anchor Bolt Gage (in.)	Masonry Plate Thickness (in.)	Sole Plate Thickness (in.)	UBP + LBP + Disc Ht. (in.)	see note ②
300	25 1/2	19 1/2	3/4	7/8	3 3/4	5 1/2
400	27	21	3/4	7/8	4 1/8	5 7/8
500	28 1/2	22 1/2	3/4	1	4 5/8	6 1/2
600	30 1/2	24 1/2	1	1	5 1/4	7 3/8
700	32 1/2	26 1/2	1	1	5 1/2	7 5/8
800	34 1/2	28 1/2	1	1	6	8 1/8
900	36	30	1	1	6 1/2	8 5/8
1000	38	32	1 1/4	1	6 3/8	8 3/4

① Refers to the maximum unfactored DL+(LL+IM) reaction.

② Includes sole plate, upper bearing plate (UBP), disc, lower bearing plate (LBP), masonry plate, and 1/8" preformed bearing pad thicknesses.
For final height, adjust by adding 1/8" per percent of grade to the overall height shown in the table. Show the slope required on the sole plate to accommodate the required grade.

Notes

- Bearings of these sizes will accommodate .02 radians rotation.
- The bolt gages shown are for square masonry plates.
- The thicknesses listed for the masonry plate, sole plate, upper bearing plate (UBP), lower bearing plate (LBP), and polyether-urethane elastomeric disc are estimated to ensure that the total bearing height satisfies design requirements.

DISC BEARING DESIGN DATA

FIGURE 6 - 125

Fixed Disc Bearings						
① Vertical Load (kN)	Masonry Plate Width (mm)	Anchor Bolt Gage (mm)	Masonry Plate Thickness (mm)	Sole Plate Thickness (mm)	UBP + LBP + Disc Ht. (mm)	see note ②
1334	495	343	19	22	92	136
1779	533	381	19	22	92	136
2224	572	420	19	25	92	139
2669	622	470	25	25	105	158
3114	673	521	25	25	108	161
3559	724	572	25	25	124	177
4003	762	610	25	25	130	183
4448	813	661	32	25	133	193

Expansion Disc Bearings						
① Vertical Load (kN)	Masonry Plate Width (mm)	Anchor Bolt Gage (mm)	Masonry Plate Thickness (mm)	Sole Plate Thickness (mm)	UBP + LBP + Disc Ht. (mm)	see note ②
1334	648	496	19	22	95	139
1779	686	534	19	22	105	149
2224	724	572	19	25	117	164
2669	775	623	25	25	133	186
3114	826	674	25	25	140	193
3559	876	724	25	25	152	205
4003	914	762	25	25	165	218
4448	965	813	32	25	162	222

① Refers to the maximum unfactored DL+(LL+IM) reaction.

