PENNDOT Project # 03-03 (C07)
Development of Pot Bearing Standards

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National Pot Bearing Standards
FHWA, FDOT, NCDOT, PENNDOT

in association with:
Michael Baker Jr., Inc.
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COMMENT/RESPONSE FORM

Submission Subject: **National Pot Bearing Standards**
Review of PENNDOT Standard BD-613M

Prepared By: **Eric L. Martz, P.E. / Robert T. Doble, Jr., P.E.**

Date of Response: **May 9, 2005** **Date of Receipt:** **August 2004**

Comment No.	Comment	Response
FHWA	**Comments from FHWA: Vasant Mistry, P.E.**	
1	In general, the presentation and the design look good.	No response required.
2	GUIDED BEARING AND FIXED BEARING: If the additional cost of a groove weld is not prohibitive, we recommend a groove weld at the guide bar connection with the side plate for the guided bearing and at the piston connection with the plate for the fixed bearing in lieu of the fillet weld shown.	We discussed this issue with a pot bearing manufacturer. They stated that a groove weld is considerably more expensive than a fillet weld. They also stated that they have used fillet welded connections successfully on hundreds of projects.
3	It is not clear if ring tension is considered in the design of the pot of the pot bearing. We recommend considering ring tension in designing the pot for pot bearings.	The equation listed as AASHTO Equation 14.7.4.7-1 is taken from NCHRP Report 432, Equation D-15 (page D16). Note that the constant in the equation was increased by AASHTO from 33 to 40. This equation is the result of a derivation that accounts for both hoop stresses and bending stresses.
FDOT	**Comments from FDOT: Henry T. Bollmann, P.E.**	
1	Were the DS Brown MathCad calculations checked in detail by Michael Baker or a PE at PENNDOT? Need verification as the Standards are based on the DS Brown calculations.	Yes, the Mathcad calculations developed by D.S. Brown were checked by Baker. Baker presented a summary of the calculation check to PENNDOT during the BD-613M development stage and PENNDOT agreed with the calculation methodology.
2	Need provision in the Tables for plate thickness dimension at all 4 corners of the sole plate. These plates are often beveled transversely and longitudinally.	The sole plate thickness provided in the BD-613M standards is based on satisfying an allowable bending stress of 0.55*Fy. Since nearly every bridge will require different bevels in the longitudinal and/or transverse directions, the standards show the minimum sole plate thickness only. The designer then adds to the minimum thickness to account for the bevel (if required) and adjusts the total bearing height accordingly. This is explained in the “Sole Plate Design” notes (Note 2) on Sheet 1 of the BD-613M standards.

3	Am I clear on how these "standards" are to be used? Bridge designer uses these sheets to size the pot bearing and related plates. Uses the notes and details as needed. The bearing supplier provides shop drawings for approval.	The intent of the BD-613M standards is to provide bearing component sizes based on calculated loads in lieu of performing a complete bearing design. PENNDOT still requires the pot bearings to be detailed on the contract drawings as per the BD-613M standards. The fabricator is still required to submit shop drawings during construction. However, as long as the bearing is detailed in accordance with the contract drawings, design calculations are not required with the shop drawing submission. PENNDOT's intent is to evolve the BD-613M standards into construction standards, which would eliminate the need for shop drawings.
4	I like the design methodology shown here and the bearing design examples are helpful. I would use these "standards". The design of the pot bearings and detailing has always been a time consuming task.	No response required.
5	It's not clear to me where the direction of the guide bars is shown. I think in the plan view, section B-B sheet BD-613M, the direction of the guide needs to be shown (as a bearing) and how the masonry plate is oriented on the bridge pier. Note that for curved bridges each pot bearing will often have a different guide bearing angle.	The BD-613M standards depict the guide bars as parallel to the CL girder/beam and the masonry plate as perpendicular to the CL girder/beam. This is shown in Sections B-B and C-C on Sheet 12 of the standards. However, the designer can change the orientation of the guide bars and masonry plates as required as long as geometric clearances are verified. This is discussed in Note 12 on Sheet 1 of the standards.
6	There are notes "weld as per design"….as where pot is attached to the masonry plate. Are these notes directed to the Bridge designer or the pot bearing supplier?	The BD-613M standards are intended to be used by the bridge design engineer. Therefore, the notes are directed to the design engineer and as such he or she would be responsible for sizing the pot to masonry plate weld.
7	See the plan sheets I sent to Patricia Kiehl. Note the 6 inch block out for the swedge anchor bolt sheet C-112. We recommend this for construction tolerances. See note 9 on sheet C-112….we found this necessary to keep the bearings from being turned the wrong way in field placement. This has happened several times.	The BD-613M standards show a generic detail for the anchor bolt embedment. However, the blockout detail you refer to has been used on occasion for PENNDOT bridges as well. Notes 12 & 13 on Sheet 14 of the BD-613M standards are intended to eliminate bearing misplacement in the field. The project team is willing to discuss the inclusion of additional anchor bolt details and field placement instructions.

8	Note the angle of the bolts which attach the top plate / bevel plate to the girder…sheet C-111. On our last job the contractor drilled the holes in the bottom flange of the girder at 90 degrees to the bottom of the box girder flange and the pot bearing manufacturer installed the bolts at 90 degrees to the top plate and so there was a fit up problem in the field…they had to bend the bolts to fit.	The sole plate attachment detail you reference is similar to the tapped bolt detail shown on Sheet 15 of the BD-613M standards. This sheet provides details for connecting sole plates to both steel girders and P/S concrete beams. However, situations often vary where other sole plate connection details are required. We suggest adding a note to the detail on Sheet 15 of the BD-613M standards that makes the designer aware of the potential for bolt/thread misalignment when using beveled plates.
9	An item of interest: DS Brown elected to fabricate the top plate and bevel plate shown on sheet C-111 from one plate. (made these into one plate).	No response required.
NCDOT	**Comments from NCDOT:** **James Gaither, PE [comments 1 –11] ;** **T.K. Koch, PE [comments 12 -17]**	
1	**Standard Drawing Comments:** Sheet 8—several of the sole plate, guide plate and guide bars are greater than 4" thick. Plates greater than 4" thick may not be available in M270 (ASTM A709), Grade 50. The AASHTO and ASTM specifications do not specify the yield for plates greater than 4". Equivalent ASTM specifications require reduced yield for plates greater than 4".	We agree that the ASTM and AASHTO specifications do not specify yield strengths for plates over 4". This was apparently overlooked during the generation of the standards. The pot bearing manufacturer that we contacted performed a review of material certifications for plates they received that were over 4" thick. Their certifications show that the yield strength is still generally above 50 ksi. However, the project panel members should discuss the incorporation of a dual material specification for plates greater than 4" thick.

2	Sheet 10, pot is recessed into the masonry plate and caulked. We require the plate welded to the masonry plate and not recessed. We could not find reference in AASHTO on attaching the pot base to the masonry plate. There may be cost savings in welding instead of recessing and during an earthquake welding may perform better than recessing.	The primary reason for the recessed detail is to allow for future replacement of the pot bearing without the need to grind the existing weld or remove the masonry plate. See the last paragraph of AASHTO LRFD Bridge Design Specifications, Section C14.8.1, which suggests the recessed detail. Please note that the BD-613M standards also include an alternate welded connection for attaching the pot to the masonry plate (see BD-613M, Sheet 14, "Alternate Pot Plate Attachment"). This welded detail was included in the standards because PENNDOT used to specify welding only throughout the state.
3	Sheet 11: ss plate is 13 gauge. AASHTO LRFD 14.7.2.3.2 and our PSP requires 11 gauge when dimension greater than 12"	The AASHTO LRFD Bridge Design Specifications (1998 & 2004), Section 14.7.2.3.2 states that the SS mating surface shall be at least 16 gage when the maximum dimension of the surface is less than or equal to 12", and at least 13 gage when the maximum dimension of the surface exceeds 12".
4	Sheet 12: two guide bars and a guide plate instead of a center guide key will significantly increase fabrication cost. It may be appropriate to develop a separate standard for light-loaded and heavy-loaded bearings.	PENNDOT prefers external guide bars for bearing inspection purposes. If center guide bars are used, they may not be as visible during inspections. In addition, AASHTO LRFD (1998) Section C14.7.4.7 discusses a few disadvantages of using a center guide bar. However, if the project team members prefer to use center guide bars, these details will be incorporated into the standards as an option.
5	Sheet 13: bedding material 1/8". We require 3/16", although we have heard just recently that pads not in 1/8" increments are hard to obtain and are considering modifying this size.	The bedding material is used to create a more uniform bearing area under the masonry plate since the substructure concrete finish may be rough. Both material thicknesses mentioned will likely serve this purpose.
6	Sheet 13: PTFE is attached to the guide plate by three methods (countersunk screws, adhesive and recessed PTFE). AASHTO requires only two attachment methods. Screw heads may be exposed after PTFE is worn down and damage the SS.	To ensure that the PTFE surfaces do not separate from the steel plates, PENNDOT prefers all three attachment methods. The standards could be modified to include attachment methods preferred by all agencies.
7	Sheet 14: anchor bolts are F1554 Grade 55, we use A449.	PENNDOT prefers to use F1554 Gr. 55 anchor bolts. PENNDOT does not allow the use of A449 bolts because the bolts are quenched and tempered, and we are concerned about the potential for brittle failures.

8	Sheet 14, for curved girder bridges should guide bars be oriented toward fixed bearings, and if so how?	The guide bar orientation is determined by the bridge design engineer. Many factors may influence the preferred orientation, such as intended direction of movement, bearing configuration at other substructure units, expansion dam type, and others.
9	**Calculation comments:** Sheet 3, Section 3F and Sheet 4 Section 4B—The equation to determine recess required for pot to masonry plate connection is not the equation referenced in eq. 6.7.6.2-1 and 6.7.6.2.2-2.	We agree. The calculation references to AASHTO LRFD, Section 6 are incorrect. The recess calculation is based on checking against the allowable bearing stress of 0.8*Fy using 1/3 of the pot circumference for bearing. A minimum recess depth of ¼" is used if the stress check yields a smaller recess. The allowable stress of 0.8*Fy is taken from the AASHTO Standard Specifications for bearing on pins.
10	Sheet 6, Section 6C iv and Sheet 7 6D iv – To determine weld required for the guide bar SS connection, the calculations reference 1992 AASHTO Section 10.32.2 and Eq. 10-12. Why did it not reference AASHTO LRFD specification?	The AASHTO LRFD Bridge Design Specifications do not list provisions for service load design of welds. Therefore, the equations from the 1992 AASHTO Standard Specifications were used to determine the required weld size based on service loads. (Note that PENNDOT used the 1992 AASHTO Standard Specifications prior to switching to LRFD. The 1992 Standard Specifications are still used in lieu of the 1996 Standard Specifications for non-LRFD designs such as curved girder bridges.) We suggest adding a note to the BD-613M standards listing the allowable service stress for weld design.
11	Sheet 7, section 6E and sheet 10 Section 8D—To determine guide plate and sole plate thickness; the loaded area was calculated using a 56.31 degree angle. This could be a simplification of a finite element analysis; in any event, the origin of this value is unclear.	The 56.31 degree angle represents a 1.5:1 distribution of load through the plates.
12	3a) Piston Face width --The calculations do not appear to be using the latest equations from LRFD, especially 14.7.4.7-2. There is now a 1.5 in the numerator instead of 2.5.	The pot bearing design calculations supporting the BD-613M standards are based on the AASHTO LRFD Specs. (Second Edition, 1998). AASHTO Equation 14.7.4.7-2 (1998) lists the constant 2.5 in the numerator because the term "Hs" (also in the numerator) is the applied horizontal service load. The Third Edition of the AASHTO LRFD Specs. (2004) modified equation 14.7.4.7-2 to include the constant 1.5 in the numerator in place of 2.5 because the term "Hu" is the applied lateral load from applicable strength and extreme event limit states.

13	3b) eq. 14.7.4.6-3 has changed to .04Dp.	The 0.045 factor is recommended in the Structural Committee for Economical Fabrication (SCEF) Specification, Standard 106, Section 106.4.2.1.3. This specification was used in conjunction with the AASHTO specifications to develop the BD-613M standards. PENNDOT decided to use the more conservative value of 0.045.
14	3e) eq. 14.7.4.7-1 has changed – the 40 in the numerator is now 25.	See response to comment 12. The terms "Hu" and "Θu" in AASHTO Eq. 14.7.4.7-1, which are the lateral load and rotation respectively, are calculated as strength or extreme limit state values in the Third Edition of the AASHTO LRFD Specs. Previously in the Second Edition, these terms were service limit state values. This difference accounts for the lower constant in the equation.
15	3F) the equation for pot recess does not match LRFD 6.7.6.2.2-1.	See response to comment 9.
16	4c) Piston Thickness—there appears to be no allowance for compressive deflection—i.e., no 2δu term. We should consider assuming some flat dimension like 1/16" for this term since it is difficult to quantify…	The equation cited is from the SCEF Specification, Standard 106, Section 106.4.2.3.2. This specification was used in conjunction with the AASHTO specifications to develop the BD-613M standards. The SCEF specification does not include a term for the compressive deflection. The SCEF equation was used to develop the BD-613M standards in lieu of the similar AASHTO equation. The actual compressive deflection is likely small when compared to the deflection due to rotation coupled with the extra 0.125" that is included in the calculation.
17	6E) Again – to echo JG's comments—the origin of the 56.31 degree angle is obscure. I think most designers would assume 45 degrees.	See response to comment 11.
Baker	**Comments from Baker:**	
1	Sheet 1 of BD-613M, note 9 under "Instructions for Using Design Tables" lists dimension "Z" as one of the dimensions to reevaluate should the longitudinal movement exceed 3". Dimension "Z" is the length of the guide bar and should not be included in this note. The guide bar is designed to accommodate the required length of guide plate PTFE and would be unaffected by a longitudinal movement greater than 3".	We agree that the dimension "Z" is unaffected if longitudinal movements greater than 3" need to be accommodated. This dimension should be removed from the note.

2	If this standard is to be used nationally, the references to PENNDOT specifications (DM-4 & Pub. 408) should be removed and replaced with specifications appropriate for a national standard.	Perhaps more generic references to construction specifications could be incorporated to indicate use of specifications from the applicable state DOTs.
3	Consider adding a note to the example "DESIGN LOADS" tables on sheet 2 of BD-613M alerting designers that all applicable horizontal and vertical loads should be considered when calculating the design horizontal and vertical loads. (CF, BR, and etc. may apply to the design of pot bearings in certain situations, not just DL, LL+I and wind.)	An additional note may be a helpful reminder to designers.
4	Dimension "V" listed in the BD-613M bearing tables is the piston diameter and has been set as 0.02" less than dimension "S", which is the pot inside diameter and neoprene disc diameter. The 0.02" difference between these two dimensions represents the total clearance between the piston and the pot wall (0.01" clear around the perimeter) and is consistent for all bearing sizes listed in the BD-613M tables. AASHTO Section C14.7.4.7 states that an acceptable range for this clearance is 0.02" to 0.04". AASHTO Equation 14.7.4.7-4 is also provided to determine the clearance required to prevent the escape of elastomer between the piston and pot wall and is based on geometry. Note that the 0.02" minimum controls over AASHTO Equation 14.7.4.7-4 for all design cases covered in the standards. In a recent review of shop drawings provided for pot bearings, the fabricator modified the clear dimension between the pot and piston to 0.04" (0.02" clear around the perimeter). The fabricator stated that the 0.02" total clearance was very tight and essentially unachievable given the tolerances in machining the pot and piston. As a result, the fabricator reduced the piston diameter to provide a total clearance of 0.04". Consider modifying the piston diameter (dimension "V") to allow for a clearance range, or list the minimum piston diameter allowed.	The bearing manufacturer we contacted prefers that the difference between the pot inside diameter and the piston outside diameter be a minimum of 0.04". They also stated that additional consideration should be included to have this clearance increased if extremely high horizontal loads are required which cause large piston face widths. As a result, the project team should discuss this issue and possibly revise the clearance.

5	The length of the PTFE attached to the top of the guide plate (dimension “HH”) for guided pot bearings is less than the length of the PTFE mounted on the sides of the guide plate (dimension “KK”) for every design case listed in the BD-613M standards. Hence, one would expect the length of stainless steel mated to each of the PTFE surfaces (dimension “LL” for the guide plate stainless steel and dimension “NN” for the guide bar stainless steel) to vary in accordance with the length differences in PTFE surfaces so that the same movement capacity would be provided for each of the components. However, both the guide plate and guide bar stainless steel surfaces are listed as the same length in the guided pot bearing tables in the BD-613M standards. The guide plate stainless steel length (dimension “LL”) could be reduced based on the difference in PTFE lengths (dimension “KK” minus dimension “HH”).	We agree that the stainless steel sheet attached to the sole plate that mates with the top PTFE surface could be reduced in length as stated. However, this would be a small reduction in length. In addition, it is likely that the same sheet of stainless steel would be used to fabricate both the guide bar stainless steel sheets and the sole plate stainless steel sheets. Therefore, making the sole plate sheet shorter would require an additional cut in the fabrication process. Please note that the dimensions of the PTFE surfaces mated to the top and sides of the guide plate were sized based on the allowable stress of the PTFE. Since the applied stress is different in the vertical and horizontal directions, the length of top PTFE surface is different than the length of the side PTFE surface.

cc: Patricia Kiehl, P.E., PENNDOT
Vasant Mistry, P.E., FHWA
Henry T. Bollmann, P.E., FDOT
Tom Koch, P.E., NCDOT

PENNDOT DEPARTMENT OF TRANSPORTATION
BUREAU OF PLANNING AND RESEARCH
PROJECT # 03-03 (C07)
"Development of Pot Bearing Standards"

Task 2: Literature Review

Background

This project is a collaborative effort between the Federal Highway Administration (FHWA), the Florida Department of Transportation (FDOT), the North Carolina Department of Transportation (NCDOT), and the Pennsylvania Department of Transportation (PENNDOT). The goal of the project is to examine PENNDOT's existing design standards and drawings for high load multi-rotational bearings (pot bearings), compare the standards to the procedures and methods used by the other participating agencies, and determine if a revised pot bearing design standard can be developed that can be utilized by all agencies involved.

In 2003, PENNDOT published pot bearing design standards and drawings entitled "BD-613M: HIGH LOAD MULTI-ROTATIONAL POT BEARINGS". These standards provide designs for three configurations of pot bearings: fixed, guided, and non-guided. The standard designs are listed in tabular format and allow the designer to select the size of the various pot bearing components once the applied forces, movements, and rotations are known. The implementation of the standards greatly reduces the time required to design and detail pot bearings and ensures uniformity in pot bearing design throughout Pennsylvania. A copy of the BD-613M standards is included in Appendix A for reference and an overview of the standards is included below in the section entitled "BD-613M Overview".

Introduction

The intent of this task report is to review the available pot bearing literature from the participating agencies and compare and contrast those guidelines to the BD-613M standards. Design standards, specifications, and sample design drawings submitted by the participating agencies were reviewed to determine how the BD-613M standards may be modified to encompass any differing guidelines. The literature considered in the development of this report is included in the appendices.

In this report, the typical components of a pot bearing are discussed individually, and the material and design requirements are reviewed. Where these vary from agency to agency, the differences are highlighted and discussed. Terminology used in this report corresponds to BD-613M since the names of the various components may vary from agency to agency.

Typical Types of Pot Bearings

As stated previously, BD-613M includes design tables and details for fixed, guided, and non-guided types of pot bearings. Fixed bearings are designed to resist movement in all directions and allow rotation in all directions. Guided bearings are designed to resist horizontal movement along one axis and allow rotation in all directions. Non-guided bearings are designed to allow movement and rotation in all directions.

BD-613M Overview

Service load design methodology was used in developing the BD-613M standards. However, the standards accommodate applied loads developed from either the AASHTO Standard Specifications for Highway Bridges (Standard Specs.) by using the service load group combinations or from the AASHTO LRFD Bridge Design Specifications (LRFD Specs.) by using the Service I and Extreme Event I limit states.

Both English unit and Metric unit tables are provided for each of the three types of pot bearings. The tables include pot bearing designs that will accommodate vertical loads from 200 kips (890 kN) to 1500 kips (5293 kN), with a choice of horizontal load values equal to 10% or 30% of the vertical load (the 30% horizontal load table is omitted for non-guided bearings). The pot bearing component sizes were designed for a total rotation of 0.03 radians, which includes 0.02 radians for construction tolerance.

The guided and non-guided bearings were designed to accommodate a maximum calculated longitudinal movement of 3”, plus 1” of construction tolerance in each direction. Additional longitudinal movement can be accommodated by increasing the length of the sole plate, stainless steel and guide bars. The non-guided bearings were designed to accommodate a maximum calculated transverse movement of ½”, plus ¾” of construction tolerance in each direction. Additional transverse movement can be accommodated by increasing the dimension of the sole plate and stainless steel.

Once the design loads, rotations, and movements are known, the designer can select pot bearing component sizes from the tables provided in the standards. Note that if the design horizontal load exceeds 10% of the vertical load for a fixed or guided pot bearing, the designer has two options: the 30% horizontal load table may be used, or the 10% horizontal load table may be used by proceeding to a larger vertical load case with a corresponding 10% horizontal load greater than the design horizontal load. The only caution required for the latter case is to ensure that the minimum design vertical load is at least 20% of the tabulated vertical load.

The procedure described above demonstrates how the BD-613M standards provide “off-the-shelf” pot bearing designs. Although the design of pot bearings with vertical design loads greater than 1500 kips is currently beyond the scope of BD-613M, the standards could be expanded.

Pot Bearing Design Specifications

The BD-613M design standards were developed with the understanding that service load design methodology would be phased out in favor of the LRFD Specifications. However, curved steel bridges are designed using the Standard Specifications, and PENNDOT wanted to ensure that the BD-613M standards could be used for curved steel bridges. Therefore, the standards were developed to accommodate both specifications. The following lists the design procedure and specifications used by the participating DOT agencies:

- ***FDOT***: *Designers calculate loads per the AASHTO LRFD specifications and design several components of the pot bearing in accordance with the procedure outlined in the Structural Bearing Specification (SBI 1008 – 1991) by FHWA/SCEF (see Appendix B). The intent of the FDOT design is to determine the total maximum bearing height at the design stage to prevent significant changes in the bearing elevations during the shop drawing stage. The design also determines the outside diameter of the pot so that the masonry plate can be sized at the design stage. The major component dimensions of the pot bearings are shown on the design plans (see Appendix B for a sample set of pot bearing contract drawings). The remaining pot bearing components, such as the neoprene disc and piston, are sized by the designer by comparing different manufacturers' sizes and selecting the component size which yields the largest total bearing height. However, the actual component design is left to the manufacturer during the shop drawing stage.*

- ***NCDOT***: *Designers provide service loads, rotations, and movements based on the AASHTO Standard Specifications and the manufacturer is responsible for the pot bearing design.*

Pot Bearing Construction Specifications

The BD-613M standards specify that the bearing manufacturer must provide materials and workmanship in accordance with PENNDOT Specifications, Publication 408 (specifically Section 1111, see Appendix A), ANSI/AASHTO/AWSD1.5 Bridge Welding Code, and contract special provisions. The other participating agencies list their construction specifications as follows:

- ***FDOT***: *Standard Specification 461, entitled "Multirotational Bearings"*

- ***NCDOT***: *Standard Specification entitled "Pot Bearings"*

These specifications are included in the appendices. Differences between the specifications will be discussed on a component basis as outlined below.

Comparison of Pot Bearing Materials & Components: Design & Construction

Steel:

Structural steel is the primary material used in the manufacture of pot bearings. BD-613M specifies the use of AASHTO M270/ASTM A709, Grade 50 steel. (Publication 408 also lists Grade 36 and 50W.)

- ***FDOT***: *ASTM A709 Grade 50W steel per their Standard Specification entitled "Multirotational Bearings"*

- ***NCDOT****: AASHTO M270 Grade 50W steel per their Standard Specification entitled “Pot Bearings”*

Steel corrosion protection is required by PENNDOT for all three types of pot bearings. BD-613M requires shop painting the structural steel in accordance with Publication 408, Section 1060. Surfaces that are not to be painted include the PTFE, stainless steel, and the inside of the pot. In addition, only a prime coat of paint is to be applied to the contact area between the beam bottom flange and the sole plate, and to the bottom surface of the masonry plate.

- ***FDOT*** *specifies metallization of steel for pot bearings in accordance with their specification entitled “Multirotational Bearings”. However, in discussions with FDOT, the coating system for pot bearings varies among projects.*

- ***NCDOT*** *specifies metallization of steel for pot bearings in accordance with their Special Provision for “Thermal Sprayed Coatings (Metallization)” (included in Appendix C).*

Pot:

The pot is a typical component of all three types of pot bearings. This component is designed to resist the applied horizontal loads and to provide confinement for the neoprene disc under load.

In BD-613M, the pot wall thickness for fixed and guided bearings is calculated using AASHTO LRFD (1998), Equation 14.7.4.7-1 and Section C14.7.4.6. The pot wall thickness for non-guided bearings is designed for a nominal horizontal load equal to 10% of the vertical capacity of the bearing, as well as AASHTO LRFD (1998) Equation 14.7.4.6-5 and Section C14.7.4.6. The thickness of the pot base is calculated using AASHTO LRFD (1998) Equations 14.7.4.6-3 and 14.7.4.6-4.

The preferred method of attaching the pot to the masonry plate in BD-613M is to machine a recess into the masonry plate and place the pot in the recess. However, welding the pot to the masonry plate is an accepted alternative. When the recessed method is used, the perimeter of the pot is sealed to the masonry plate with an approved caulking compound in the shop after the paint has dried. The caulk is specified as Sikaflex IA or an approved equal. Recessing the pot in the masonry plate allows for ease of future replacement without the need to remove the anchor bolts and masonry plate.

- ***FDOT****: The pot base thickness is sized by the manufacturer. The sample contract drawings provided indicate a 3/16” recessed connection detail similar to that shown in the BD-613M standards.*

- ***NCDOT****: The pot is designed by the manufacturer. The specification entitled “Pot Bearings” discusses welding the pot to the masonry plate but does not limit the attachment otherwise. The standard pot bearing details provided show a welded connection between the pot and masonry plate.*

Elastomeric (Neoprene) Disc:

The elastomeric disc is a typical component of all three types of pot bearings. This component is confined by the pot and designed to accommodate vertical load and rotation.

In BD-613M, the disc diameter was calculated by limiting the average stress to 3.5 ksi per AASHTO LRFD (1998) Section 14.7.4.4. The disc thickness was calculated using AASHTO LRFD (1998) Equation 14.7.4.3-1.

The material for the elastomeric disc is specified in BD-613M as virgin plain neoprene or natural rubber with hardness of 50 Durometer (+/- 10) in accordance with AASHTO M251. The disc surfaces are to be lubricated with silicone grease in accordance with Military Specification MIL-S-8660 and as recommended by AASHTO LRFD (1998) Section C14.7.4.4.

- ***FDOT**: The manufacturer is responsible for the design of the neoprene disc per the applicable design specification (either the Standard Specifications or the LRFD Specifications). Note that their specification entitled "Multirotational Bearings" does not discuss the material requirements for the neoprene disc. The sample contract drawings provided indicate the use of a PTFE sheet on top and bottom of the neoprene pad.*

- ***NCDOT**: Per their Pot Bearing specification, the maximum average stress on the disc is limited to 3500 psi. The material requirements for the disc are similar with a 50 Durometer hardness specified, but no allowable variance in hardness is listed. In addition, their specification states that the disc should allow for a minimum rotation of 0.02 radians. Instead of lubricating the disc with silicon grease, their specification indicates the use of a 1/64" thick PTFE disc on either side (top or bottom) of the disc or other material as approved by the Engineer.*

Sealing Rings:

Sealing rings are a typical component of all three types of pot bearings. The purpose of the sealing rings is to prevent leakage of the neoprene disc under load.

In BD-613M, the sealing rings are comprised of three, 3/32" thick flat brass sealing rings with rectangular cross sections. Three rings are stacked and placed in a recess in the neoprene disc so that the top of the upper ring is flush with the top surface of the neoprene disc. Each end of the sealing rings is cut at a 45° angle with a maximum opening between the ends of 0.05". The openings are staggered 120° apart. The width of the sealing rings listed in BD-613M was calculated by AASHTO LRFD (1998) Section 14.7.4.5.2. Sealing ring material requirements are per ASTM B36 (half hard).

- ***FDOT**: Designers do not design or detail the sealing rings on the design drawings. This item is left to the manufacturer to detail in the shop drawing stage. Note that the SCEF SBI-1008 (1991) specification allows the use of flat or round sealing rings.*

- ***NCDOT:*** *Their Pot Bearing specification discusses the use of a brass sealing ring. A round ring is shown on their standard details sheet, but the material specification is not mentioned. The manufacturer is responsible for sizing and detailing the sealing rings.*

Piston:

The piston is a typical component of all three types of pot bearings. The purpose of the piston is to transfer loads and rotations from the sole plate or guide plate to the neoprene disc and the pot.

In BD-613M, the piston face width was calculated using AASHTO LRFD (1998) Equations 14.7.4.7-2 and 14.7.4.7-3, along with the provisions of Section C14.7.4.7. The piston diameter was calculated as the pot inner diameter minus a calculated clearance. The clearance is the maximum of the dimension calculated using AASHTO LRFD (1998) Equation 14.7.4.7-4 and 0.02" per AASHTO LRFD (1998) 14.7.4.7. However, given the range of pot bearing sizes and rotations covered by BD-613M, the minimum clearance of 0.02" controls over Equation 14.7.4.7-4. Therefore, the piston diameter is always 0.02" less than the inside pot diameter for standard derived bearings.

- ***FDOT****: Designers select a maximum piston height by comparing several manufacturers' catalogs so that the total bearing height is known during the design stage. However, the piston face width and clearance are determined by the manufacturer. If the piston height is modified by the manufacturer during the shop drawing stage, the contractor is required to adjust the bearing elevations accordingly.*

- ***NCDOT:*** *The manufacturer is responsible for sizing and detailing the piston based on design loads provided on the contract drawings by the designer.*

Sole Plate:

The sole plate is a typical component of all three types of pot bearings. The purpose of this component is to provide a means of attachment to the beam/girder above the bearing. The sole plate is usually designed so its bottom surface is level and the top surface matches the anticipated slope of the bottom of the beam/girder in the final erected position.

For fixed bearings, the sole plate plan dimensions are a function of the piston diameter. For non-guided bearings, the sole plate plan dimensions are controlled by the piston diameter and the excess length and width required to accommodate the anticipated movements. For guided bearings, sole plate plan dimensions are set by the required length and width of the guide system. In addition, connection details to the beam/girder above may increase the plan dimensions. This is especially true with skewed structures.

In BD-613M, the thickness of the sole plate was designed for flexure by assuming an equivalent square area of the circular piston area or the square area of the PTFE attached to the upper surface of the guide plate. The pressure transferred from the piston or PTFE was assumed to distribute through the sole plate at a 1.5:1 slope. The moment in the sole plate was determined by assuming that the sole plate acts as a cantilever beam with a length equal to the length of the loaded area beyond the edge of the piston or PTFE sheet. The required plate thickness was then determined using the calculated moment and an allowable bending stress of 0.55*Fy = 27.50 ksi.

Note that the BD-613M tables do not include any allowance for additional sole plate thickness that may be required for beveling the plate to match roadway geometry and/or beam camber. The total bearing heights listed in the BD-613M tables are based on the minimum sole plate thickness indicated. The total bearing height needs to be adjusted by the designer if the sole plate thickness is not constant.

- ***FDOT**: The SCEF SBI-1008 (1991) specification lists the allowable bending stress at 0.75*Fy for sole plates. The example contract drawings provided by FDOT show a suggested beveled sole plate-to-beam connection using 1 ½" diameter A325 threaded rods with double heavy hex nuts. The sole plate plan dimensions and bevel thicknesses are provided by the designer on the contract drawings.*

- ***NCDOT:** The sample pot bearing details provided by NCDOT indicate that the sole plate dimensions are determined by the manufacturer based on the design loads provided on the contract drawings.*

Guide Plate:

The guide plate is a typical component of guided pot bearings only. The guide plate is set on top of the piston in a guided bearing assembly.

The guide plate plan dimensions are controlled by the piston diameter and the dimensions of the PTFE required on top of the plate. The guide plate-to-piston connection detail shown in BD-613M includes recessing the piston into the guide plate.

In BD-613M, the thickness of the guide plate was designed for flexure by assuming the piston acts on an equivalent square area of the guide plate. The pressure transferred from the piston was assumed to distribute through the guide plate at a 1.5:1 slope. The moment in the guide plate was determined by assuming that the guide plate acts as a cantilever beam with a length equal to the length of the loaded area beyond the edge of piston. The required plate thickness was then determined using the calculated moment and an allowable bending stress of 0.55*Fy = 27.50 ksi. In addition, consideration of the required height of PTFE attached to the sides of the guide plate may control the required guide plate thickness.

- ***FDOT:** The guide plate (termed "top plate") thickness is shown on the sample contract drawings provided, indicating that the designer calculates the thickness. The drawings also indicate that the plate is bolted to the sole plate by the use of threaded rods as discussed previously. The plate is connected to the piston through the use of a guide key.*

- ***NCDOT:*** *The guide plate (termed "top steel plate") is designed by the pot bearing manufacturer. The plate is attached to the piston through the use of a guide key.*

Guide Bars:

Guide bars are a typical component of guided pot bearings only. The bars are typically welded to the sole plate, bolted to the sole plate, or machined in the sole plate. Their function is to restrict movement of the beam/girder along one horizontal axis.

Welded guide bars are shown in BD-613M, but the guide bars may also be machined in the sole plate from a single block of steel. Bolted guide bars are not preferred by PENNDOT.

In BD-613M, the guide bar height was designed to accommodate the thickness of the stainless steel sheet attached to the sole plate, the exposed thickness of the PTFE sheet embedded in the guide plate, and the depth of the guide plate. The length of the guide bars was set equal to the required sole plate length so that horizontal restraint is provided under all longitudinal movement conditions. The guide bar attachment was designed by considering the shear and moment applied to the guide bars through horizontal forces acting on the bearing.

- ***FDOT:*** *The sample contract drawings provided show a single guide key placed along the centerline of the bearing. The thickness of the key is shown as ½" indicating that the designer sized the key, but the key height and keyway opening are determined by the manufacturer. (In speaking with a FDOT representative, we understand that their Department uses a simplified dynamic seismic analysis that generally equates to lower horizontal design forces when compared to the AASHTO simplified static force calculation. Note that the AASHTO contour maps showing acceleration coefficients for different parts of the country (AASHTO Figure 3.10.2-2) yield low acceleration coefficients for the state of Florida.)*

- ***NCDOT:*** *The standard pot bearing details provided also show a single, central guide key. Horizontal design loads are provided on the plans by the designer and the pot bearing manufacturer is responsible for the design of the guide key.*

PTFE:

PTFE sheets are typical components of guided and non-guided pot bearings. The PTFE sheets are recessed into and bonded to the guide plate in guided bearings and to the piston in non-guided bearings to allow for movement with minimal friction. Stainless steel sheets are welded to the opposing steel surfaces and bear on the PTFE sheets.

For guided bearings that include guide bars instead of guide keys, PTFE surfaces and opposing stainless steel sheets are used between the guide bar/guide plate interfaces. This detail is shown on Sheet 13 of 15 in the BD-613M standards (see Appendix A).

For the PTFE surface attached to the piston for non-guided bearings, BD-613M details the PTFE sheets as 3/16” thick and cut circular in plan so that they mirror the piston geometry. For guided bearings, the PTFE is also 3/16” thick but is cut square with ½” rounded corners to match the shape of the guide plate.

BD-613M specifies that the PTFE sheets are to be unfilled, dimpled, and lubricated. The PTFE that is mounted to the sides of the guide plate is to be pigmented. The PTFE sheets are to be manufactured from virgin TFE resin and conform to ASTM D4894. The dimples in the PTFE are to have a minimum edge distance of ½” and conform to AASHTO LRFD (1998) Section 14.7.2.

To facilitate bonding the PTFE to the steel surfaces, both the PTFE and the steel surfaces are to be grit blasted and degreased prior to bonding. The BD-613M standards also require etching of the PTFE on the side to be bonded to the steel surface. The bonding adhesive is to be applied per the manufacturer’s instructions. For the PTFE that is attached to the guide bars, PENNDOT requires the PTFE to be recessed, bonded, and mechanically fastened.

For design of the PTFE sheets, BD-613M specifies maximum and minimum stresses on the PTFE of 3.5 ksi and 0.7 ksi. A coefficient of friction between the PTFE and stainless steel sheets was assumed to be 0.04 for calculating the horizontal load transfer due to sliding.

- ***FDOT:*** *Unfilled PTFE sheets are shown on the sample contract drawings provided. Their specification entitled “Multirotational Bearings” allows the use of unfilled virgin PTFE or glass-fiber filled PTFE. The resin is to conform to ASTM D1457.*

- ***NCDOT:*** *Their standard specification for pot bearings indicates that the PTFE sheets are to be designed by the manufacturer. The specification lists acceptable material types as unfilled virgin PTFE or glass-fiber filled PTFE with resins conforming to the requirements of ASTM D4894 or D4895. The stress limit for design of the PTFE is limited to 3.5 ksi per the specification.*

Stainless Steel Sheets:

Stainless steel sheets are typical components of guided and non-guided pot bearings. The sheets are mated with the PTFE material to reduce friction during movement of the bearing.

BD-613M specifies the use of 13 gage stainless steel sheets meeting the requirements of ASTM A240, Grade 30, Type 304, with an ANSI 0.02 mil surface finish or less. The stainless steel is attached to the guide bars or sole plate with a 1/16” continuous fillet weld around the perimeter of the sheet.

- ***FDOT:*** *Their specification and sample contract drawings provided indicate that the stainless steel sheets are to conform to ASTM A240, Type 316. The sheet thickness is not indicated on the drawings, but their specification lists a minimum thickness of 1/16”.*

- ***NCDOT:*** *The manufacturer is responsible for designing the stainless steel sheets. Their standard specification for pot bearings lists the minimum sheet thicknesses as 16 gage for sheets less than 12" in plan and 11 gage for sheets greater than 12" in plan. The material type is listed as ASTM A240/A167, Type 304 with a minimum #8 mirror finish.*

Masonry Plate:

The masonry plate is a typical component of all three types of pot bearings. The purpose of the masonry plate is to transfer loads from the pot to the bridge substructure.

In BD-613M, the masonry plate was sized assuming it will be placed normal to the beam/girder centerline. Other orientations are permitted, but the designer must then design the masonry plate according to the methodology outlined in the standards and ensure all geometric clearances are satisfied.

The masonry plate widths (dimension normal to the beam/girder centerline) listed in BD-613M were set by placing the anchor bolts outside the sole plate to ensure adequate horizontal clearance and adding the minimum edge distances from the anchor bolt centerline to the edge of plate. The masonry plate lengths (dimension parallel to the beam/girder centerline) were established based on the required width to resist shear applied by the horizontal loads acting through the pot.

To determine the required masonry plate thickness, the calculations used to develop the BD-613M standards assume the vertical load acting through the pot is evenly distributed through the masonry plate. The moment was calculated assuming the plate acts like a cantilever beam outside the diameter of the pot. The longest cantilever length from either direction is used to calculate the maximum moment in the plate. The allowable bending stress in the plate is limited to 0.55*Fy = 27.50 ksi per AASHTO Table 10.32.1A and the allowable concrete bearing stress is assumed to be 0.30 ksi.

BD-613M indicates two different details for attaching the pot to the masonry plate. The first detail includes setting the pot into a machined recess in the masonry plate and sealing around the perimeter of the pot base with an approved caulking compound. The second detail includes welding the pot to the masonry plate.

- ***FDOT:*** *The masonry plate is sized by the designer per the SCEF SBI-1008 (1991) specification, which lists procedures to be used for masonry plate design. Note that this specification sets the allowable bending stress in the plate at 0.75*Fy. The sample contract drawings provided show the pot attached to the masonry plate through the use of a 3/16" deep machined recess.*

- ***NCDOT:*** *The masonry plate is sized by the designer and detailed on the contract drawings. The standard details provided show the pot attached to the masonry plate through the use of a welded connection.*

Anchor Bolts:

Anchor bolts are a typical component of all three types of pot bearings. Anchor bolts are embedded in the bridge concrete substructure and attach the masonry plate to the substructure to ensure load transfer.

BD-613M requires the use of swedged anchor bolts meeting the requirements of ASTM F1554, Grade 55. The number of anchor bolts was determined by limiting the shear stress in the bolts to 0.33*Fy = 18.15 ksi. Anchor bolt nuts are to meet the requirements of ASTM A563, Grade DH and the washers are to meet the requirements of ASTM F436, Type 1.

Anchor bolts, nuts and washers are galvanized per PENNDOT Publication 408, Section 1105.02(S). The nut and washer installation procedure specified in BD-613M indicates that a single nut and washer are to be installed on each anchor bolt. The nut is to be installed finger-tight against the washer and then backed off ¼ turn. The anchor bolt threads are peened after the nut is installed to prevent the nut from loosening.

The anchor bolt detail in BD-613M indicates that the swedged bolts are embedded in the concrete substructure. However, another common method includes the use of preformed holes placed in the concrete substructure. This method allows installation of the anchor bolts through the use of non-shrink grout after construction of the substructure unit.