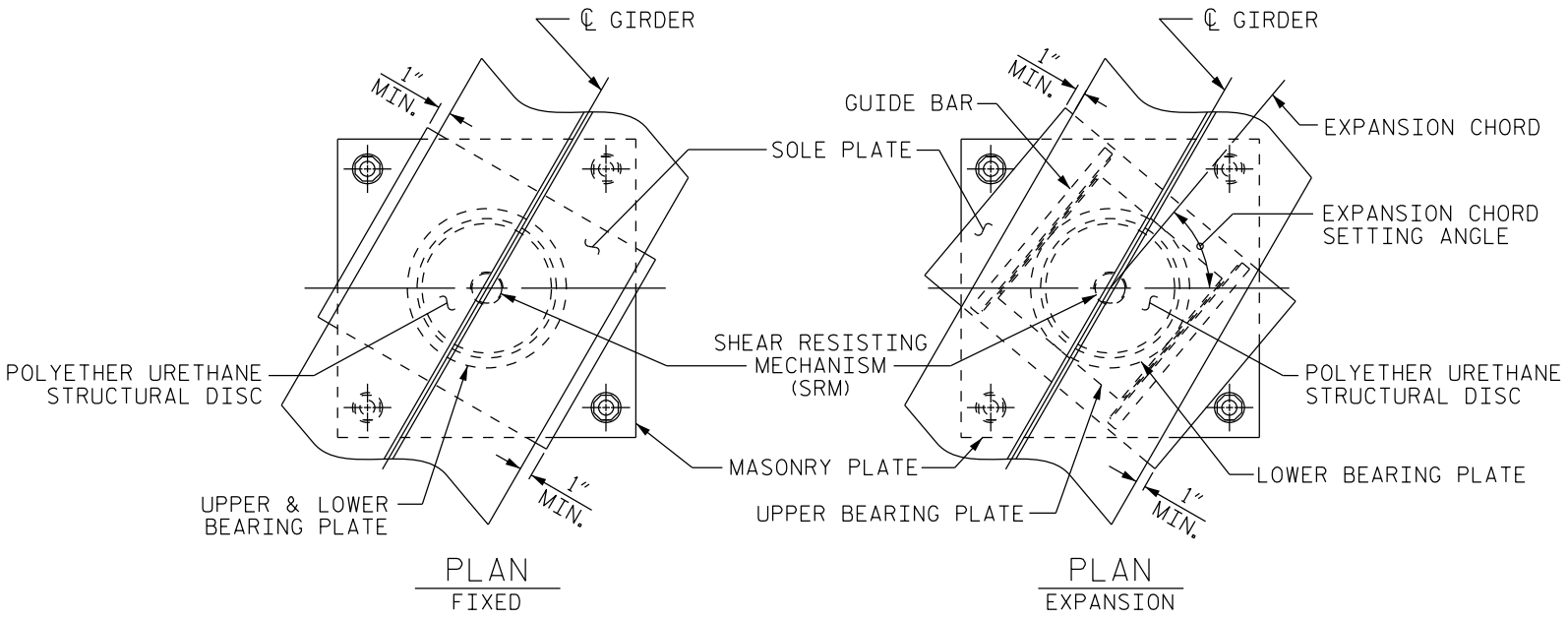
② Includes sole plate, upper bearing plate (UBP), disc, lower bearing plate (LBP), masonry plate, and 3mm preformed bearing pad thicknesses.
For final height, adjust by adding 3mm per percent of grade to the overall height shown in the table. Show the slope required on the sole plate to accommodate the required grade.