- ***FDOT:*** *The sample contract drawings provided show a 6" diameter preformed blockout in the concrete substructure for anchor bolt installation. Notes provided on the sample contract drawings indicate that the swedged anchor bolts are to conform to ASTM A307 and are to be galvanized. The designer provides the anchor bolt diameter, length, and configuration on the contract drawings. Note that their specification entitled "Multirotational Bearings" does not discuss anchor bolts.*

- ***NCDOT:*** *The standard details provided show a preformed hole in the concrete substructure. The hole is created by using a 4" diameter x 1'-3" long standard pipe with a closed end. A grout tube is also placed outside of the masonry plate plan area and is attached to the side of the pipe near the bottom to facilitate placing of the non-shrink, non-metallic grout. Their standard specification for pot bearings indicates that the anchor bolt size and length are provided by the designer and detailed on the contract drawings.*

Bedding Material:

Bedding material placed on top of the concrete substructure and under the masonry plate is typical for all three types of pot bearings. BD-613M specifies the use of 1/8" thick bedding material meeting the requirements of ASTM D378.

- ***FDOT:*** *A 1/8" thick neoprene pad under the masonry plate is shown on the sample contract drawings provided.*

- *NCDOT: A 3/16" thick preformed neoprene pad under the masonry plate is shown on the standard details provided.*

Conclusions & Recommendations

The component by component comparison outlined above demonstrates that there are more similarities than differences between the DOT agencies with regard to pot bearing design and manufacture. Through future discussions, the differences will likely be reduced or allowance can be made to account for the differences through the use of expanded design standards.

Upon PENNDOT approval, Baker recommends distributing the final report to the other project panel members for review and comment. Following the review and comment period, we also suggest meeting with all project panel members to determine the exact scope for expansion of the current BD-613M standards. This meeting will be the springboard for advancing the project to "Task 3: Research and Drafting of Pot Bearing Standards".

SUMMARY OF POT BEARING DESIGN & CONSTRUCTION: AGENCY COMPARISON BY COMPONENT			
COMPONENT	**PENNDOT**	**FDOT**	**NCDOT**
Design Specifications	AASHTO Standard Specifications for Highway Bridges (Fifteenth Edition, 1992) / AASHTO LRFD Bridge Design Specifications (Second Edition, 1998)	AASHTO LRFD Bridge Design Specifications & SCEF SBI 1008-1991	AASHTO Standard Specifications for Highway Bridges
Construction Specifications	Specification entitled "Publication 408", Section 1111	Standard Specification 461, entitled "Multirotational Bearings"	Standard Specification entitled "Pot Bearings"
Structural Steel	AASHTO M270/ASTM A709, Grade 50 (Grades 36 and 50W are also listed in Pub. 408)	ASTM A709, Grade 50W	AASHTO M270 Grade 50W
Steel Corrosion Protection	Shop painting is required in accordance with Publication 408, Section 1060.	Metallization of steel for pot bearings in accordance with their standard specification	Metallization of steel for pot bearings in accordance with their special provision for "Thermal Sprayed Coatings (Metallization)"
Pot	The pot wall thickness and pot base thickness are designed according to equations in AASHTO LRFD (Second Edition). The preferred method of attaching the pot to the masonry plate is to machine a recess into the masonry plate and place the pot in the recess. However, welding is an acceptable connection alternative.	The pot base thickness is sized by the manufacturer. A sample drawing provided shows a 3/16" recessed connection detail, similar to the one in PENNDOT's BD-613M standard.	The pot is designed by the manufacturer. The specification entitled "Pot Bearings" discusses welding the pot to the masonry plate, but does not limit the attachment method. The standard pot bearing details provided show a welded connection between the pot and masonry plate.
Elastomeric Disc	Virgin plain neoprene or natural rubber with hardness of 50 durometer (+/-10) per AASHTO M251. The disc surfaces are lubricated with silicone grease. Allowable design pressure = 3,500 psi (max) & 700 psi (min).	Manufacturer is responsible for design of the neoprene disc per the applicable design specification. The FDOT specification does not discuss the material requirements. The contract drawings provided indicate the use of a PTFE sheet on top and bottom of the neoprene pad.	Neoprene with a hardness of 50 durometer capable of a minimum rotation of 0.02 radians. The NCDOT specification requires a 1/64" thick unfilled PTFE disc on either side of the neoprene disc inside the bearing. Other Engineer-approved material is permitted. Allowable design pressure = 3,500 psi (max).
Sealing Rings	PENNDOT requires 3 flat brass sealing rings meeting ASTM B36 (half hard) specification. Ends are cut at a 45° angle with a maximum gap of 0.05". The openings are staggered in the brass rings 120° apart. Sealing rings are recessed in elastomeric discs so that the top sealing ring is flush with upper surface of elastomeric disc.	Manufacturer is responsible for design of the sealing rings.	Manufacturer is responsible for sizing and detailing the rings. A single, brass sealing ring with round cross section is shown on the NCDOT standard details sheet. Material specification is not mentioned on the standard details sheet. Rings are placed on top of the elastomeric disc in pot.
Piston	The piston face width is calculated using equations in AASHTO LRFD (Second edition). The piston diameter is always 0.02" less than the inside pot diameter for standard derived bearings.	Designers select the piston height by comparing several manufacturer's catalogs so that the total bearing height is known during the design stage. However, the piston face width and clearance are determined by the manufacturer. If the piston height is modified by the manufacturer, the contractor is required to adjust the bearing elevations accordingly.	The manufacturer is responsible for sizing and detailing the piston based on design loads provided on the contract drawings by the designer.
Sole Plates	The thickness of the sole plate is designed for flexure based on an allowable bending stress of 0.55*Fy. The standards show a tapped bolt or welded connection between the sole plate and girder. The sole plate plan dimensions and bevel thicknesses are provided by the designer on the contract drawings.	The SCEF SBI-1008 (1991) specification lists the allowable bending stress at 0.75*Fy for sole plates. The example contract drawings provided show a beveled sole plate to girder connection using threaded rods with double heavy hex nuts. The sole plate plan dimensions and bevel thicknesses are provided by the designer on the contract drawings.	Sole plate dimensions are determined by the manufacturer based on the design loads provided on the contract drawings.
Guide Plate	The thickness of the guide plate is designed for flexure based on an allowable bending stress of 0.55*Fy. The plate is connected to the piston by recessing the piston into the guide plate. The PTFE and SS are located between the guide plate and sole plate.	The guide plate (termed "top plate") thickness is provided by the designer on the contract drawings. The plate is bolted to the sole plate by the use of threaded rods. The plate is connected to the piston through the use of a center guide key. The PTFE and SS are located between the piston and guide plate.	The guide plate (termed "top steel plate") is designed by the pot bearing manufacturer. The plate is attached to the piston through the use of a center guide key. The PTFE and SS are located between the piston and guide plate.
Guide Bar	External guide bars are typically welded to the sole plate, bolted to the sole plate or machined in the sole plate.	A single guide key is placed along the centerline of the bearing. The thickness is designed by the designer but the key height and keyway opening are determined by the manufacturer.	A single, central guide key is used. Horizontal design loads are provided by the designer and the pot bearing manufacturer is responsible for the design of the guide key.
PTFE	PTFE is required to be unfilled, dimpled and lubricated. Made from virgin TFE resin per ASTM D4894. Dimples must have a minimum edge distance of 1/2" and conform to 1998 AASHTO LRFD Section 14.7.2. Allowable design pressure = 3,500 psi (max). For non-guided pot bearings, the PTFE is bonded in a 3/32" recess in the top of the piston. For guided pot bearings, the PTFE attached to the top of the guide plate is bonded in a 3/32" recess, while the PTFE on the edges of the guide plate is recessed, bonded, and mechanically fastened with countersunk screws.	Unfilled PTFE sheets are shown on the sample drawings provided. The FDOT specification entitled "Multi-rotational Bearings" allows the use of unfilled virgin PTFE or glass-fiber filled PTFE. The resin is to conform to ASTM D1457. The sample drawing provided shows the PTFE bonded in a 1/16" recess on the top of the piston.	Acceptable PTFE types are unfilled, virgin PTFE sheets or glass-fiber filled PTFE sheets, resulting from skiving billets formed under hydraulic pressure and heat. Resin is to conform to ASTM D4894 or D4895. Allowable design pressure = 3,500 psi (max). The specification provided states that the PTFE is bonded to the piston by using heat cured high temperature epoxy capable of withstanding temperature of -320° F to 500° F.
Stainless Steel	Stainless steel sheets are 13 gage and conform to ASTM A240, Grade 30, Type 304 with an ANSI 0.02 mil surface finish or less. Stainless steel is attached to the guide bars or sole plate with a 1/16" continuous fillet weld around the perimeter of the sheet. The design coefficient of friction when mated with PTFE is 0.04.	Stainless steel sheets are to conform to ASTM A240, Type 316. Specification lists a minimum thickness of 1/16".	NCDOT specification calls for ASTM A240/A167, Type 304 with a minimum #8 mirror surface finish. Thickness provided is 16 gage for max. plan dimension <= 12", 11 gage for max. plan dimension > 12".
Masonry Plate	Designed using an allowable bending stress of 0.55*Fy. Two methods to attach pot to masonry plate: setting the pot in a machined recess in the masonry plate and sealing around the perimeter of the pot base with an approved caulking compound, or by welding.	Sized by the designer per the SCEF SBI-1008 (1991) specification, which lists procedures to be used for the masonry plate design. Allowable bending stress is 0.75*Fy. Pot is attached to the masonry plate with a 3/16" deep machined recess on sample drawings provided.	Sized by the designer and detailed on the contract drawings. Pot is attached to the masonry plate using a welded connection.
Anchor Bolts	Galvanized, swedged anchor bolts conforming to ASTM F1554, Grade 55 are used. Hex nut and washer to be drawn up finger tight to masonry plate then back off 1/4 turn. The anchor bolt threads are peened after installation. The swedged bolts are embedded in the concrete substructure.	Galvanized, swedged anchor bolts conforming to ASTM A307 are used. Anchor bolts are installed using 6" diameter preformed blockouts. Designer provides anchor bolt diameter, length and configuration.	Preformed holes are used for anchor bolt installation. The holes are created by using a 4" diameter x 1'-3" long standard pipe with a closed end. A grout tube is also placed outside of the masonry plate plan area and is attached to the side of the pipe near the bottom to facilitate placing of the non-shrink, non-metallic grout. Designer provides anchor bolt diameter, length, and configuration.
Bedding Material	A 1/8" thick bedding material meeting the requirements of ASTM D378 is shown in the PENNDOT standards.	A 1/8" thick neoprene pad is shown on the sample drawings provided.	A 3/16" thick preformed neoprene pad is shown on the standard details provided.

Project #03-03 (C07)
DEVELOPMENT OF POT BEARING STANDARDS
MEETING MINUTES

Purpose:	Project Status Report
Date/Time:	Thursday, May 26th, 2005, 2:30 PM
Place:	Michael Baker Jr, Inc. (Harrisburg Office – via conference call)
S.O. #:	103731
Author:	Robert Doble, Michael Baker Jr., Inc.
Issued on:	July 13, 2005

Attendees:

Patti Kiehl	PENNDOT, Technical Advisor
Tom Koch	North Carolina DOT
Henry Bollmann	Florida DOT
Vasant Mistry	FHWA
Dave Marchese	Baker, Agreement Manager
Eric Martz	Baker, Project Manager
Dave Frey	Baker, QA/QC
Robert Doble	Baker, Project Engineer

Discussion:

On May 10, 2005, Baker sent out the Task 2 Report, along with responses to the Task 1 comments, to the project panel members for their review and comment. A conference call was held on May 26, 2005 with all project panel members to verify that comments were addressed and to discuss the scope for expanding the pot bearing standards.

Agenda Item 1: Task 1 Comments/Reponses

Eric Martz (Baker) asked each panel member if they were satisfied with the responses to the Task 1 Comments and if they had any further comments. Henry Bollmann (Florida DOT) questioned how the BD-613M (bridge design) standard is used by PENNDOT. Eric stated that the Engineer develops the pot bearing loads, uses the tables in the standards to determine the pot bearing component dimensions, and uses the standard details to develop contract drawings. PENNDOT also provides standard Bridge Construction drawings that show construction details and are only referred to in the contract drawings. However, a PENNDOT bridge construction standard has not yet been developed for pot bearings.

Henry stated that the BD-613M standards seem to give the Engineer nearly all the information that is needed to detail the pot bearings except for the corner dimensions of the sole plate. Henry recommended adding columns to the design tables to include the corner dimensions of the sole plates. Henry stated that if the columns were added, the standards could serve as shop drawings.

Eric stated that since nearly every bridge will require different sole plate bevels, the BD-613M standards were developed assuming a constant thickness sole plate which equates to the minimum thickness required to satisfy flexural stresses. It is the Engineer's responsibility to determine the required sole plate bevels and to increase the sole plate thickness up from the minimum listed in the standards accordingly.

Patti Kiehl (PENNDOT) stated that the details in the standards are generic for all loading conditions and are not intended to be used as contract drawings without modification.

Henry reiterated that if sole plate corner dimension tables were provided in the standards with blank values to be input by the Engineer during design, then the BD-613M drawings could be used as contract drawings without modification.

Vasant Mistry (FHWA) stated that he was satisfied with the responses to the Task 1 Comments.

Tom Koch (North Carolina DOT) stated that he had not received the Task 2 Report or Responses to the Task 1 comments. (Baker later verified that the package had been sent to the correct address and signed for. Tom located the report the next day.)

Agenda Item 2: Task 2 Report

Henry and Vasant stated that they were satisfied with the Task 2 Report and had no further comments.

Agenda Item 3: Expansion of the PENNDOT BD-613M Standards

Patti Kiehl provided a list of items that would need to be modified to expand PENNDOT's BD-613M standard based on the comments received by the project panel members to date. The list is as follows (note: text in parentheses indicates the agency and Task 1 comment number, if applicable):

- Dual material specs for plates > 4" thick (NC1)
- Bedding Material (NC5)
- PTFE Attachment Methods (NC6)
- Piston Thickness (NC16)
- Revise notes to be generic and not state specific
- Add metallizing as steel corrosion protection method
- Add round sealing ring details
- Add internal guide details (NC4)
- Add preformed anchor hole detail & include field placement instructions (FL7)
- Add note on sheet 15 alerting designer of potential bolt/thread misalignment when using beveled plates (FL8)
- Add note listing allowable service stress for weld design (NC10)
- Delete dimension "Z" from note 9 (Baker1)

Robert Doble cautioned that any proposed alternate details would need to be considered carefully to determine the potential effect to the design calculations. For example, providing an internal guide detail will likely affect many other dimensions and would require revised design calculations and a new table of dimensions.

Henry stated that FDOT would not mind using external guide bars only. Tom said that he would check with fabricators in North Carolina to see if they would be receptive to using external guide bars exclusively.

Patti asked Tom (when he received the package) to check if he was satisfied with the response to his comment regarding the equation for piston thickness.

Eric asked the panel members if they had any further requests regarding the expansion of the standards. Henry asked if PENNDOT's BD-613M standard could be modified to incorporate more stringent seismic requirements. Eric stated that there are separate tables in the standards for horizontal loads equal to 10% and 30% of the vertical capacity. If higher seismic forces create a horizontal load greater than 30%, a larger vertical capacity bearing can be used to provide a larger horizontal load capacity (assuming the minimum vertical load criteria is satisfied).

Henry stated that Eric's explanation makes sense, but the pot bearing sizes can get too large using that procedure. Vasant stated that other bearing types may need to be utilized if the seismic forces are significantly higher than 30% times the vertical load. Vasant then stated that separate standards may be needed for bearings in high seismic areas.

Dave Marchese stated that special bearings may not be needed, just special details to hold the bearings down on the bearing seat. He stated that external guide bars can accommodate seismic forces easier than an internal guide bar.

Henry asked if FDOT could use the MATHCAD template developed by DS Brown if FDOT verified that the template agreed with their design spreadsheets currently in use. Patti said she would contact DS Brown to determine if they would be willing to release the electronic files.

Henry asked if PENNDOT's BD-613M standards were sent to fabricators throughout Pennsylvania. Patti stated that the standards were sent to fabricators during the development stage, but only a few comments were received.

Subsequent to the conference call, Tom Koch sent the following comments via e-mail:

[*I've had a chance to review your responses to NCDOT's comments and offer the following:*

On page 12 -- NCDOT uses a 3/16 " preformed cotton duck pad, not a neoprene pad. However-- we are in the middle of changing our specs. to require a 1/8" pad since availability is greater for cotton duck pads in 1/8" increments.

One other comment -- several of PennDot's standards show a "neoprene disc" as the elastomer in the Pot bearing. We would prefer that to say "elastomer disc" since we, like most states, allow Neoprene or natural rubber.

Also -- while we recognize the benefit of using a double external guide bar system, we would like to still have the option to use a single bar guide key system.

I've also still got some of our other shop drawing review guys looking at it and I will submit any comments they have to you.]

Agenda Item 4: Presentation to the AASHTO T-2 Bearing Committee on June 28, 2005

Eric stated he would be giving a presentation to the AASHTO T-2 Bearing Committee on June 28, 2005. Vasant asked if the AASHTO T-2 Bearing Committee could approve the National Pot Bearing Standards once complete, similar to the approval AASHTO granted the Segmental Bridge Details. Eric stated he would find out if an approval was possible.

Eric asked the panel members if they agreed with the service limit state design philosophy that the BD-613M standards are based on. The panel members acknowledged that they agreed with that methodology. Eric stated that the presentation to the AASHTO T-2 Bearing Committee would include a suggestion to modify the AASHTO Section 14.7.4 equations currently based on strength/extreme event limit states back to service limit state equations.

The information presented in these minutes represents the author's interpretation and understanding of the discussions and decisions that occurred during the meeting. Any clarifications, corrections, or additions to these minutes are to be provided to the author within fifteen (15) days of the date issued. No response implies that information presented is agreed to be correct as written.

cc: Attendees:
Patricia Kiehl - PENNDOT
Henry Bollman – FDOT
Vasant Mistry – FHWA
Tom Koch – NCDOT
cfile

DESIGN METHODOLOGY:

1. THE INFORMATION SHOWN IN THIS STANDARD IS PROVIDED FOR USE IN THE DEVELOPMENT OF THE CONTRACT DOCUMENTS. THE DESIGNER IS RESPONSIBLE FOR THE PRESENTATION OF ALL DESIGN INFORMATION. BEARING DESIGN DRAWINGS SHOULD INCLUDE, AS A MINIMUM, PLAN AND ELEVATION VIEWS, SECTIONS, DETAILS OF VARIOUS POT COMPONENTS, ALL DIMENSIONS, MATERIAL SPECIFICATIONS, AND ANY OTHER DETAILS NECESSARY FOR THE COMPLETION OF SHOP DRAWINGS AND FABRICATION BY THE CONTRACTOR.

2. THE INFORMATION SHOWN IN THESE STANDARDS MAY BE USED FOR BEARING DESIGNS BY EITHER AASHTO STANDARD SPECIFICATIONS UTILIZING SERVICE LOADS OR AASHTO LRFD SPECIFICATIONS UTILIZING SERVICE AND EXTREME EVENT LIMIT STATE LOAD COMBINATIONS AND AS MODIFIED HEREIN.

3. DIVIDE THE HORIZONTAL SEISMIC LOADS, DERIVED FROM EITHER SPECIFICATION, BY 1.5 PER AASHTO (1992) STANDARD SPECIFICATION, DIVISION I-A, SECTION 7.1

4. A TOTAL DESIGN ROTATION OF 0.03 RADIANS (INCLUDING 0.02 RADIANS OF CONSTRUCTION TOLERANCE) WAS USED FOR THIS STANDARD.

5. GUIDED AND NON-GUIDED BEARINGS ARE DESIGNED FOR A TOTAL LONGITUDINAL MOVEMENT OF 75 (3") (PLUS 25 (1") OF CONSTRUCTION TOLERANCE IN EACH DIRECTION). ADDITIONAL LONGITUDINAL MOVEMENT CAN BE ACCOMMODATED BY INCREASING THE LENGTH OF THE SOLE PLATE, STAINLESS STEEL, GUIDE BARS, AND GUIDE PLATE.

6. NON-GUIDED BEARINGS ARE DESIGNED FOR A TOTAL TRANSVERSE MOVEMENT OF 12 (0.5") (PLUS 19 (0.75") OF CONSTRUCTION TOLERANCE IN EACH DIRECTION). ADDITIONAL TRANSVERSE MOVEMENT CAN BE ACCOMMODATED BY INCREASING APPROPRIATE COMPONENT DIMENSIONS.

7. WELDED CONNECTIONS ARE DESIGNED USING ALLOWABLE STRESS DESIGN.

POT DESIGN:

1. THE THICKNESS OF THE POT WALL OF THE FIXED AND GUIDED BEARINGS WAS CALCULATED USING AASHTO (1998) LRFD EQUATION 14.7.4.7-1 AND SECTION C14.7.4.6.

2. THE THICKNESS OF THE POT WALL OF THE NON-GUIDED BEARINGS ARE DESIGNED FOR A NOMINAL HORIZONTAL LOAD EQUAL TO 10% OF THE DESIGN VERTICAL CAPACITY (P_V), AND USING AASHTO (1998) LRFD EQUATION 14.7.4.6-5 (P_r=10%P_V) AND SECTION C14.7.4.6.

3. THE THICKNESS OF THE POT BASE WAS CALCULATED USING AASHTO (1998) LRFD EQUATIONS 14.7.4.6-3 AND 14.7.4.6-4.

PISTON DESIGN:

1. THE HEIGHT OF THE PISTON RIM WAS CALCULATED USING AASHTO (1998) LRFD EQUATIONS 14.7.4.7-2 AND 14.7.4.7-3 ALONG WITH SECTION C14.7.4.7.

2. THE DIAMETER OF THE PISTON WAS CALCULATED USING AASHTO (1998) LRFD EQUATION 14.7.4.7-4 AND USING A MAXIMUM CLEARANCE OF 0.508 (0.02") BETWEEN THE PISTON AND THE POT AND A DESIGN ROTATION OF 0.03 RADIANS.

MASONRY PLATE DESIGN:

1. THE MASONRY PLATE WAS DESIGNED ASSUMING IT WILL BE PLACED NORMAL TO THE BEAM/GIRDER CENTERLINE. OTHER ORIENTATIONS BETWEEN THE MASONRY PLATE AND THE BEAM/GIRDER CENTERLINE ARE PERMITTED. HOWEVER, THE ENGINEER IS REQUIRED TO CHECK ALL GEOMETRY TO ENSURE THAT ALL CLEARANCE REQUIREMENTS ARE SATISFIED.

2. THE MASONRY PLATE THICKNESS (A) HAS BEEN DESIGNED FOR BENDING IN THE FOLLOWING MANNER: THE PRESSURE DUE TO THE BEARING REACTION IS ASSUMED TO DISTRIBUTE EVENLY OVER THE ENTIRE MASONRY PLATE. THE MINIMUM PLATE THICKNESS IS THEN DESIGNED BY MODELING THE MASONRY PLATE AS A CANTILEVER BEAM WITH A CANTILEVER LENGTH EQUAL TO THE LONGEST PERPENDICULAR DISTANCE BETWEEN THE EDGE OF THE MASONRY PLATE AND EDGE OF THE POT PLATE.

SOLE PLATE DESIGN:

1. THE SOLE PLATE THICKNESS (H) HAS BEEN DESIGNED FOR BENDING IN THE FOLLOWING MANNER: CIRCULAR PTFE (OR THE PISTON FOR A FIXED BEARING) IS ASSUMED AS AN EQUIVALENT SQUARE AREA. THE PRESSURE IS THEN ASSUMED TO DISTRIBUTE FROM THE PTFE (OR PISTON) THROUGH THE SOLE PLATE AT A 1:1.5 SLOPE. THE MINIMUM PLATE THICKNESS IS THEN DESIGNED BY MODELING THE SOLE PLATE AS A CANTILEVER BEAM. THE CANTILEVER BEAM LENGTH ASSUMED IS THE MINIMUM OF THE FOLLOWING DIMENSIONS:
   - THE LARGEST DISTANCE FROM THE EDGE OF DISTRIBUTED PRESSURE AREA TO THE EDGE OF THE PTFE'S (OR PISTON'S) ASSUMED EQUIVALENT SQUARE AREA.
   - THE LARGEST DISTANCE FROM THE EDGE OF THE SOLE PLATE TO THE EDGE OF THE PTFE'S (OR PISTON'S) ASSUMED EQUIVALENT SQUARE AREA.

2. THE SOLE PLATE THICKNESS GIVEN IN COLUMN "H" IS THE MINIMUM THICKNESS. ANY ADDITIONAL THICKNESS, "I", REQUIRED TO ACCOMMODATE THE BEVEL MUST BE ADDED TO THE OVERALL BEARING HEIGHT GIVEN IN COLUMN "PP".

3. A MINIMUM SOLE PLATE THICKNESS OF 21(0.8125") WAS USED FOR THIS STANDARD.

INSTRUCTIONS FOR USING DESIGN TABLES:

1. CALCULATE THE MINIMUM AND MAXIMUM VERTICAL DESIGN LOAD REACTIONS PER BEARING AS FOLLOWS:

   LRFD SPECIFICATIONS
   - USE THE SERVICE I AND EXTREME EVENT I LIMIT STATES.
   - COMPUTE THE MINIMUM REACTION LOADS BY INCLUDING THE MINIMUM VALUE OF PERMANENT LOADS AND THE LOADS THAT PRODUCE UPLIFT.

   STANDARD SPECIFICATIONS
   - USE ALL SERVICE LOAD GROUPS.
   - REDUCE LOADS BY THE PERCENT INCREASE IN ALLOWABLE STRESS AS PERMITTED BY AASHTO.
   - THE PERCENT INCREASE IN ALLOWABLE STRESS, AS DEFINED BY AASHTO, SHOULD NOT BE USED FOR THE CALCULATION OF THE MINIMUM VERTICAL DESIGN LOAD.
   - COMPUTE THE MINIMUM REACTION LOADS BY INCLUDING THE MINIMUM VALUE OF PERMANENT LOADS AND THE LOADS THAT PRODUCE UPLIFT.

2. FOR FIXED AND GUIDED BEARING CALCULATE THE MAXIMUM HORIZONTAL DESIGN LOAD PER BEARING AS FOLLOWS:

   LRFD SPECIFICATIONS
   - USE THE SERVICE I AND EXTREME EVENT I LIMIT STATES.
   - DIVIDE THE EXTREME EVENT I LIMIT STATE LOADS BY 1.50.
   - FOR FIXED BEARINGS COMPUTE THE MAXIMUM HORIZONTAL DESIGN LOAD AS THE RESULTANT VECTOR SUM OF THE HORIZONTAL LOADS FOR EACH LIMIT STATE.
   - FOR GUIDED BEARINGS, COMPUTE THE MAXIMUM HORIZONTAL DESIGN LOAD AS THE SUM OF THE HORIZONTAL LOADS FOR EACH LIMIT STATE APPLIED NORMAL TO THE ORIENTATION OF THE GUIDE BAR.

   STANDARD SPECIFICATIONS
   - USE ALL SERVICE LOAD GROUPS.
   - REDUCE LOADS BY THE PERCENT INCREASE IN ALLOWABLE STRESS AS PERMITTED BY AASHTO.
   - DIVIDE THE GROUP VII LOADS BY 1.50.
   - FOR FIXED BEARINGS COMPUTE THE MAXIMUM HORIZONTAL DESIGN LOAD AS THE RESULTANT VECTOR SUM OF THE HORIZONTAL LOADS FOR EACH LOAD GROUP.
   - FOR GUIDED BEARINGS, COMPUTE THE MAXIMUM HORIZONTAL DESIGN LOAD AS THE RESULTANT SUM OF THE HORIZONTAL LOADS FOR EACH LOAD GROUP APPLIED NORMAL TO THE ORIENTATION OF THE GUIDE BAR.

   INSTRUCTIONS BELOW ARE APPLICABLE TO BOTH THE AASHTO LRFD SPECIFICATIONS AND STANDARD SPECIFICATIONS

3. DETERMINE THE CONTROLLING MINIMUM AND MAXIMUM VERTICAL DESIGN LOAD REACTIONS AND THE MAXIMUM HORIZONTAL DESIGN LOAD. THESE ARE THE DESIGN LOADS TO BE USED WITH THE DESIGN TABLES. IF THE MAXIMUM DESIGN LOAD IS GREATER THAN 6672 KN (1500 KIPS) THESE DESIGN STANDARDS ARE NOT APPLICABLE.

4. CALCULATE THE MAXIMUM GIRDER END ROTATION ABOUT EACH AXIS DUE TO MAXIMUM LIVE LOAD PLUS IMPACT AS WELL AS ALL PERMANENT LOADS AND GEOMETRIC CONSTRAINTS SUCH AS ROADWAY GEOMETRY AND CAMBER. ALL OR MOST OF THE ROTATION DUE TO PERMANENT LOADS AND GEOMETRY MAY BE ACCOMMODATED BY BEVELING THE SOLE PLATE. INCLUDE THE ROTATIONS NOT ACCOMMODATED BY THE BEVELED SOLE PLATE IN THE DESIGN ROTATION. COMPUTE THE VECTOR RESULTANT SUM OF THE TRANSVERSE AND LONGITUDINAL ROTATIONS AND ADD 0.02 RADIANS FOR CONSTRUCTION TOLERANCE. IF THE TOTAL ROTATION INCLUDING THE CONSTRUCTION TOLERANCE EXCEEDS 0.03 RADIANS, THESE DESIGN TABLES ARE NOT APPLICABLE. COMPUTE ROTATIONS USING THE SERVICE I LIMIT STATE FOR LRFD DESIGNS. COMPUTE ROTATIONS USING APPLICABLE SERVICE LOAD GROUPS FOR DESIGNS USING STANDARD SPECIFICATIONS.

5. FOR FIXED AND GUIDED BEARINGS, COMPUTE THE RATIO OF THE MAXIMUM HORIZONTAL DESIGN LOAD TO THE MAXIMUM VERTICAL DESIGN LOAD (H/V) DES ON THE BEARING. FOR (H/V)DES RATIOS LESS THAN OR EQUAL TO 0.10, USE THE 10% HORIZONTAL LOAD TABLES. FOR (H/V)DES RATIOS GREATER THAN 0.10 AND LESS THAN OR EQUAL TO 0.30, USE THE 30% HORIZONTAL LOAD TABLES.

   NOTE THAT IT IS ACCEPTABLE TO USE BEARINGS WITH VERTICAL LOAD CAPACITIES GREATER THAN THE MAXIMUM VERTICAL DESIGN LOAD TO PROVIDE A GREATER HORIZONTAL LOAD CAPACITY. THIS PROCEDURE MAY BE USED FOR THE SELECTION OF MORE ECONOMICAL BEARINGS OR TO ACHIEVE A SATISFACTORY DESIGN WHERE THE PRELIMINARY BEARING SELECTION DOES NOT SATISFY THE (H/V)DES RATIO CRITERIA OF 0.30.

6. CHOOSE THE APPROPRIATE DESIGN TABLE. TABLES ARE DIVIDED BASED ON BEARING TYPE AND H/V RATIOS.

7. SELECT A PRELIMINARY BEARING SIZE FROM THE DESIGN TABLES WITH A LOAD CAPACITY EQUAL TO OR EXCEEDING THE DESIGN LOAD IN BOTH THE HORIZONTAL AND VERTICAL DIRECTIONS.

8. COMPUTE THE RATIO OF THE MINIMUM VERTICAL DESIGN LOAD TO VERTICAL LOAD CAPACITY OF THE BEARING. IF THIS RATIO IS LESS THAN 0.20, THESE DESIGN TABLES ARE NOT APPLICABLE.

9. FOR GUIDED AND NON-GUIDED BEARINGS, CALCULATE THE TOTAL LONGITUDINAL MOVEMENT (NOT INCLUDING THE 25(1") CONSTRUCTION TOLERANCE IN EACH DIRECTION). IF THE TOTAL LONGITUDINAL MOVEMENT IS GREATER THAN 75 (3"), INCREASE THE FOLLOWING DIMENSIONS AN AMOUNT EQUAL THE TOTAL LONGITUDINAL MOVEMENT MINUS 75 (3")
   - SOLE PLATE: "J"
   - STAINLESS STEEL PLATES: "LL" AND "NN"
   - GUIDE BARS: "CC"

10. ONCE ALL DESIGN LOAD CRITERIA ARE SATISFIED, THE BEARING DIMENSIONS SHOWN IN THE DESIGN TABLES FOR THE INDIVIDUAL BEARING MAY BE USED.

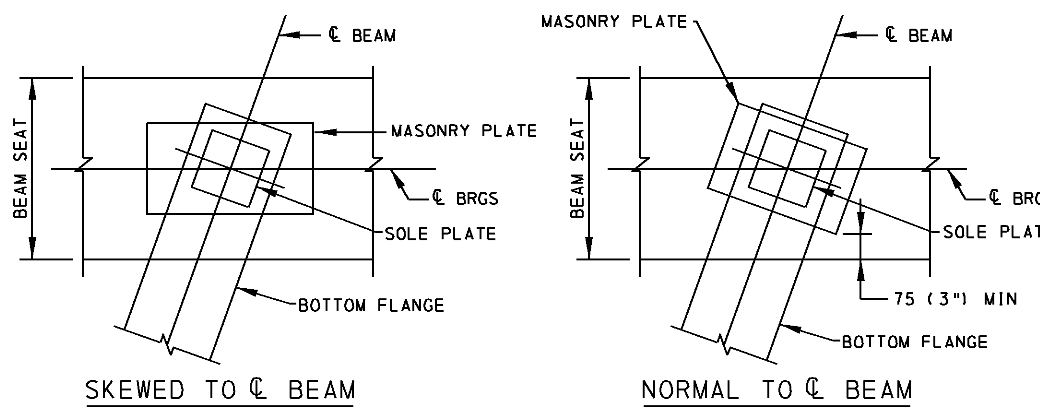
11. DESIGN THE CONNECTION OF THE SOLE PLATE TO THE GIRDER IN ACCORDANCE WITH THE SCHEMATICS OF THESE STANDARDS AND THE AASHTO BRIDGE DESIGN SPECIFICATIONS. ALL TABULATED SOLE PLATE DIMENSIONS ARE MINIMUMS.

INSTRUCTIONS FOR USING DESIGN TABLES CON'T:

12. WHERE THE CENTERLINE OF THE MASONRY PLATE IS NOT PARALLEL TO THE CENTERLINE OF THE BEAM AND SOLE PLATE, COMPUTE CLEARANCES BETWEEN THE TOP OF ANCHOR BOLTS AND THE SOLE PLATE AND GUIDE BARS. IF REQUIRED, TO PROVIDE NECESSARY CLEARANCES, RESIZE THE FOLLOWING MASONRY PLATE DIMENSIONS:
    - MASONRY PLATE WIDTH: "B"
    - MASONRY PLATE LENGTH: "C"
    - MASONRY PLATE THICKNESS: "A"
    - ANCHOR BOLT LOCATION: "D"

13. CHECK OVERALL GEOMETRY AND VERIFY THAT ALL OTHER DESIGN REQUIREMENTS ARE SATISFIED. RECOMPUTE THE BEARING HEIGHT, "PP", WHEN BEVELED SOLE PLATES ARE USED AND/OR THE MASONRY PLATE THICKNESS IS INCREASED.

14. CHECK THAT ANCHOR BOLTS DO NOT INTERFERE WITH PIER OR ABUTMENT REINFORCEMENT, AND THAT THE BEARING ASSEMBLY MEETS ALL CLEARANCE REQUIREMENTS RELATIVE TO ITS PLACEMENT ON THE SUBSTRUCTURE AND CONNECTION TO THE SUPERSTRUCTURE.



SOLE AND MASONRY PLATE ORIENTATION OPTIONS

INDEX OF SHEETS	
SHEET NO.	SHEET TITLE
1	DESIGN METHODOLOGY
2	ILLUSTRATIVE DESIGN EXAMPLE
3	FIXED - 10% HORIZONTAL LOAD (DESIGN TABLE)
4	FIXED - 30% HORIZONTAL LOAD (DESIGN TABLE)
5	NON-GUIDED (DESIGN TABLE)
6	GUIDED - 10% HORIZONTAL LOAD (ENGLISH) (DESIGN TABLE)
7	GUIDED - 10% HORIZONTAL LOAD (METRIC) (DESIGN TABLE)
8	GUIDED - 30% HORIZONTAL LOAD (ENGLISH) (DESIGN TABLE)
9	GUIDED - 30% HORIZONTAL LOAD (METRIC) (DESIGN TABLE)
10	FIXED - DETAILS
11	NON-GUIDED - DETAILS
12	GUIDED - DETAILS-1
13	GUIDED - DETAILS-2
14	GENERAL NOTES AND DETAILS
15	CONNECTION OPTIONS

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

STANDARD ABBREVIATIONS:

HLMR - HIGH LOAD MULTI-ROTATIONAL
DIA. - DIAMETER
I.D. - INSIDE DIAMETER
Ø - DIAMETER
PTFE - POLYTETRAFLUOROETHYLENE
G.P. - GUIDE PLATE
G.B. - GUIDE BAR

NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS
DESIGN METHODOLOGY

GUIDED POT BEARING DESIGN EXAMPLE
LRFD SPECIFICATIONS

AASHTO LRFD LIMIT STATES	DESIGN LOADS (KIPS)										
	VERTICAL								HORIZONTAL		
	DL		LL+I		WIND		TOTAL		TRANSVERSE	LONGITUDINAL	RESOLUTION
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX			
SERVICE I	200	220	-5	124	-7	20	188	364	44	0	44
EXTREME EVENT I	180	250	0	0	0	0	180	250	46	0	46/1.5=30.7

PARAMETERS:

US CUSTOMARY UNITS
DESIGN LOADS: SEE BEARING SCHEDULE
SKEW ANGLE: 70 DEGREES
SERVICE LOAD ROTATION: 0.007 RADIANS
TOTAL LONGITUDINAL MOVEMENT: 2.70" (2 X CONTRACTION OF 1.35")

DESIGN:

1. DETERMINE CONTROLLING DESIGN LOADS (SEE TABLE):

   VERTICAL LOADS:
   MAXIMUM: 364 KIPS
   MINIMUM: 180 KIPS

   HORIZONTAL LOAD: 44 KIPS

2. CHECK ROTATIONAL CAPACITY:

   SERVICE ROTATION = 0.007 RADIANS
   CONSTRUCTION ROTATION TOLERANCE = 0.02 RADIANS
   DESIGN ROTATION = 0.007 + 0.02 = 0.027 RADIANS < 0.03 OK
   TO USE DESIGN TABLES

3. SELECT APPROPRIATE LOAD TABLE:

   DESIGN HORIZONTAL LOAD/DESIGN VERTICAL LOAD = 44/364 = 12%
   TRY 30% LOAD TABLES

4. SELECT PRELIMINARY BEARING SIZE:

   REQUIRED VERTICAL LOAD CAPACITY = 364 KIPS
   REQUIRED HORIZONTAL LOAD CAPACITY = 44
   TRY 400 KIP BEARING > 364 OK
   HORIZONTAL LOAD CAPACITY 120 > 44 OK

   ALTERNATIVELY, A 450 KIP BEARING FROM THE 10% LOAD TABLE COULD BE SELECTED SINCE THE HORIZONTAL CAPACITY IS LISTED AS 45 KIPS WHICH IS > THAN THE 44 KIP DESIGN LOAD.

5. CHECK 20% VERTICAL LOAD CRITERION

   VERTICAL CAPACITY = 400 KIPS
   MINIMUM VERTICAL LOAD = 180 KIPS
   MINIMUM VERTICAL DESIGN LOAD / VERTICAL CAPACITY = 180/400 = 0.45 > 0.20 OK

6. CHECK ALTERNATIVE DESIGN(USING 10% DESIGN TABLE):

   VERTICAL CAPACITY = 450 KIPS
   MINIMUM VERTICAL DESIGN LOAD /VERTICAL CAPACITY = 180/450 = 0.33 > 0.20 OK

   ALTHOUGH BOTH BEARINGS SATISFY THE LOAD CHECKS, ONE MAY BE MORE APPROPRIATE FOR A PARTICULAR APPLICATION. SELECT MOST APPROPRIATE BEARING.

7. CHECK MOVEMENT CAPACITY:
   TOTAL MOVEMENT = 2 X ONE-WAY MOVEMENT = 2 X 1.35" = 2.70" < 3.0" OK

8. ONCE ALL DESIGN LOAD CRITERIA ARE SATISFIED, THE BEARING DIMENSIONS SHOWN IN THE DESIGN TABLES FOR THE INDIVIDUAL BEARING MAY BE USED.

9. DESIGN THE CONNECTION OF THE SOLE PLATE TO THE GIRDER IN ACCORDANCE WITH THE SCHEMATICS OF THESE STANDARDS AND THE AASHTO BRIDGE DESIGN SPECIFICATIONS. ALL TABULATED SOLE PLATE DIMENSIONS ARE MINIMUMS.

10. IF THE CENTERLINE OF THE MASONRY PLATE IS NOT PARALLEL TO THE CENTERLINE OF THE BEAM AND SOLE PLATE, CLEARANCES BETWEEN THE TOP OF ANCHOR BOLTS AND THE SOLE PLATE AND GUIDE BARS MUST BE CHECKED. IF REQUIRED TO PROVIDE NECESSARY CLEARANCES, RESIZE THE FOLLOWING MASONRY PLATE DIMENSIONS:

    MASONRY PLATE WIDTH: "B"
    MASONRY PLATE LENGTH: "C"
    MASONRY PLATE THICKNESS: "A"
    ANCHOR BOLT LOCATION: "D"

11. CHECK OVERALL GEOMETRY AND VERIFY THAT ALL OTHER DESIGN REQUIREMENTS ARE SATISFIED. RECOMPUTE THE BEARING HEIGHT, "PP", WHEN BEVELED SOLE PLATES ARE USED AND/OR THE MASONRY PLATE THICKNESS IS INCREASED.