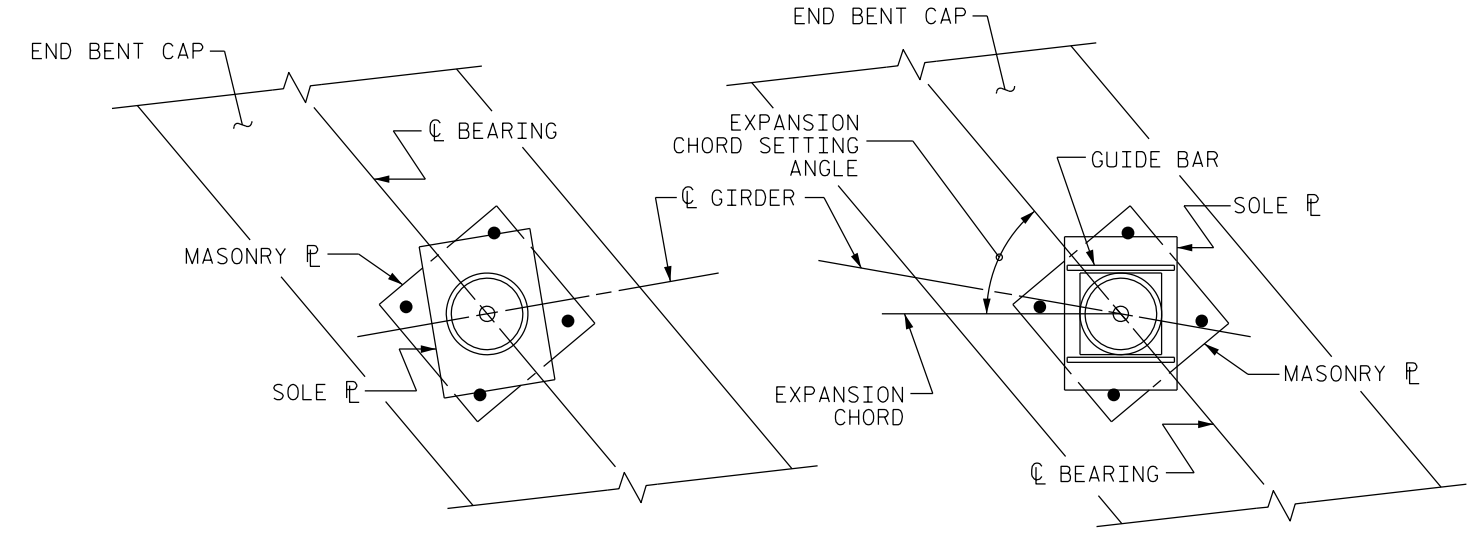
Notes

- Bearings of these sizes will accommodate .02 radians rotation.
- The bolt gages shown are for square masonry plates.
- The thicknesses listed for the masonry plate, sole plate, upper bearing plate (UBP), lower bearing plate (LBP), and polyether-urethane elastomeric disc are estimated to ensure that the total bearing height satisfies design requirements.

DISC BEARING DESIGN DATA

FIGURE 6 - 125 M



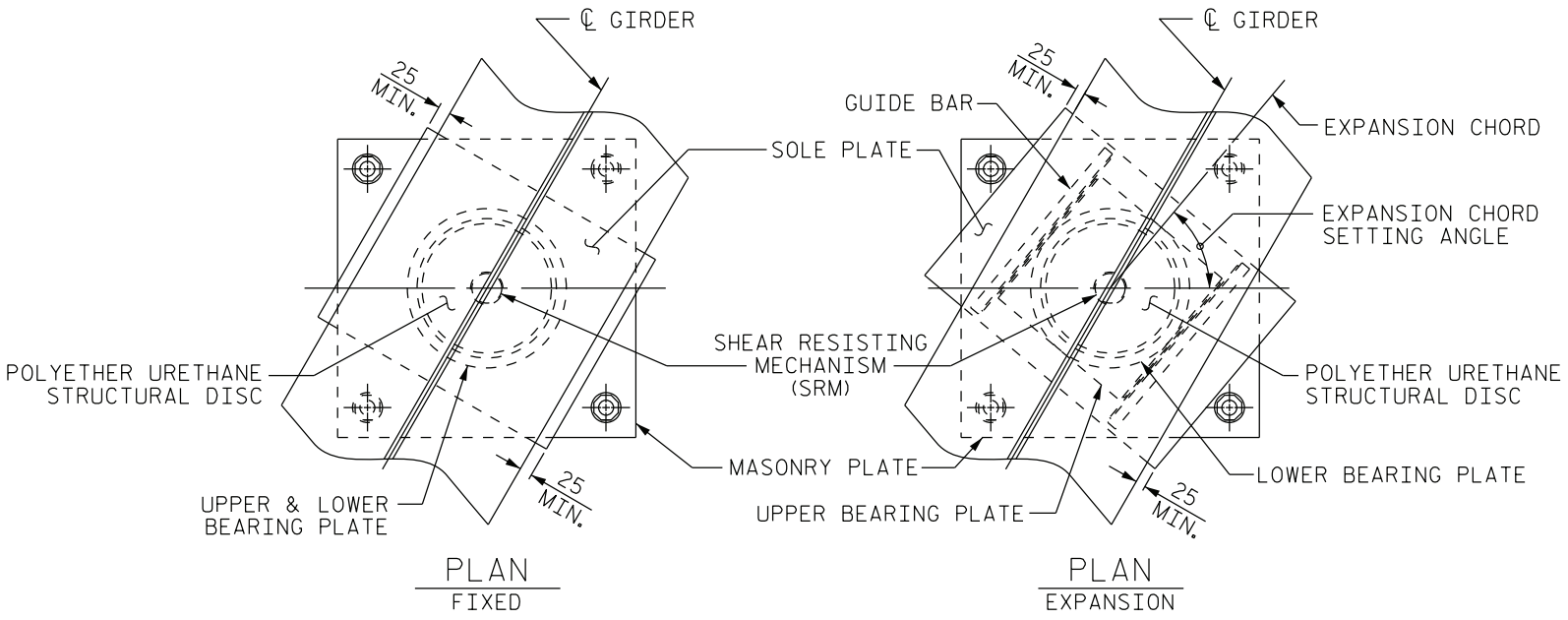


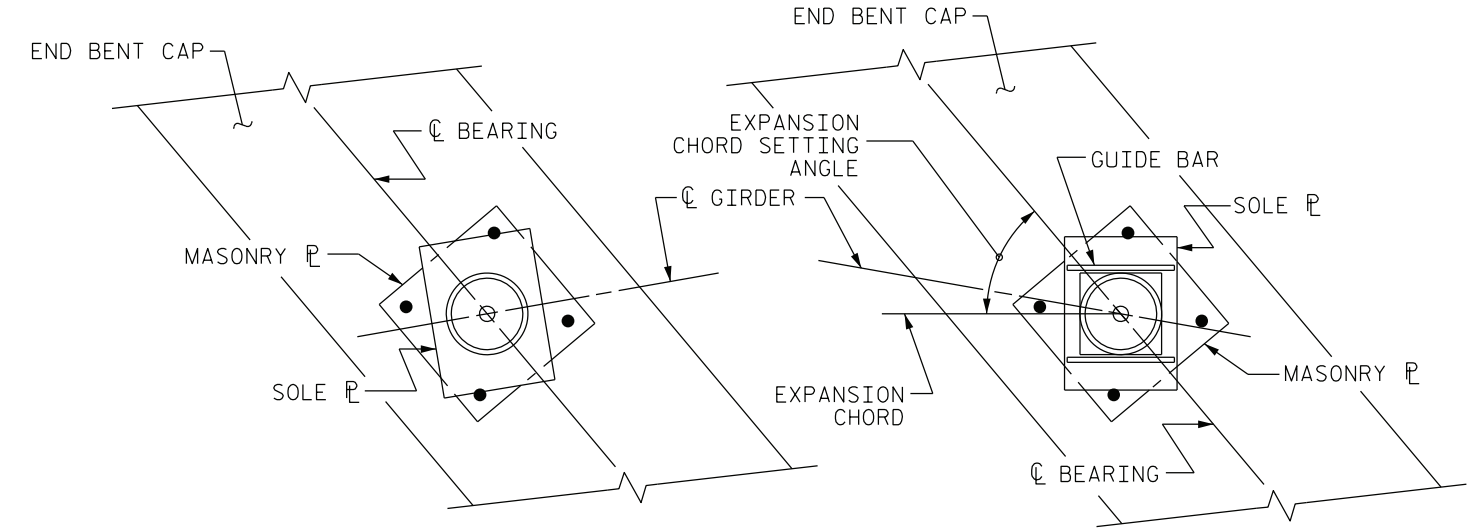
EXPANSION CHORD SETTING ANGLES	
GIRDER	END BENT #2
#1	57°-39′-24″
#2	57°-57′-02″
#3	58°-14′-23″
#4	58°-31′-26″

DISC BEARING SETTING DETAILS

CURVED GIRDER EXAMPLE

FIGURE 6 – 126





EXPANSION CHORD SETTING ANGLES	
GIRDER	END BENT #2
#1	57°-39′-24″
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DISC BEARING SETTING DETAILS

CURVED GIRDER EXAMPLE

FIGURE 6 – 126 M