12. CHECK THAT ANCHOR BOLTS DO NOT INTERFERE WITH PIER OR ABUTMENT REINFORCEMENT, AND THAT THE BEARING ASSEMBLY MEETS ALL CLEARANCE REQUIREMENTS RELATIVE TO ITS PLACEMENT ON THE SUBSTRUCTURE AND CONNECTION TO THE SUPERSTRUCTURE.

GUIDED POT BEARING DESIGN EXAMPLE
STANDARD SPECIFICATIONS - SERVICE LOAD DESIGN

AASHTO SERVICE LOAD GROUP	DESIGN LOADS (KIPS)										
	VERTICAL								HORIZONTAL		
	DL		LL+I		WIND		TOTAL		TRANSVERSE	LONGITUDINAL	RESOLUTION
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX			
1	200	220	-5	124	-	-	195	344	0	0	0
2	200	220	-	-	-7	20	193	240/1.25=192	38	0	38/1.25=30.4
3	200	220	-5	124	-2	6	193	350/1.25=280	22	0	22/1.25=17.6
4	200	220	-5	124	-	-	195	344/1.25=275.2	0	0	0
5	200	220	-	-	-7	20	193	240/1.4=171.4	38	0	38/1.4=27.1
6	200	220	-5	124	-2	6	193	350/1.4=250	22	0	22/1.4=15.7
7	200	220	-	-	-	-	200	220/1.5=146.7	46	0	46/1.5=30.7

PARAMETERS:

US CUSTOMARY UNITS
DESIGN LOADS: SEE BEARING SCHEDULE
SKEW ANGLE: 70 DEGREES
SERVICE LOAD ROTATION: 0.007 RADIANS
TOTAL LONGITUDINAL MOVEMENT: 2.70" (2 X CONTRACTION OF 1.35")

DESIGN:

1. DETERMINE CONTROLLING DESIGN LOADS(SEE TABLE):

   VERTICAL LOADS:
   MAXIMUM: 344 KIPS
   MINIMUM: 193 KIPS

   HORIZONTAL LOAD: 30.7 KIPS

2. CHECK ROTATIONAL CAPACITY:

   SERVICE ROTATION = 0.007 RADIANS
   CONSTRUCTION ROTATION TOLERANCE = 0.02 RADIANS
   DESIGN ROTATION = 0.007 + 0.02 = 0.027 RADIANS < 0.03 OK
   TO USE DESIGN TABLES

3. SELECT APPROPRIATE LOAD TABLE:

   DESIGN HORIZONTAL LOAD/DESIGN VERTICAL LOAD = 30.7/344 = 8.9%
   USE 10% LOAD TABLES

4. SELECT PRELIMINARY BEARING SIZE:

   REQUIRED VERTICAL LOAD CAPACITY = 344 KIPS
   REQUIRED HORIZONTAL LOAD CAPACITY = 30.7 KIPS
   TRY 350 KIP BEARING > 344 OK
   HORIZONTAL LOAD CAPACITY 35 > 30.7 OK

5. CHECK 20% VERTICAL LOAD CRITERION

   VERTICAL CAPACITY = 350 KIPS
   MINIMUM VERTICAL DESIGN LOAD / VERTICAL CAPACITY = 193/350 = 0.55 > 0.20 OK

6. CHECK MOVEMENT CAPACITY:
   TOTAL LONGITUDINAL MOVEMENT = 2 X ONE-WAY MOVEMENT = 2 X = 1.35" = 2.70" < 3.0" OK

7. ONCE ALL DESIGN LOAD CRITERIA ARE SATISFIED, THE BEARING DIMENSIONS SHOWN IN THE DESIGN TABLES FOR THE INDIVIDUAL BEARING MAY BE USED.

8. DESIGN THE CONNECTION OF THE SOLE PLATE TO THE GIRDER IN ACCORDANCE WITH THE SCHEMATICS OF THESE STANDARDS AND THE AASHTO BRIDGE DESIGN SPECIFICATIONS. ALL TABULATED SOLE PLATE DIMENSIONS ARE MINIMUMS.

9. IF THE CENTERLINE OF THE MASONRY PLATE IS NOT PARALLEL TO THE CENTERLINE OF THE BEAM AND SOLE PLATE, CLEARANCES BETWEEN THE TOP OF ANCHOR BOLTS AND THE SOLE PLATE AND GUIDE BARS MUST BE CHECKED. IF REQUIRED TO PROVIDE NECESSARY CLEARANCES, RESIZE THE FOLLOWING MASONRY PLATE DIMENSIONS:

   MASONRY PLATE WIDTH: "B"
   MASONRY PLATE LENGTH: "C"
   MASONRY PLATE THICKNESS: "A"
   ANCHOR BOLT LOCATION: "D"

10. CHECK OVERALL GEOMETRY AND VERIFY THAT ALL OTHER DESIGN REQUIREMENTS ARE SATISFIED. RECOMPUTE THE BEARING HEIGHT, "PP", WHEN BEVELED SOLE PLATES ARE USED AND/OR THE MASONRY PLATE THICKNESS IS INCREASED.

11. CHECK THAT ANCHOR BOLTS DO NOT INTERFERE WITH PIER OR ABUTMENT REINFORCEMENT, AND THAT THE BEARING ASSEMBLY MEETS ALL CLEARANCE REQUIREMENTS RELATIVE TO ITS PLACEMENT ON THE SUBSTRUCTURE AND CONNECTION TO THE SUPERSTRUCTURE.

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

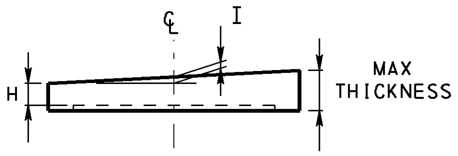
NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS
ILLUSTRATIVE DESIGN EXAMPLE

DESIGN TABLES FOR FIXED POT BEARINGS (10% HORIZONTAL LOAD) - ENGLISH UNITS

VERTICAL LOAD (KIPS)	HORIZONTAL LOAD (KIPS)	ROTATION (RADS.)	MASONRY PLATE						ANCHOR BOLT		SOLE PLATE				POT						ELASTOMERIC DISC			PISTON				BEARING * HEIGHT
			A	B	C	D	E	F	QTY.	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	PP
200	20	0.03	1 1/2"	11 7/8"	19 3/8"	7 7/16"	3 11/16"	-	4	1 1/4"	13/16"	PER DESIGN (BEVELED SOLE PLATE)	10 3/8"	10 3/8"	2 1/16"	10 3/8"	1 1/2"	9/16"	1/4"	3/4"	1"	8 7/8"	3/8"	1 1/8"	8.835	5/16"	1/4"	5 1/8"
250	25	0.03	1 1/2"	13 1/8"	20 5/8"	8 1/16"	4 5/16"	-	4	1 1/4"	13/16"		11 5/8"	11 5/8"	2 3/16"	11 5/8"	1 9/16"	5/8"	1/4"	7/8"	1"	9 7/8"	3/8"	1 1/8"	9.835	5/16"	1/4"	5 3/16"
300	30	0.03	1 1/2"	14"	21 1/2"	8 1/2"	4 3/4"	-	4	1 1/4"	13/16"		12 1/2"	12 1/2"	2 5/16"	12 1/2"	1 3/4"	9/16"	1/4"	7/8"	1 1/8"	10 3/4"	3/8"	1 1/4"	10.710	3/8"	1/4"	5 3/8"
350	35	0.03	1 1/2"	15 1/4"	22 5/8"	9 1/16"	5 3/8"	-	4	1 1/4"	13/16"		13 5/8"	13 5/8"	2 7/16"	13 5/8"	1 7/8"	9/16"	1/4"	1"	1 1/4"	11 5/8"	3/8"	1 1/4"	11.585	3/8"	1/4"	5 1/2"
400	40	0.03	1 5/8"	15 7/8"	23 3/8"	9 7/16"	5 11/16"	-	4	1 1/4"	13/16"		14 3/8"	14 3/8"	2 9/16"	14 3/8"	1 15/16"	5/8"	1/4"	1"	1 1/4"	12 3/8"	3/8"	1 1/4"	12.335	3/8"	1/4"	5 11/16"
450	45	0.03	1 5/8"	16 7/8"	24 3/8"	9 15/16"	6 3/16"	-	4	1 1/4"	13/16"		15 3/8"	15 3/8"	2 3/4"	15 3/8"	2 1/16"	11/16"	1/4"	1 1/8"	1 3/8"	13 1/8"	3/8"	1 3/8"	13.085	7/16"	1/4"	6"
500	50	0.03	1 5/8"	17 1/2"	25"	10 1/4"	6 1/2"	-	4	1 1/4"	13/16"		16"	16"	2 13/16"	16"	2 1/8"	11/16"	1/4"	1 1/8"	1 3/8"	13 3/4"	3/8"	1 3/8"	13.710	7/16"	1/4"	6"
550	55	0.03	1 5/8"	18 1/2"	26"	10 3/4"	7"	-	4	1 1/4"	13/16"		17"	17"	3 3/16"	17"	2 1/4"	15/16"	1/4"	1 1/4"	1 1/2"	14 1/2"	3/8"	1 1/2"	14.460	7/16"	1/4"	6 1/2"
600	60	0.03	1 5/8"	19 7/8"	26 5/8"	11 1/16"	7 11/16"	-	4	1 1/4"	13/16"		17 5/8"	17 5/8"	3 3/16"	17 5/8"	2 7/16"	3/4"	1/4"	1 1/4"	1 5/8"	15 1/8"	3/8"	1 1/2"	15.085	1/2"	1/4"	6 7/16"
650	65	0.03	1 5/8"	21 1/4"	27 1/4"	11 3/8"	8 3/8"	-	4	1 1/4"	13/16"		18 1/4"	18 1/4"	3 3/16"	18 1/4"	2 7/16"	3/4"	1/4"	1 1/4"	1 5/8"	15 3/4"	3/8"	1 1/2"	15.710	1/2"	1/4"	6 7/16"
700	70	0.03	1 5/8"	22 1/2"	28"	11 3/4"	9"	-	4	1 1/4"	13/16"		19"	19"	3 7/16"	19"	2 1/2"	15/16"	1/4"	1 3/8"	1 5/8"	16 1/4"	3/8"	1 1/2"	16.210	1/2"	1/4"	6 5/8"
750	75	0.03	1 5/8"	23 3/4"	28 5/8"	12 1/16"	9 5/8"	-	4	1 1/4"	13/16"		19 5/8"	19 5/8"	3 7/16"	19 5/8"	2 5/8"	13/16"	1/4"	1 3/8"	1 3/4"	16 7/8"	3/8"	1 5/8"	16.835	1/2"	1/4"	6 3/4"
800	80	0.03	1 5/8"	24 7/8"	29 3/8"	12 7/16"	10 3/16"	-	4	1 1/4"	13/16"		20 3/8"	20 3/8"	3 11/16"	20 3/8"	2 11/16"	1"	1/4"	1 1/2"	1 3/4"	17 3/8"	3/8"	1 5/8"	17.335	9/16"	1/4"	6 15/16"
850	85	0.03	1 5/8"	26 1/8"	29 7/8"	12 11/16"	10 13/16"	-	4	1 1/4"	13/16"		20 7/8"	20 7/8"	3 11/16"	20 7/8"	2 13/16"	7/8"	1/4"	1 1/2"	1 7/8"	17 7/8"	3/8"	1 5/8"	17.835	9/16"	1/4"	6 15/16"
900	90	0.03	1 7/8"	26 1/8"	31 7/8"	13 5/16"	10 7/16"	-	4	1 1/2"	13/16"		21 3/8"	21 3/8"	3 11/16"	21 3/8"	2 13/16"	7/8"	1/4"	1 1/2"	1 7/8"	18 3/8"	3/8"	1 5/8"	18.335	9/16"	1/4"	7 3/16"
950	95	0.03	1 7/8"	27"	32 5/8"	13 11/16"	10 7/8"	-	4	1 1/2"	13/16"		22 1/8"	22 1/8"	3 15/16"	22 1/8"	3"	15/16"	1/4"	1 5/8"	2"	18 7/8"	1/2"	1 3/4"	18.835	9/16"	1/4"	7 1/2"
1000	100	0.03	1 7/8"	28 1/8"	33 1/8"	13 15/16"	11 7/16"	-	4	1 1/2"	13/16"		22 5/8"	22 5/8"	3 15/16"	22 5/8"	3"	15/16"	1/4"	1 5/8"	2"	19 3/8"	1/2"	1 3/4"	19.335	5/8"	1/4"	7 1/2"
1100	110	0.03	1 7/8"	30 1/4"	34 1/8"	14 7/16"	12 1/2"	-	4	1 1/2"	13/16"		23 5/8"	23 5/8"	4 3/16"	23 5/8"	3 3/16"	1"	1/4"	1 5/8"	2 1/8"	20 3/8"	1/2"	1 3/4"	20.335	5/8"	1/4"	7 11/16"
1200	120	0.03	1 7/8"	32 1/8"	35 1/4"	15"	13 7/16"	-	4	1 1/2"	13/16"		24 3/4"	24 3/4"	4 3/16"	24 3/4"	3 3/16"	1"	1/4"	1 3/4"	2 1/8"	21 1/4"	1/2"	1 7/8"	21.210	11/16"	1/4"	7 13/16"
1300	130	0.03	2"	33 7/8"	37 3/4"	15 7/8"	13 15/16"	-	4	1 3/4"	13/16"		25 3/4"	25 3/4"	4 7/16"	25 3/4"	3 3/8"	1 1/16"	1/4"	1 7/8"	2 1/4"	22"	1/2"	1 7/8"	21.960	11/16"	1/4"	8 1/8"
1400	140	0.03	2"	35 5/8"	38 5/8"	16 5/16"	14 13/16"	-	4	1 3/4"	13/16"		26 5/8"	26 5/8"	4 11/16"	26 5/8"	3 1/2"	1 3/16"	1/4"	1 7/8"	2 3/8"	22 7/8"	1/2"	2"	22.835	11/16"	1/4"	8 1/2"
1500	150	0.03	2"	37 1/4"	39 5/8"	16 13/16"	15 5/8"	-	4	1 3/4"	13/16"		27 5/8"	27 5/8"	4 11/16"	27 5/8"	3 9/16"	1 1/8"	1/4"	2"	2 3/8"	23 5/8"	1/2"	2"	23.585	3/4"	1/4"	8 7/16"

DESIGN TABLES FOR FIXED POT BEARINGS (10% HORIZONTAL LOAD) - METRIC UNITS

VERTICAL LOAD (KN)	HORIZONTAL LOAD (KN)	ROTATION (RADS.)	MASONRY PLATE						ANCHOR BOLT		SOLE PLATE				POT						ELASTOMERIC DISC			PISTON				BEARING * HEIGHT
			A	B	C	D	E	F	QTY	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	PP
890	89	0.03	38	302	492	189	94	-	4	32	21	PER DESIGN (BEVELED SOLE PLATE)	264	264	51	264	38	13	6	19	25	225	10	29	224	7	6	129
1112	111	0.03	38	333	524	205	110	-	4	32	21		295	295	55	295	39	15	6	22	25	251	10	29	250	8	6	131
1334	133	0.03	38	356	546	216	121	-	4	32	21		318	318	58	318	43	14	6	22	29	273	10	32	272	8	6	137
1557	156	0.03	38	387	575	230	137	-	4	32	21		346	346	61	346	48	13	6	25	32	295	10	32	294	9	6	139
1779	178	0.03	42	403	594	240	144	-	4	32	21		365	365	64	365	48	16	6	25	32	314	10	32	313	9	6	146
2002	200	0.03	42	429	619	252	157	-	4	32	21		391	391	70	391	52	18	6	29	35	333	10	35	332	10	6	154
2224	222	0.03	42	445	635	260	165	-	4	32	21		406	406	70	406	53	17	6	29	35	349	10	35	348	10	6	153
2446	245	0.03	42	470	660	273	178	-	4	32	21		432	432	80	432	57	23	6	32	38	368	10	38	367	11	6	165
2669	267	0.03	42	505	676	281	195	-	4	32	21		448	448	80	448	61	19	6	32	41	384	10	38	383	12	6	164
2891	289	0.03	42	540	692	289	213	-	4	32	21		464	464	80	464	62	18	6	32	41	400	10	38	399	12	6	163
3114	311	0.03	42	572	711	298	229	-	4	32	21		483	483	86	483	62	24	6	35	41	413	10	38	412	12	6	169
3336	334	0.03	42	603	727	306	244	-	4	32	21		498	498	86	498	66	20	6	35	44	429	10	41	428	13	6	171
3558	356	0.03	42	632	746	316	259	-	4	32	21		518	518	93	518	67	26	6	38	44	441	10	41	440	13	6	177
3781	378	0.03	42	664	759	322	275	-	4	32	21		530	530	93	530	71	22	6	38	48	454	10	41	453	14	6	177
4003	400	0.03	48	664	810	338	265	-	4	38	21		543	543	93	543	71	22	6	38	48	467	10	41	466	14	6	183
4226	423	0.03	48	686	829	348	276	-	4	38	21		562	562	99	562	75	24	6	41	51	479	13	45	478	14	6	192
4448	445	0.03	48	714	841	354	291	-	4	38	21		575	575	99	575	75	24	6	41	51	492	13	45	491	15	6	192
4893	489	0.03	48	768	867	367	318	-	4	38	21		600	600	105	600	80	26	6	41	54	518	13	45	517	16	6	197
5338	534	0.03	48	816	895	381	341	-	4	38	21		629	629	105	629	81	25	6	44	54	540	13	48	539	16	6	199
5782	578	0.03	51	860	959	403	354	-	4	44	21		654	654	112	654	85	27	6	48	57	559	13	48	558	17	6	207
6227	623	0.03	51	905	981	414	376	-	4	44	21		676	676	118	676	89	29	6	48	60	581	13	51	580	17	6	215
6672	667	0.03	51	946	1006	427	397	-	4	44	21		702	702	118	702	90	28	6	51	60	600	13	51	599	18	6	214



BEVELED SOLE PLATE DETAIL

*- BEARING HEIGHT INCLUDES 3.2 (1/8") BEDDING MATERIAL. EFFECTS OF BEVELED SOLE PLATE ARE NOT INCLUDED. IF BEVELED SOLE PLATE IS USED CALCULATE INCREASED BEARING HEIGHT ACCORDININGLY.

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS - FIXED
10% HORIZONTAL LOAD

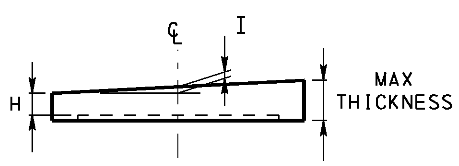
SHEET 3 OF 15

DESIGN TABLES FOR FIXED POT BEARINGS (30% HORIZONTAL LOAD) - ENGLISH UNITS

VERTICAL LOAD (KIPS)	HORIZONTAL LOAD (KIPS)	ROTATION (RADS.)	MASONRY PLATE						ANCHOR BOLT		SOLE PLATE				POT						ELASTOMERIC DISC			PISTON				BEARING* HEIGHT
			A	B	C	D	E	F	QTY	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	PP
200	60	0.03	1 3/8"	12 7/8"	20 3/8"	7 15/16"	4 3/16"	-	4	1 1/4"	13/16"	PER DESIGN (BEVELED SOLE PLATE)	11 3/8"	11 3/8"	2 1/4"	11 3/8"	1 5/8"	5/8"	1/4"	1 1/4"	1"	8 7/8"	3/8"	1 1/8"	8.835	5/16"	1/4"	5 1/16"
250	75	0.03	1 3/8"	14 1/8"	21 5/8"	8 9/16"	4 13/16"	-	4	1 1/4"	13/16"		12 5/8"	12 5/8"	2 3/16"	12 5/8"	1 5/8"	9/16"	1/4"	1 3/8"	1"	9 7/8"	3/8"	1 1/4"	9.835	3/8"	1/4"	5 1/8"
300	90	0.03	1 5/8"	15 1/4"	24 1/4"	9 1/2"	5"	-	4	1 1/2"	13/16"		13 3/4"	13 3/4"	2 7/16"	13 3/4"	1 13/16"	5/8"	1/4"	1 1/2"	1 1/8"	10 3/4"	3/8"	1 3/8"	10.710	7/16"	1/4"	5 11/16"
350	105	0.03	1 5/8"	16 3/8"	25 3/8"	10 1/16"	5 9/16"	-	4	1 1/2"	13/16"		14 7/8"	14 7/8"	2 9/16"	14 7/8"	2"	9/16"	1/4"	1 5/8"	1 1/4"	11 5/8"	3/8"	1 3/8"	11.585	7/16"	1/4"	5 3/4"
400	120	0.03	1 5/8"	17 3/8"	26 3/8"	10 9/16"	6 1/16"	-	4	1 1/2"	13/16"		15 7/8"	15 7/8"	2 11/16"	15 7/8"	2 1/16"	5/8"	1/4"	1 3/4"	1 1/4"	12 3/8"	3/8"	1 1/2"	12.335	1/2"	1/4"	5 15/16"
450	135	0.03	1 7/8"	18 3/8"	28 7/8"	11 7/16"	6 3/16"	-	4	1 3/4"	13/16"		16 7/8"	16 7/8"	2 15/16"	16 7/8"	2 1/4"	11/16"	1/4"	1 7/8"	1 3/8"	13 1/8"	3/8"	1 1/2"	13.085	1/2"	1/4"	6 3/8"
500	150	0.03	1 7/8"	19 1/4"	29 3/4"	11 7/8"	6 5/8"	-	4	1 3/4"	13/16"		17 3/4"	17 3/4"	2 15/16"	17 3/4"	2 1/4"	11/16"	1/4"	2"	1 3/8"	13 3/4"	3/8"	1 1/2"	13.710	9/16"	5/16"	6 3/8"
550	165	0.03	1 7/8"	20 1/4"	30 1/2"	12 1/4"	7 1/8"	-	4	1 3/4"	13/16"		18 1/2"	18 1/2"	3 3/16"	18 1/2"	2 7/16"	3/4"	1/4"	2"	1 1/2"	14 1/2"	3/8"	1 5/8"	14.460	9/16"	5/16"	6 11/16"
600	180	0.03	2 1/8"	20 7/8"	32 7/8"	13 1/16"	7 1/16"	-	4	2"	13/16"		19 3/8"	19 3/8"	3 7/16"	19 3/8"	2 9/16"	7/8"	1/4"	2 1/8"	1 5/8"	15 1/8"	3/8"	1 5/8"	15.085	5/8"	5/16"	7 3/16"
650	195	0.03	2 1/8"	21 3/4"	33 3/4"	13 1/2"	7 1/2"	-	4	2"	13/16"		20 1/4"	20 1/4"	3 7/16"	20 1/4"	2 5/8"	13/16"	1/4"	2 1/4"	1 5/8"	15 3/4"	3/8"	1 3/4"	15.710	5/8"	5/16"	7 1/4"
700	210	0.03	2 1/8"	22 1/2"	34 1/4"	13 3/4"	7 7/8"	-	4	2"	13/16"		20 3/4"	20 3/4"	3 7/16"	20 3/4"	2 5/8"	13/16"	1/4"	2 1/4"	1 5/8"	16 1/4"	3/8"	1 3/4"	16.210	11/16"	5/16"	7 1/4"
750	225	0.03	2 1/8"	23 5/8"	35 1/8"	14 3/16"	8 7/16"	-	4	2"	13/16"		21 5/8"	21 5/8"	3 11/16"	21 5/8"	2 13/16"	7/8"	1/4"	2 3/8"	1 3/4"	16 7/8"	3/8"	1 7/8"	16.835	11/16"	5/16"	7 9/16"
800	240	0.03	2"	24"	34 3/8"	14 3/16"	9"	-	6	1 3/4"	13/16"		22 3/8"	22 3/8"	3 11/16"	22 3/8"	2 13/16"	7/8"	1/4"	2 1/2"	1 3/4"	17 3/8"	3/8"	1 7/8"	17.335	11/16"	3/8"	7 7/16"
850	255	0.03	1 15/16"	24 1/2"	34 7/8"	14 7/16"	9 1/4"	-	6	1 3/4"	13/16"		22 7/8"	22 7/8"	3 15/16"	22 7/8"	3"	15/16"	5/16"	2 1/2"	1 7/8"	17 7/8"	3/8"	2"	17.835	11/16"	3/8"	7 11/16"
900	270	0.03	2 3/16"	25 1/4"	37 1/8"	15 3/16"	9 1/4"	-	6	2"	13/16"		23 5/8"	23 5/8"	4 1/8"	23 5/8"	3 3/16"	15/16"	5/16"	2 5/8"	1 7/8"	18 3/8"	3/8"	2"	18.335	3/4"	3/8"	7 15/16"
950	285	0.03	2 3/16"	25 7/8"	37 5/8"	15 7/16"	9 9/16"	-	6	2"	13/16"		24 1/8"	24 1/8"	4 3/16"	24 1/8"	3 3/16"	1"	5/16"	2 5/8"	2"	18 7/8"	1/2"	2"	18.835	3/4"	3/8"	8 1/8"
1000	300	0.03	2 3/16"	26 5/8"	38 3/8"	15 13/16"	9 15/16"	-	6	2"	13/16"		24 7/8"	24 7/8"	4 3/8"	24 7/8"	3 3/8"	1"	5/16"	2 3/4"	2"	19 3/8"	1/2"	2 1/8"	19.335	3/4"	3/8"	8 1/4"
1100	330	0.03	2 3/16"	28 5/8"	39 5/8"	16 7/16"	10 15/16"	-	6	2"	13/16"		26 1/8"	26 1/8"	4 7/16"	26 1/8"	3 3/8"	1 1/16"	5/16"	2 7/8"	2 1/8"	20 3/8"	1/2"	2 1/8"	20.335	13/16"	7/16"	8 7/16"
1200	360	0.03	2 5/16"	29 1/8"	40 3/4"	17"	11 3/16"	5"	8	2"	13/16"		27 1/4"	27 1/4"	4 7/16"	27 1/4"	3 7/16"	1"	5/16"	3"	2 1/8"	21 1/4"	1/2"	2 1/4"	21.210	7/8"	7/16"	8 5/8"
1300	390	0.03	2 1/4"	30 1/4"	41 3/4"	17 1/2"	11 3/4"	5 1/16"	8	2"	13/16"		28 1/4"	28 1/4"	4 5/8"	28 1/4"	3 9/16"	1 1/16"	3/8"	3 1/8"	2 1/4"	22"	1/2"	2 3/8"	21.960	7/8"	7/16"	8 7/8"
1400	420	0.03	2 1/4"	31 1/2"	42 7/8"	18 1/16"	12 3/8"	5 1/4"	8	2"	13/16"		29 3/8"	29 3/8"	4 15/16"	29 3/8"	3 3/4"	1 3/16"	3/8"	3 1/4"	2 3/8"	22 7/8"	1/2"	2 3/8"	22.835	15/16"	7/16"	9 1/8"
1500	450	0.03	2 1/4"	33"	43 7/8"	18 9/16"	13 1/8"	5 1/2"	8	2"	13/16"		30 3/8"	30 3/8"	4 15/16"	30 3/8"	3 13/16"	1 1/8"	3/8"	3 3/8"	2 3/8"	23 5/8"	1/2"	2 1/2"	23.585	15/16"	1/2"	9 3/16"

DESIGN TABLES FOR FIXED POT BEARINGS (30% HORIZONTAL LOAD) - METRIC UNITS

VERTICAL LOAD (KN)	HORIZONTAL LOAD (KN)	ROTATION (RADS.)	MASONRY PLATE						ANCHOR BOLT		SOLE PLATE				POT						ELASTOMERIC DISC			PISTON				BEARING* HEIGHT
			A	B	C	D	E	F	QTY	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	PP
890	267	0.03	35	327	518	202	106	-	4	32	21	PER DESIGN (BEVELED SOLE PLATE)	289	289	55	289	40	15	6	32	25	225	10	29	224	9	6	128
1112	334	0.03	35	359	549	217	122	-	4	32	21		321	321	55	321	41	13	6	35	25	251	10	32	250	10	6	129
1334	400	0.03	41	387	616	241	127	-	4	38	21		349	349	61	349	46	15	6	38	29	273	10	35	272	11	6	144
1557	467	0.03	41	416	645	256	141	-	4	38	21		378	378	64	378	50	14	6	41	32	295	10	35	294	11	6	146
1779	534	0.03	41	441	670	268	154	-	4	38	21		403	403	67	403	51	16	6	44	32	314	10	38	313	12	6	151
2002	600	0.03	48	467	733	291	157	-	4	44	21		429	429	74	429	56	18	6	48	35	333	10	38	332	13	6	163
2224	667	0.03	48	489	756	302	168	-	4	44	21		451	451	74	451	57	17	6	51	35	349	10	38	348	14	7	162
2446	734	0.03	48	514	775	311	181	-	4	44	21		470	470	80	470	61	19	6	51	38	368	10	41	367	14	7	170
2669	801	0.03	54	530	835	332	179	-	4	51	21		495	495	86	492	65	22	6	54	41	384	10	41	383	15	7	182
2891	867	0.03	54	552	857	343	191	-	4	51	21		514	514	86	514	66	21	6	57	41	400	10	45	399	16	8	185
3114	934	0.03	54	572	870	349	200	-	4	51	21		527	527	86	527	66	20	6	57	41	413	10	45	412	16	8	184
3336	1001	0.03	54	600	892	360	214	-	4	51	21		549	549	93	549	70	22	6	60	44	429	10	48	428	17	8	192
3558	1068	0.03	51	610	873	360	229	-	6	44	21		568	568	93	568	71	22	7	64	44	441	10	48	440	18	8	189
3781	1134	0.03	50	622	886	367	235	-	6	44	21		581	581	99	581	75	24	7	64	48	454	10	51	453	18	9	197
4003	1201	0.03	57	641	943	386	235	-	6	51	21		600	600	99	600	76	23	7	67	48	467	10	51	466	19	9	203
4226	1268	0.03	56	657	956	392	243	-	6	51	21		613	613	105	613	80	26	7	67	51	479	13	51	478	19	9	208
4448	1334	0.03	56	676	975	402	252	-	6	51	21		632	632	105	632	80	25	7	70	51	492	13	54	491	20	9	210
4893	1468	0.03	56	727	1006	418	278	-	6	51	21		664	664	112	664	85	27	8	73	54	518	13	54	517	21	10	215
5338	1601	0.03	59	740	1035	432	284	127	8	51	21		692	692	112	692	86	26	8	76	54	540	13	57	539	22	10	220
5782	1735	0.03	58	768	1060	445	298	129	8	51	21		718	718	118	718	91	28	8	79	57	559	13	60	558	23	11	227
6227	1868	0.03	58	800	1089	459	314	133	8	51	21		746	746	124	746	95	30	9	83	60	581	13	60	580	23	11	232
6672	2002	0.03	58	838	1114	471	333	140	8	51	21		772	772	124	772	96	28	9	86	60	600	13	64	599	24	12	234



BEVELED SOLE PLATE DETAIL

*- BEARING HEIGHT INCLUDES 3.2 (1/8") BEDDING MATERIAL. EFFECTS OF BEVELED SOLE PLATE ARE NOT INCLUDED. IF BEVELED SOLE PLATE IS USED CALCULATE INCREASED BEARING HEIGHT ACCORDININGLY.

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

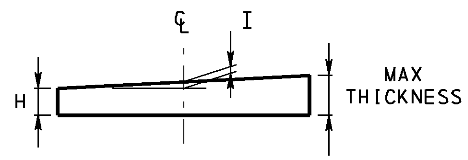
NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS - FIXED
30% HORIZONTAL LOAD

DESIGN TABLES FOR NON-GUIDED POT BEARINGS - ENGLISH UNITS

VERTICAL LOAD (KIPS)	HORIZONTAL LOAD (KIPS)	ROTATION (RADS.)	MASONRY PLATE					ANCHOR BOLT		SOLE PLATE				POT						ELASTOMERIC DISC			PISTON			PTFE	STAINLESS STEEL		BEARING * HEIGHT
			A	B	C	D	E	QTY.	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	HH	LL	MM	PP
200	20	0.03	1 1/2"	11 7/8"	19 7/8"	7 11/16"	3 11/16"	4	1 1/4"	13/16"	PER DESIGN (BEVELED SOLE PLATE)	13 7/8"	10 7/8"	2 1/16"	10 3/8"	1 1/2"	9/16"	1/4"	3/4"	1"	8 7/8"	3/8"	13/16"	8.835	5/16"	8 5/8"	13 5/8"	10 5/8"	5"
250	25	0.03	1 1/2"	13 1/8"	20 7/8"	8 3/16"	4 5/16"	4	1 1/4"	13/16"		14 7/8"	11 7/8"	2 3/16"	11 3/8"	1 9/16"	5/8"	1/4"	3/4"	1"	9 7/8"	3/8"	15/16"	9.835	5/16"	9 5/8"	14 5/8"	11 5/8"	5 3/16"
300	30	0.03	1 5/8"	13 3/4"	21 3/4"	8 5/8"	4 5/8"	4	1 1/4"	13/16"		15 3/4"	12 3/4"	2 5/16"	12 1/4"	1 3/4"	9/16"	1/4"	3/4"	1 1/8"	10 3/4"	3/8"	15/16"	10.710	3/8"	10 1/2"	15 1/2"	12 1/2"	5 3/8"
350	35	0.03	1 5/8"	14 5/8"	22 5/8"	9 1/16"	5 1/16"	4	1 1/4"	13/16"		16 5/8"	13 5/8"	2 3/8"	13 1/8"	1 7/8"	1/2"	1/4"	3/4"	1 1/4"	11 5/8"	3/8"	1 1/16"	11.585	3/8"	11 3/8"	16 3/8"	13 3/8"	5 9/16"
400	40	0.03	1 5/8"	16"	23 3/8"	9 7/16"	5 3/4"	4	1 1/4"	13/16"		17 3/8"	14 3/8"	2 5/8"	13 7/8"	1 15/16"	11/16"	1/4"	3/4"	1 1/4"	12 3/8"	3/8"	1 1/16"	12.335	3/8"	12 1/8"	17 1/8"	14 1/8"	5 3/4"
450	45	0.03	1 3/4"	16 1/8"	24 1/8"	9 13/16"	5 13/16"	4	1 1/4"	13/16"		18 1/8"	15 1/8"	2 13/16"	14 5/8"	2 1/16"	3/4"	1/4"	3/4"	1 3/8"	13 1/8"	3/8"	1 1/16"	13.085	7/16"	12 7/8"	17 7/8"	14 7/8"	6 1/16"
500	50	0.03	1 3/4"	17 3/8"	24 3/4"	10 1/8"	6 7/16"	4	1 1/4"	13/16"		18 3/4"	15 3/4"	2 7/8"	15 1/4"	2 3/16"	11/16"	1/4"	3/4"	1 3/8"	13 3/4"	3/8"	1 3/16"	13.710	7/16"	13 1/2"	18 1/2"	15 1/2"	6 1/8"
550	55	0.03	1 3/4"	18 7/8"	25 1/2"	10 1/2"	7 3/16"	4	1 1/4"	13/16"		19 1/2"	16 1/2"	3 1/8"	16"	2 1/4"	7/8"	1/4"	3/4"	1 1/2"	14 1/2"	3/8"	1 3/16"	14.460	7/16"	14 1/4"	19 1/4"	16 1/4"	6 7/16"
600	60	0.03	1 3/4"	20 1/4"	26 1/8"	10 13/16"	7 7/8"	4	1 1/4"	13/16"		20 1/8"	17 1/8"	3 3/16"	16 5/8"	2 7/16"	3/4"	1/4"	3/4"	1 5/8"	15 1/8"	3/8"	1 3/16"	15.085	1/2"	14 7/8"	19 7/8"	16 7/8"	6 7/16"
650	65	0.03	1 3/4"	21 5/8"	26 3/4"	11 1/8"	8 9/16"	4	1 1/4"	13/16"		20 3/4"	17 3/4"	3 3/16"	17 1/4"	2 7/16"	11/16"	1/4"	3/4"	1 5/8"	15 3/4"	3/8"	1 5/16"	15.710	1/2"	15 1/2"	20 1/2"	17 1/2"	6 1/2"
700	70	0.03	1 3/4"	23 1/8"	27 1/4"	11 3/8"	9 5/16"	4	1 1/4"	13/16"		21 1/4"	18 1/4"	3 7/16"	17 3/4"	2 1/2"	15/16"	1/4"	3/4"	1 5/8"	16 1/4"	3/8"	1 5/16"	16.210	1/2"	16"	21"	18"	6 3/4"
750	75	0.03	1 3/4"	24 3/8"	27 7/8"	11 11/16"	9 15/16"	4	1 1/4"	13/16"		21 7/8"	18 7/8"	3 7/16"	18 3/8"	2 5/8"	13/16"	1/4"	3/4"	1 3/4"	16 7/8"	3/8"	1 5/16"	16.835	1/2"	16 5/8"	21 5/8"	18 5/8"	6 3/4"
800	80	0.03	1 3/4"	25 3/4"	28 3/8"	11 15/16"	10 5/8"	4	1 1/4"	13/16"		22 3/8"	19 3/8"	3 3/4"	18 7/8"	2 11/16"	1 1/16"	1/4"	3/4"	1 3/4"	17 3/8"	3/8"	1 5/16"	17.335	9/16"	17 1/8"	22 1/8"	19 1/8"	7"
850	85	0.03	1 3/4"	27"	28 7/8"	12 3/16"	11 1/4"	4	1 1/4"	13/16"		22 7/8"	19 7/8"	3 11/16"	19 3/8"	2 13/16"	7/8"	1/4"	3/4"	1 7/8"	17 7/8"	3/8"	1 7/16"	17.835	9/16"	17 5/8"	22 5/8"	19 5/8"	7 1/16"
900	90	0.03	1 7/8"	27 3/8"	30 7/8"	12 13/16"	11 1/16"	4	1 1/2"	13/16"		23 3/8"	20 3/8"	3 11/16"	19 7/8"	2 13/16"	7/8"	1/4"	3/4"	1 7/8"	18 3/8"	3/8"	1 7/16"	18.335	9/16"	18 1/8"	23 1/8"	20 1/8"	7 3/16"
950	95	0.03	1 7/8"	28 1/2"	31 3/8"	13 1/16"	11 5/8"	4	1 1/2"	13/16"		23 7/8"	20 7/8"	3 15/16"	20 3/8"	3"	15/16"	1/4"	3/4"	2"	18 7/8"	1/2"	1 7/16"	18.835	9/16"	18 5/8"	23 5/8"	20 5/8"	7 3/8"
1000	100	0.03	1 7/8"	29 1/2"	31 7/8"	13 5/16"	12 1/8"	4	1 1/2"	13/16"		24 3/8"	21 3/8"	3 15/16"	20 7/8"	3"	15/16"	1/4"	3/4"	2"	19 3/8"	1/2"	1 7/16"	19.335	5/8"	19 1/8"	24 1/8"	21 1/8"	7 3/8"
1100	110	0.03	1 7/8"	31 1/2"	32 7/8"	13 13/16"	13 1/8"	4	1 1/2"	13/16"		25 3/8"	22 3/8"	4 1/4"	21 7/8"	3 3/16"	1 1/16"	1/4"	3/4"	2 1/8"	20 3/8"	1/2"	1 9/16"	20.335	5/8"	20 1/8"	25 1/8"	22 1/8"	7 3/4"
1200	120	0.03	1 7/8"	33 1/2"	33 3/4"	14 1/4"	14 1/8"	4	1 1/2"	13/16"		26 1/4"	23 1/4"	4 1/8"	22 3/4"	3 3/16"	15/16"	1/4"	3/4"	2 1/8"	21 1/4"	1/2"	1 9/16"	21.210	11/16"	21"	26"	23"	7 5/8"
1300	130	0.03	2 1/8"	34 3/8"	36"	15"	14 3/16"	4	1 3/4"	13/16"		27"	24"	4 7/16"	23 1/2"	3 3/8"	1 1/16"	1/4"	3/4"	2 1/4"	22"	1/2"	1 11/16"	21.960	11/16"	21 3/4"	26 3/4"	23 3/4"	8 1/4"
1400	140	0.03	2 1/8"	36 1/4"	36 7/8"	15 7/16"	15 1/8"	4	1 3/4"	13/16"		27 7/8"	24 7/8"	4 5/8"	24 3/8"	3 1/2"	1 1/8"	1/4"	3/4"	2 3/8"	22 7/8"	1/2"	1 11/16"	22.835	11/16"	22 5/8"	27 5/8"	24 5/8"	8 7/16"
1500	150	0.03	2 1/4"	38"	38"	16"	16"	4	1 3/4"	13/16"		28 5/8"	25 5/8"	4 11/16"	25 1/8"	3 9/16"	1 1/8"	1/4"	3/4"	2 3/8"	23 5/8"	1/2"	1 11/16"	23.585	3/4"	23 3/8"	28 3/8"	25 3/8"	8 9/16"

DESIGN TABLES FOR NON-GUIDED POT BEARINGS - METRIC UNITS

VERTICAL LOAD(KN)	HORIZONTAL LOAD(KN)	ROTATION (RADS.)	MASONRY PLATE					ANCHOR BOLT		SOLE PLATE				POT						ELASTOMERIC DISC			PISTON			PTFE	STAINLESS STEEL		BEARING * HEIGHT
			A	B	C	D	E	QTY.	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	HH	LL	MM	PP
890	89	0.03	38	302	505	195	94	4	32	21	PER DESIGN (BEVELED SOLE PLATE)	352	276	51	264	38	13	6	19	25	225	10	21	224	7	219	346	270	126
1112	111	0.03	38	333	530	208	110	4	32	21		378	302	55	289	39	15	6	19	25	251	10	24	250	8	244	371	295	131
1334	133	0.03	41	349	552	219	117	4	32	21		400	324	58	311	43	14	6	19	29	273	10	24	272	8	267	394	318	137
1557	156	0.03	41	371	575	230	129	4	32	21		422	346	61	333	48	13	6	19	32	295	10	27	294	9	289	416	340	142
1779	178	0.03	41	406	594	240	146	4	32	21		441	365	65	352	48	17	6	19	32	314	10	27	313	9	308	435	359	146
2002	200	0.03	44	410	613	249	148	4	32	21		460	384	70	371	52	18	6	19	35	333	10	27	332	10	327	454	378	153
2224	222	0.03	44	441	629	257	164	4	32	21		476	400	70	387	53	17	6	19	35	349	10	30	348	10	343	470	394	155
2446	245	0.03	44	479	648	267	183	4	32	21		495	419	80	406	57	23	6	19	38	368	10	30	367	11	362	489	413	164
2669	267	0.03	44	514	664	275	200	4	32	21		511	435	80	422	61	19	6	19	41	384	10	30	383	12	378	505	429	163
2891	289	0.03	44	549	679	283	217	4	32	21		527	451	80	438	62	18	6	19	41	400	10	33	399	12	394	521	445	165
3114	311	0.03	44	587	692	289	237	4	32	21		540	464	86	451	62	24	6	19	41	413	10	33	412	12	406	533	457	171
3336	334	0.03	44	619	708	297	252	4	32	21		556	479	86	467	66	20	6	19	44	429	10	33	428	13	422	549	473	170
3558	356	0.03	44	654	721	303	270	4	32	21		568	492	93	479	67	26	6	19	44	441	10	33	440	13	435	562	486	176
3781	378	0.03	44	686	733	310	286	4	32	21		581	505	93	492	71	22	6	19	48	454	10	37	453	14	448	575	498	180
4003	400	0.03	48	695	784	325	281	4	38	21		594	518	93	505	71	22	6	19	48	467	10	37	466	14	460	587	511	184
4226	423	0.03	48	724	797	332	295	4	38	21		606	530	99	518	75	24	6	19	51	479	13	37	478	14	473	600	524	189
4448	445	0.03	48	749	810	338	308	4	38	21		619	543	99	530	75	24	6	19	51	492	13	37	491	15	486	613	537	189
4893	489	0.03	48	800	835	351	333	4	38	21		645	568	105	556	80	26	6	19	54	518	13	40	517	16	511	638	562	197
5338	534	0.03	48	851	857	362	359	4	38	21		667	591	105	578	81	25	6	19	54	540	13	40	539	16	533	660	584	196
5782	578	0.03	54	873	914	381	360	4	44	21		686	610	112	597	85	27	6	19	57	559	13	43	558	17	552	679	603	210
6227	623	0.03	54	921	937	392	384	4	44	21		708	632	118	619	89	29	6	19	60	581	13	43	580	17	575	702	625	215
6672	667	0.03	57	965	965	406	406	4	44	21		727	651	118	638	90	28	6	19	60	600	13	43	599	18	594	721	645	217



BEVELED SOLE PLATE DETAIL

*- BEARING HEIGHT INCLUDES 3.2 (1/8") BEDDING MATERIAL. EFFECTS OF BEVELED SOLE PLATE ARE NOT INCLUDED. IF BEVELED SOLE PLATE IS USED CALCULATE INCREASED BEARING HEIGHT ACCORDININGLY.

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS - NON-GUIDED

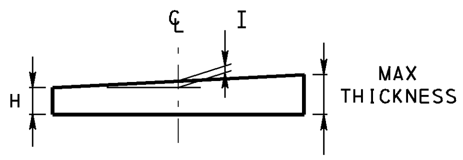
DESIGN TABLES FOR GUIDED POT BEARINGS (10% HORIZONTAL LOAD) - ENGLISH UNITS

VERTICAL LOAD (KIPS)	HORIZONTAL LOAD (KIPS)	ROTATION (RADS.)	MASONRY PLATE						ANCHOR BOLT		SOLE PLATE	
			A	B	C	D	E	F	QTY.	G	H	
200	20	0.03	1 7/8"	11 7/8"	23 7/8"	9 11/16"	3 11/16"	-	4	1 1/4"	13/16"	PER DESIGN (BEVELED SOLE PLATE)
250	25	0.03	2"	13 1/8"	25 3/8"	10 7/16"	4 5/16"	-	4	1 1/4"	13/16"	
300	30	0.03	2"	14 3/4"	26 1/4"	10 7/8"	5 1/8"	-	4	1 1/4"	13/16"	
350	35	0.03	2 1/8"	15 1/8"	27 5/8"	11 9/16"	5 5/16"	-	4	1 1/4"	13/16"	
400	40	0.03	2 1/8"	16 3/4"	28 3/8"	11 15/16"	6 1/8"	-	4	1 1/4"	13/16"	
450	45	0.03	2 1/4"	16 7/8"	29 5/8"	12 9/16"	6 3/16"	-	4	1 1/4"	13/16"	
500	50	0.03	2 1/4"	18 1/8"	30 1/4"	12 7/8"	6 13/16"	-	4	1 1/4"	13/16"	
550	55	0.03	2 3/8"	18 1/2"	31 1/4"	13 3/8"	7"	-	4	1 1/4"	13/16"	
600	60	0.03	2 3/8"	19 1/8"	32 1/8"	13 13/16"	7 5/16"	-	4	1 1/4"	13/16"	
650	65	0.03	2 1/2"	19 3/4"	32 3/4"	14 1/8"	7 5/8"	-	4	1 1/4"	13/16"	
700	70	0.03	2 1/2"	20 1/2"	33 1/2"	14 1/2"	8"	-	4	1 1/4"	13/16"	
750	75	0.03	2 1/2"	21 1/8"	34 3/8"	14 15/16"	8 5/16"	-	4	1 1/4"	13/16"	
800	80	0.03	2 1/2"	21 7/8"	35 1/8"	15 5/16"	8 11/16"	-	4	1 1/4"	13/16"	
850	85	0.03	2 1/2"	22 3/4"	35 5/8"	15 9/16"	9 1/8"	-	4	1 1/4"	13/16"	
900	90	0.03	2 3/4"	22 7/8"	37 5/8"	16 3/16"	8 13/16"	-	4	1 1/2"	13/16"	
950	95	0.03	2 3/4"	24 1/4"	38 5/8"	16 11/16"	9 1/2"	-	4	1 1/2"	13/16"	
1000	100	0.03	2 3/4"	25 1/8"	39 1/8"	16 15/16"	9 15/16"	-	4	1 1/2"	13/16"	
1100	110	0.03	2 3/4"	27"	40 1/8"	17 7/16"	10 7/8"	-	4	1 1/2"	13/16"	
1200	120	0.03	3"	27 1/8"	41 5/8"	18 3/16"	10 15/16"	-	4	1 1/2"	13/16"	
1300	130	0.03	3 1/4"	27 7/8"	44 1/8"	19 1/16"	10 15/16"	-	4	1 3/4"	13/16"	
1400	140	0.03	3 1/4"	29 1/2"	45 1/4"	19 5/8"	11 3/4"	-	4	1 3/4"	13/16"	
1500	150	0.03	3 1/4"	31 1/8"	46 1/4"	20 1/8"	12 9/16"	-	4	1 3/4"	13/16"	

VERTICAL LOAD (KIPS)	SOLE PLATE		POT						ELASTOMERIC DISC			PISTON				GUIDE PLATE	
	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
200	15 1/4"	14 7/8"	2"	10 3/8"	1 1/2"	1/2"	1/4"	3/4"	1"	8 7/8"	3/8"	1 1/8"	8.835	5/16"	1/4"	1 1/16"	10 3/8"
250	16 1/2"	16 3/8"	2 3/16"	11 5/8"	1 9/16"	5/8"	1/4"	7/8"	1"	9 7/8"	3/8"	1 1/4"	9.835	5/16"	1/4"	1 1/4"	11 5/8"
300	17 3/8"	17 1/4"	2 5/16"	12 1/2"	1 3/4"	9/16"	1/4"	7/8"	1 1/8"	10 3/4"	3/8"	1 1/4"	10.710	3/8"	1/4"	1 1/4"	12 1/2"
350	18 1/2"	18 5/8"	2 3/8"	13 5/8"	1 7/8"	1/2"	1/4"	1"	1 1/4"	11 5/8"	3/8"	1 3/8"	11.585	3/8"	1/4"	1 3/8"	13 5/8"
400	19 1/4"	19 3/8"	2 9/16"	14 3/8"	1 15/16"	5/8"	1/4"	1"	1 1/4"	12 3/8"	3/8"	1 3/8"	12.335	3/8"	1/4"	1 3/8"	14 3/8"
450	20 1/4"	20 5/8"	2 13/16"	15 3/8"	2 1/8"	11/16"	1/4"	1 1/8"	1 3/8"	13 1/8"	3/8"	1 1/2"	13.085	7/16"	1/4"	1 1/2"	15 3/8"
500	20 7/8"	21 1/4"	2 13/16"	16"	2 1/8"	11/16"	1/4"	1 1/8"	1 3/8"	13 3/4"	3/8"	1 1/2"	13.710	7/16"	1/4"	1 1/2"	16"
550	21 7/8"	22 1/4"	3 1/8"	17"	2 1/4"	7/8"	1/4"	1 1/4"	1 1/2"	14 1/2"	3/8"	1 1/2"	14.460	7/16"	1/4"	1 1/2"	17"
600	22 1/2"	23 1/8"	3 3/16"	17 5/8"	2 7/16"	3/4"	1/4"	1 1/4"	1 5/8"	15 1/8"	3/8"	1 5/8"	15.085	1/2"	1/4"	1 5/8"	17 5/8"
650	23 1/8"	23 3/4"	3 1/8"	18 1/4"	2 7/16"	11/16"	1/4"	1 1/4"	1 5/8"	15 3/4"	3/8"	1 5/8"	15.710	1/2"	1/4"	1 5/8"	18 1/4"
700	23 7/8"	24 1/2"	3 7/16"	19"	2 7/16"	15/16"	1/4"	1 3/8"	1 5/8"	16 1/4"	3/8"	1 5/8"	16.210	1/2"	1/4"	1 5/8"	19"
750	24 1/2"	25 3/8"	3 7/16"	19 5/8"	2 5/8"	13/16"	1/4"	1 3/8"	1 3/4"	16 7/8"	3/8"	1 5/8"	16.835	9/16"	1/4"	1 3/4"	19 5/8"
800	25 1/2"	26 1/8"	3 3/4"	20 3/8"	2 11/16"	1 1/16"	1/4"	1 1/2"	1 3/4"	17 3/8"	3/8"	1 3/4"	17.335	9/16"	1/4"	1 3/4"	20 3/8"
850	25 3/4"	26 5/8"	3 9/16"	20 7/8"	2 11/16"	7/8"	1/4"	1 1/2"	1 7/8"	17 7/8"	3/8"	1 3/4"	17.835	9/16"	1/4"	1 3/4"	20 7/8"
900	26 1/4"	27 1/8"	3 11/16"	21 3/8"	2 13/16"	7/8"	1/4"	1 1/2"	1 7/8"	18 3/8"	3/8"	1 3/4"	18.335	9/16"	1/4"	1 3/4"	21 3/8"
950	27"	28 1/8"	3 15/16"	22 1/8"	3"	15/16"	1/4"	1 5/8"	2"	18 7/8"	1/2"	1 3/4"	18.835	5/8"	1/4"	1 7/8"	22 1/8"
1000	27 1/2"	28 5/8"	3 15/16"	22 5/8"	3"	15/16"	1/4"	1 5/8"	2"	19 3/8"	1/2"	1 7/8"	19.335	5/8"	1/4"	1 7/8"	22 5/8"
1100	28 1/2"	29 5/8"	4 3/16"	23 5/8"	3 3/16"	1"	1/4"	1 5/8"	2 1/8"	20 3/8"	1/2"	1 7/8"	20.335	5/8"	1/4"	1 7/8"	23 5/8"
1200	29 5/8"	31 1/8"	4 5/16"	24 3/4"	3 3/16"	1 1/8"	1/4"	1 3/4"	2 1/8"	21 1/4"	1/2"	1 7/8"	21.210	11/16"	1/4"	2"	24 3/4"
1300	30 5/8"	32 1/8"	4 9/16"	25 3/4"	3 3/8"	1 3/16"	1/4"	1 7/8"	2 1/4"	22"	1/2"	2"	21.960	11/16"	1/4"	2"	25 3/4"
1400	31 1/2"	33 1/4"	4 9/16"	26 5/8"	3 1/2"	1 1/16"	1/4"	1 7/8"	2 3/8"	22 7/8"	1/2"	2"	22.835	11/16"	1/4"	2 1/8"	26 5/8"
1500	32 1/2"	34 1/4"	4 13/16"	27 5/8"	3 9/16"	1 1/4"	1/4"	2"	2 3/8"	23 5/8"	1/2"	2 1/8"	23.585	3/4"	1/4"	2 1/8"	27 5/8"

VERTICAL LOAD (KIPS)	HORIZONTAL LOAD (KIPS)	GUIDE BARS							PTFE				STAINLESS STEEL				BEARING * HEIGHT
		AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP
200	20	1 3/8"	1 3/8"	15 1/4"	5/16"	7/16"	5/16"	5.434	7 5/8"	3/16"	5/8"	10 1/8"	15 1/8"	8 5/8"	15 1/8"	7/8"	6 7/16"
250	25	1 1/2"	1 1/2"	16 1/2"	5/16"	7/16"	5/16"	6.059	8 1/2"	3/16"	3/4"	11 3/8"	16 3/8"	9 1/2"	16 3/8"	1"	7"
300	30	1 1/2"	1 1/2"	17 3/8"	5/16"	7/16"	5/16"	6.496	9 3/8"	3/16"	3/4"	12 1/4"	17 1/4"	10 3/8"	17 1/4"	1"	7 1/16"
350	35	1 5/8"	1 5/8"	18 1/2"	5/16"	7/16"	5/16"	7.059	10 1/8"	3/16"	7/8"	13 3/8"	18 3/8"	11 1/8"	18 3/8"	1 1/8"	7 1/2"
400	40	1 5/8"	1 5/8"	19 1/4"	5/16"	7/16"	5/16"	7.434	10 3/4"	3/16"	7/8"	14 1/8"	19 1/8"	11 3/4"	19 1/8"	1 1/8"	7 5/8"
450	45	1 3/4"	1 3/4"	20 1/4"	5/16"	7/16"	5/16"	7.934	11 3/8"	3/16"	1"	15 1/8"	20 1/8"	12 3/8"	20 1/8"	1 1/4"	8 3/16"
500	50	1 3/4"	1 3/4"	20 7/8"	5/16"	7/16"	5/16"	8.246	12"	3/16"	1"	15 3/4"	20 3/4"	13"	20 3/4"	1 1/4"	8 3/16"
550	55	1 3/4"	1 3/4"	21 7/8"	5/16"	7/16"	5/16"	8.746	12 5/8"	3/16"	1"	16 3/4"	21 3/4"	13 5/8"	21 3/4"	1 1/4"	8 5/8"
600	60	1 7/8"	1 7/8"	22 1/2"	5/16"	7/16"	5/16"	9.059	13 1/8"	3/16"	1 1/8"	17 3/8"	22 3/8"	14 1/8"	22 3/8"	1 3/8"	8 7/8"
650	65	1 7/8"	1 7/8"	23 1/8"	5/16"	7/16"	5/16"	9.371	13 3/4"	3/16"	1 1/8"	18"	23"	14 3/4"	23"	1 3/8"	8 15/16"
700	70	1 7/8"	1 7/8"	23 7/8"	5/16"	7/16"	5/16"	9.746	14 1/4"	3/16"	1 1/8"	18 3/4"	23 3/4"	15 1/4"	23 3/4"	1 3/8"	9 3/16"
750	75	2"	2"	24 1/2"	5/16"	7/16"	5/16"	10.059	14 3/4"	3/16"	1 1/4"	19 3/8"	24 3/8"	15 3/4"	24 3/8"	1 1/2"	9 5/16"
800	80	2"	2"	25 1/4"	5/16"	7/16"	5/16"	10.434	15 1/4"	3/16"	1 1/4"	20 1/8"	25 1/8"	16 1/4"	25 1/8"	1 1/2"	9 11/16"
850	85	2"	2"	25 3/4"	5/16"	7/16"	5/16"	10.684	15 5/8"	3/16"	1 1/4"	20 5/8"	25 5/8"	16 5/8"	25 5/8"	1 1/2"	9 5/8"
900	90	2"	2"	26 1/4"	5/16"	7/16"	5/16"	10.934	16 1/8"	3/16"	1 1/4"	21 1/8"	26 1/8"	17 1/8"	26 1/8"	1 1/2"	9 7/8"
950	95	2 1/8"	2 1/8"	27"	5/16"	7/16"	5/16"	11.309	16 1/2"	3/16"	1 3/8"	21 7/8"	26 7/8"	17 1/2"	26 7/8"	1 5/8"	10 3/16"
1000	100	2 1/8"	2 1/8"	27 1/2"	5/16"	7/16"	5/16"	11.559	17"	3/16"	1 3/8"	22 3/8"	27 3/8"	18"	27 3/8"	1 5/8"	10 5/16"
1100	110	2 1/8"	2 1/8"	28 1/2"	5/16"	7/16"	5/16"	12.059	17 3/4"	3/16"	1 3/8"	23 3/8"	28 3/8"	18 3/4"	28 3/8"	1 5/8"	10 1/2"
1200	120	2 1/4"	2 1/4"	29 5/8"	5/16"	7/16"	5/16"	12.652	18 5/8"	1/4"	1 1/2"	24 1/2"	29 1/2"	19 5/8"	29 1/2"	1 3/4"	11"
1300	130	2 1/4"	2 1/4"	30 5/8"	5/16"	7/16"	5/16"	13.152	19 3/8"	1/4"	1 1/2"	25 1/2"	30 1/2"	20 3/8"	30 1/2"	1 3/4"	11 9/16"
1400	140	2 3/8"	2 3/8"	31 1/2"	5/16"	7/16"	5/16"	13.590	20 1/8"	1/4"	1 5/8"	26 3/8"	31 3/8"	21 1/8"	31 3/8"	1 7/8"	11 11/16"
1500	150	2 3/8"	2 3/8"	32 1/2"	5/16"	7/16"	5/16"	14.090	20 3/4"	1/4"	1 5/8"	27 3/8"	32 3/8"	21 3/4"	32 3/8"	1 7/8"	12"

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.



BEVELED SOLE PLATE DETAIL

*- BEARING HEIGHT INCLUDES 1/8" BEDDING MATERIAL. EFFECTS OF BEVELED SOLE PLATE ARE NOT INCLUDED. IF BEVELED SOLE PLATE IS USED CALCULATE INCREASED BEARING HEIGHT ACCORDININGLY.

NATIONAL STANDARD

HIGH LOAD MULTI-ROTATIONAL

POT BEARINGS - GUIDED

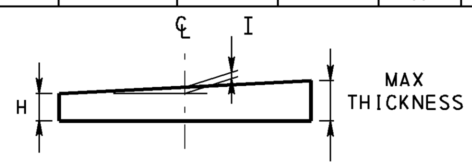
10% HORIZONTAL LOAD (ENGLISH)

DESIGN TABLES FOR GUIDED POT BEARINGS (10% HORIZONTAL LOAD) - METRIC UNITS

VERTICAL LOAD(KN)	HORIZONTAL LOAD(KN)	ROTATION (RADS.)	MASONRY PLATE						ANCHOR BOLT		SOLE PLATE				POT						ELASTOMERIC DISC			PISTON				GUIDE PLATE	
			A	B	C	D	E	F	QTY	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
890	89	0.03	48	302	606	246	94	-	4	32	21	PER DESIGN (BEVELED SOLE PLATE)	387	378	51	264	38	13	6	19	25	225	10	29	224	7	6	28	264
1112	111	0.03	51	333	645	265	110	-	4	32	21		419	416	55	295	39	15	6	22	25	251	10	32	250	8	6	31	295
1334	133	0.03	51	375	667	276	130	-	4	32	21		441	438	58	318	43	14	6	22	29	273	10	32	272	8	6	31	318
1557	156	0.03	54	384	702	294	135	-	4	32	21		470	473	61	346	48	13	6	25	32	295	10	35	294	9	6	34	346
1779	178	0.03	54	425	721	303	156	-	4	32	21		489	492	64	365	48	16	6	25	32	314	10	35	313	9	6	34	365
2002	200	0.03	57	429	752	319	157	-	4	32	21		514	524	70	391	52	18	6	29	35	333	10	38	332	10	6	37	391
2224	222	0.03	57	460	768	327	173	-	4	32	21		530	540	70	406	53	17	6	29	35	349	10	38	348	10	6	37	406
2446	245	0.03	60	470	794	340	178	-	4	32	21		556	565	80	432	57	23	6	32	38	368	10	38	367	11	6	37	432
2669	267	0.03	60	486	816	351	186	-	4	32	21		572	587	80	448	61	19	6	32	41	384	10	41	383	12	6	41	448
2891	289	0.03	64	502	832	359	194	-	4	32	21		587	603	80	464	62	18	6	32	41	400	10	41	399	12	6	41	464
3114	311	0.03	64	521	851	368	203	-	4	32	21		606	622	86	483	62	24	6	35	41	413	10	41	412	12	6	41	483
3336	334	0.03	64	537	873	379	211	-	4	32	21		622	645	86	498	66	20	6	35	44	429	10	41	428	13	6	44	498
3558	356	0.03	64	556	892	389	221	-	4	32	21		641	664	93	518	67	26	6	38	44	441	10	45	440	13	6	44	518
3781	378	0.03	64	578	905	395	232	-	4	32	21		654	676	93	530	71	22	6	38	48	454	10	45	453	14	6	44	530
4003	400	0.03	70	581	956	411	224	-	4	38	21		667	689	93	543	71	22	6	38	48	467	10	45	466	14	6	44	543
4226	423	0.03	70	616	981	424	241	-	4	38	21		686	714	99	562	75	24	6	41	51	479	13	45	478	14	6	47	562
4448	445	0.03	70	638	994	430	252	-	4	38	21		699	727	99	575	75	24	6	41	51	492	13	48	491	15	6	47	575
4893	489	0.03	70	686	1019	443	276	-	4	38	21		724	752	105	600	80	26	6	41	54	518	13	48	517	16	6	47	600
5338	534	0.03	76	689	1057	462	278	-	4	38	21		752	791	109	629	81	28	6	44	54	540	13	48	539	16	6	50	629
5782	578	0.03	83	708	1121	484	278	-	4	44	21		778	816	115	654	85	30	6	48	57	559	13	51	558	17	6	50	654
6227	623	0.03	83	749	1149	498	298	-	4	44	21		800	845	115	676	89	26	6	48	60	581	13	51	580	17	6	53	676
6672	667	0.03	83	791	1175	511	319	-	4	44	21		826	870	122	702	90	32	6	51	60	600	13	54	599	18	6	53	702

VERTICAL LOAD(KN)	HORIZONTAL LOAD(KN)	GUIDE BARS							PTFE				STAINLESS STEEL				BEARING * HEIGHT
		AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP
890	89	35	35	387	8	11	8	138.024	194	5	16	257	384	219	384	22	166
1112	111	38	38	419	8	11	8	153.899	216	5	19	289	416	241	416	25	177
1334	133	38	38	441	8	11	8	164.998	238	5	19	311	438	264	438	25	180
1557	156	41	41	470	8	11	8	179.299	257	5	22	340	467	283	467	29	191
1779	178	41	41	489	8	11	8	188.824	273	5	22	359	486	298	486	29	194
2002	200	44	44	514	8	11	8	201.524	289	5	25	384	511	314	511	32	208
2224	222	44	44	530	8	11	8	209.448	305	5	25	400	527	330	527	32	207
2446	245	44	44	556	8	11	8	222.148	321	5	25	425	552	346	552	32	219
2669	267	48	48	572	8	11	8	230.099	333	5	29	441	568	359	568	35	225
2891	289	48	48	587	8	11	8	238.023	349	5	29	457	584	375	584	35	228
3114	311	48	48	606	8	11	8	247.548	362	5	29	476	603	387	603	35	234
3336	334	51	51	622	8	11	8	255.499	375	5	32	492	619	400	619	38	236
3558	356	51	51	641	8	11	8	265.024	387	5	32	511	638	413	638	38	246
3781	378	51	51	654	8	11	8	271.374	397	5	32	524	651	422	651	38	246
4003	400	51	51	667	8	11	8	277.724	410	5	32	537	664	435	664	38	252
4226	423	54	54	686	8	11	8	287.249	419	5	35	556	683	445	683	41	260
4448	445	54	54	699	8	11	8	293.599	432	5	35	568	695	457	695	41	263
4893	489	54	54	724	8	11	8	306.299	451	5	35	594	721	476	721	41	268
5338	534	57	57	752	8	11	8	321.361	473	6	38	622	749	498	749	44	279
5782	578	57	57	778	8	11	8	334.061	492	6	38	648	775	518	775	44	294
6227	623	60	60	800	8	11	8	345.186	511	6	41	670	797	537	797	48	296
6672	667	60	60	826	8	11	8	357.886	527	6	41	695	822	552	822	48	305

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.



BEVELED SOLE PLATE DETAIL

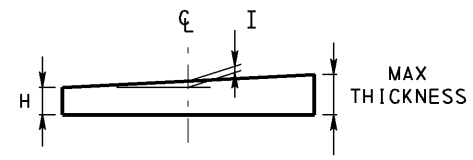
*- BEARING HEIGHT INCLUDES 3.2 BEDDING MATERIAL. EFFECTS OF BEVELED SOLE PLATE ARE NOT INCLUDED. IF BEVELED SOLE PLATE IS USED CALCULATE INCREASED BEARING HEIGHT ACCORDINGLY.

NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS - GUIDED
10% HORIZONTAL LOAD (METRIC)

DESIGN TABLES FOR GUIDED POT BEARINGS (30% HORIZONTAL LOAD) - ENGLISH UNITS

VERTICAL LOAD (KIPS)	HORIZONTAL LOAD (KIPS)	ROTATION (RADS.)	MASONRY PLATE						ANCHOR BOLT		SOLE PLATE			
			A	B	C	D	E	F	QTY.	G	H	I	J	K
200	60	0.03	2"	12 7/8"	26 7/8"	11 3/16"	4 3/16"	-	4	1 1/4"	13/16"	PER DESIGN (BEVELED SOLE PLATE)	16 1/4"	17 7/8"
250	75	0.03	2 1/8"	14 1/8"	28 5/8"	12 1/16"	4 13/16"	-	4	1 1/4"	13/16"		17 1/2"	19 5/8"
300	90	0.03	2 3/8"	15 1/4"	31 1/2"	13 1/8"	5"	-	4	1 1/2"	13/16"		18 5/8"	21"
350	105	0.03	2 3/8"	16 3/4"	32 7/8"	13 13/16"	5 3/4"	-	4	1 1/2"	13/16"		19 3/4"	23 3/8"
400	120	0.03	2 1/2"	17 3/8"	34 1/4"	14 1/2"	6 1/16"	-	4	1 1/2"	13/16"		20 3/4"	23 3/4"
450	135	0.03	2 3/4"	18 3/8"	37"	15 1/2"	6 3/16"	-	4	1 3/4"	15/16"		21 3/4"	25"
500	150	0.03	2 3/4"	19 7/8"	38 1/4"	16 1/8"	6 15/16"	-	4	1 3/4"	15/16"		22 5/8"	26 1/4"
550	165	0.03	3"	20"	39 1/4"	16 5/8"	7"	-	4	1 3/4"	1 1/16"		23 3/8"	27 1/4"
600	180	0.03	3 1/4"	20 7/8"	41 7/8"	17 9/16"	7 1/16"	-	4	2"	1 1/16"		24 1/4"	28 3/8"
650	195	0.03	3 1/4"	21 3/4"	43 1/8"	18 3/16"	7 1/2"	-	4	2"	1 3/16"		25 1/8"	29 5/8"
700	210	0.03	3 1/4"	22 1/4"	43 7/8"	18 9/16"	7 3/4"	-	4	2"	1 3/16"		25 5/8"	30 3/8"
750	225	0.03	3 1/4"	23 5/8"	45"	19 1/8"	8 7/16"	-	4	2"	1 3/16"		26 1/2"	31 1/2"
800	240	0.03	3 1/4"	24"	44 5/8"	19 5/16"	9"	-	6	1 3/4"	1 5/16"		27 1/4"	32 5/8"
850	255	0.03	3 1/4"	24 1/2"	45 1/8"	19 9/16"	9 1/4"	-	6	1 3/4"	1 5/16"		27 3/4"	33 1/8"
900	270	0.03	3 1/2"	25 1/4"	47 5/8"	20 7/16"	9 1/4"	-	6	2"	1 5/16"		28 1/2"	34 1/8"
950	285	0.03	3 1/2"	26 1/2"	48 1/2"	20 7/8"	9 7/8"	-	6	2"	1 7/16"		29"	35"
1000	300	0.03	3 1/2"	28 1/8"	49 5/8"	21 7/16"	10 11/16"	-	6	2"	1 7/16"		29 3/4"	36 1/8"
1100	330	0.03	3 11/16"	28 1/8"	51 1/8"	22 3/16"	10 11/16"	-	6	2"	1 9/16"		31"	37 5/8"
1200	360	0.03	3 11/16"	29 1/2"	52 5/8"	22 15/16"	11 3/8"	3 11/16"	8	2"	1 9/16"		32 1/8"	39 1/8"
1300	390	0.03	3 15/16"	30 1/4"	54 1/8"	23 11/16"	11 3/4"	3 7/8"	8	2"	1 11/16"		33 1/8"	40 5/8"
1400	420	0.03	3 15/16"	31 1/2"	55 5/8"	24 7/16"	12 3/8"	4 1/16"	8	2"	1 11/16"		34 1/4"	42 1/8"
1500	450	0.03	3 15/16"	33 3/8"	56 7/8"	25 1/16"	13 5/16"	4 1/4"	8	2"	1 13/16"		35 1/4"	43 3/8"

VERTICAL LOAD (KIPS)	POT						ELASTOMERIC DISC			PISTON				GUIDE PLATE	
	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
200	2 3/16"	11 3/8"	1 5/8"	9/16"	1/4"	1 1/4"	1"	8 7/8"	3/8"	1 1/4"	8.835	3/8"	1/4"	2 1/8"	11 3/8"
250	2 3/16"	12 5/8"	1 11/16"	1/2"	1/4"	1 3/8"	1"	9 7/8"	3/8"	1 3/8"	9.835	7/16"	1/4"	2 3/8"	12 5/8"
300	2 7/16"	13 3/4"	1 13/16"	5/8"	1/4"	1 1/2"	1 1/8"	10 3/4"	3/8"	1 3/8"	10.710	7/16"	1/4"	2 1/2"	13 3/4"
350	2 9/16"	14 7/8"	2"	9/16"	1/4"	1 5/8"	1 1/4"	11 5/8"	3/8"	1 1/2"	11.585	1/2"	1/4"	2 5/8"	14 7/8"
400	2 3/4"	15 7/8"	2 1/8"	5/8"	1/4"	1 3/4"	1 1/4"	12 3/8"	3/8"	1 1/2"	12.335	1/2"	1/4"	2 3/4"	15 7/8"
450	2 7/8"	16 7/8"	2 3/16"	11/16"	1/4"	1 7/8"	1 3/8"	13 1/8"	3/8"	1 5/8"	13.085	9/16"	1/4"	2 7/8"	16 7/8"
500	2 15/16"	17 3/4"	2 1/4"	11/16"	1/4"	2"	1 3/8"	13 3/4"	3/8"	1 5/8"	13.710	9/16"	5/16"	3"	17 3/4"
550	3 3/16"	18 1/2"	2 7/16"	3/4"	1/4"	2"	1 1/2"	14 1/2"	3/8"	1 5/8"	14.460	5/8"	5/16"	3 1/8"	18 1/2"
600	3 7/16"	19 3/8"	2 9/16"	7/8"	1/4"	2 1/8"	1 5/8"	15 1/8"	3/8"	1 7/8"	15.085	5/8"	5/16"	3 1/8"	19 3/8"
650	3 7/16"	20 1/4"	2 5/8"	13/16"	1/4"	2 1/4"	1 5/8"	15 3/4"	3/8"	1 7/8"	15.710	5/8"	5/16"	3 3/8"	20 1/4"
700	3 7/16"	20 3/4"	2 5/8"	13/16"	1/4"	2 1/4"	1 5/8"	16 1/4"	3/8"	2"	16.210	11/16"	5/16"	3 3/8"	20 3/4"
750	3 11/16"	21 5/8"	2 13/16"	7/8"	1/4"	2 3/8"	1 3/4"	16 7/8"	3/8"	2"	16.835	11/16"	3/8"	3 5/8"	21 5/8"
800	3 11/16"	22 3/8"	2 13/16"	7/8"	5/16"	2 1/2"	1 3/4"	17 3/8"	3/8"	2 1/8"	17.335	11/16"	3/8"	3 5/8"	22 3/8"
850	3 15/16"	22 7/8"	3"	15/16"	5/16"	2 1/2"	1 7/8"	17 7/8"	3/8"	2 1/8"	17.835	3/4"	3/8"	3 5/8"	22 7/8"
900	3 15/16"	23 5/8"	3"	15/16"	5/16"	2 5/8"	1 7/8"	18 3/8"	3/8"	2 1/8"	18.335	3/4"	3/8"	3 7/8"	23 5/8"
950	4 1/16"	24 1/8"	3 3/16"	15/16"	5/16"	2 5/8"	2"	18 7/8"	1/2"	2 1/4"	18.835	13/16"	3/8"	3 7/8"	24 1/8"
1000	4 1/16"	24 7/8"	3 3/16"	7/8"	5/16"	2 3/4"	2"	19 3/8"	1/2"	2 1/4"	19.335	13/16"	3/8"	4 1/8"	24 7/8"
1100	4 5/16"	26 1/8"	3 3/8"	7/8"	5/16"	2 7/8"	2 1/8"	20 3/8"	1/2"	2 1/4"	20.335	13/16"	7/16"	4 1/8"	26 1/8"
1200	4 7/16"	27 1/4"	3 7/16"	1"	3/8"	3"	2 1/8"	21 1/4"	1/2"	2 1/4"	21.210	7/8"	7/16"	4 3/8"	27 1/4"
1300	4 7/8"	28 1/4"	3 5/8"	1 1/4"	3/8"	3 1/8"	2 1/4"	22"	1/2"	2 1/2"	21.960	15/16"	7/16"	4 9/16"	28 1/4"
1400	4 13/16"	29 3/8"	3 3/4"	1 1/16"	3/8"	3 1/4"	2 3/8"	22 7/8"	1/2"	2 1/2"	22.835	15/16"	1/2"	4 13/16"	29 3/8"
1500	5 1/4"	30 3/8"	3 13/16"	1 7/16"	3/8"	3 3/8"	2 3/8"	23 5/8"	1/2"	2 5/8"	23.585	1"	1/2"	4 13/16"	30 3/8"



BEVELED SOLE PLATE DETAIL

VERTICAL LOAD (KIPS)	HORIZONTAL LOAD (KIPS)	GUIDE BARS							PTFE				STAINLESS STEEL				BEARING HEIGHT
		AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP
200	60	2 3/8"	2 3/8"	16 1/4"	5/16"	1/2"	5/16"	5.934	7 5/8"	3/16"	1 5/8"	11 1/8"	16 1/8"	8 5/8"	16 1/8"	1 7/8"	7 13/16"
250	75	2 5/8"	2 5/8"	17 1/2"	5/16"	1/2"	5/16"	6.559	8 1/2"	3/16"	1 7/8"	12 3/8"	17 3/8"	9 1/2"	17 3/8"	2 1/8"	8 1/4"
300	90	2 3/4"	2 3/4"	18 5/8"	5/16"	1/2"	5/16"	7.121	9 3/8"	3/16"	2"	13 1/2"	18 1/2"	10 3/8"	18 1/2"	2 1/4"	8 7/8"
350	105	2 7/8"	2 7/8"	19 3/4"	5/16"	7/16"	5/16"	7.684	10 1/8"	3/16"	2 1/8"	14 5/8"	19 5/8"	11 1/8"	19 5/8"	2 3/8"	9 3/16"
400	120	3"	3"	20 3/4"	3/8"	1/2"	3/8"	8.184	10 3/4"	3/16"	2 1/4"	15 5/8"	20 5/8"	11 3/4"	20 5/8"	2 1/2"	9 1/2"
450	135	3 1/8"	3 1/8"	21 3/4"	3/8"	1/2"	3/8"	8.684	11 3/8"	3/16"	2 3/8"	16 5/8"	21 5/8"	12 3/8"	21 5/8"	2 5/8"	10 5/16"
500	150	3 1/4"	3 1/4"	22 5/8"	7/16"	9/16"	7/16"	9.121	12"	3/16"	2 1/2"	17 1/2"	22 1/2"	13"	22 1/2"	2 3/4"	10 3/8"
550	165	3 3/8"	3 3/8"	23 3/8"	7/16"	9/16"	7/16"	9.496	12 5/8"	3/16"	2 5/8"	18 1/4"	23 1/4"	13 5/8"	23 1/4"	2 7/8"	11 1/16"
600	180	3 1/2"	3 1/2"	24 1/4"	7/16"	9/16"	7/16"	9.934	13 1/8"	3/16"	2 3/4"	19 1/8"	24 1/8"	14 1/8"	24 1/8"	3"	11 13/16"
650	195	3 5/8"	3 5/8"	25 1/8"	1/2"	5/8"	1/2"	10.371	13 3/4"	3/16"	3 7/8"	20"	25"	14 3/4"	25"	3 1/8"	12 1/8"
700	210	3 3/4"	3 3/4"	26 5/8"	1/2"	5/8"	1/2"	10.621	14 1/4"	3/16"	3"	20 1/2"	25 1/2"	15 1/4"	25 1/2"	3 1/4"	12 1/4"
750	225	3 7/8"	3 7/8"	26 1/2"	1/2"	5/8"	1/2"	11.059	14 3/4"	3/16"	3 1/8"	21 3/8"	26 3/8"	15 3/4"	26 3/8"	3 3/8"	12 5/8"
800	240	4"	4"	27 1/4"	9/16"	11/16"	9/16"	11.434	15 1/4"	3/16"	3 1/4"	22 1/8"	27 1/8"	16 1/4"	27 1/8"	3 1/2"	12 7/8"
850	255	4"	4"	27 3/4"	9/16"	11/16"	9/16"	11.684	15 5/8"	3/16"	3 1/4"	22 5/8"	27 5/8"	16 5/8"	27 5/8"	3 1/2"	13 1/16"
900	270	4 1/8"	4 1/8"	28 1/2"	9/16"	11/16"	9/16"	12.059	16 1/8"	3/16"	3 3/8"	23 3/8"	28 3/8"	17 1/8"	28 3/8"	3 5/8"	13 9/16"
950	285	4 1/4"	4 1/4"	29"	5/8"	3/4"	5/8"	12.309	16 1/2"	3/16"	3 1/2"	23 7/8"	28 7/8"	17 1/2"	28 7/8"	3 3/4"	13 15/16"
1000	300	4 3/8"	4 3/8"	29 3/4"	5/8"	3/4"	5/8"	12.715	17"	1/4"	3 5/8"	24 5/8"	29 5/8"	18"	29 5/8"	3 7/8"	14 1/8"
1100	330	4 1/2"	4 1/2"	31"	5/8"	3/4"	5/8"	13.340	17 3/4"	1/4"	3 3/4"	25 7/8"	30 7/8"	18 3/4"	30 7/8"	4"	14 1/2"
1200	360	4 5/8"	4 5/8"	32 1/8"	11/16"	13/16"	11/16"	13.902	18 5/8"	1/4"	3 7/8"	27"	32"	19 5/8"	32"	4 1/8"	14 7/8"
1300	390	4 7/8"	4 7/8"	33 1/8"	11/16"	13/16"	11/16"	14.402	19 3/8"	1/4"	4 1/8"	28"	33"	20 3/8"	33"	4 3/8"	16 1/16"
1400	420	5"	5"	34 1/4"	3/4"	7/8"	3/4"	14.965	20 1/8"	1/4"	4 1/4"	29 1/8"	34 1/8"	21 1/8"	34 1/8"	4 1/2"	16 3/16"
1500	450	5 1/8"	5 1/8"	35 1/4"	3/4"	7/8"	3/4"	15.465	20 3/4"	1/4"	4 3/8"	30 1/8"	35 1/8"	21 3/4"	35 1/8"	4 5/8"	16 13/16"

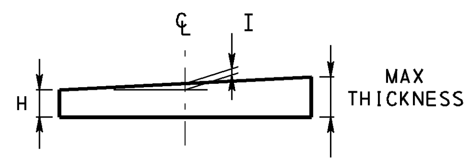
*- BEARING HEIGHT INCLUDES 1/8" BEDDING MATERIAL. EFFECTS OF BEVELED SOLE PLATE ARE NOT INCLUDED. IF BEVELED SOLE PLATE IS USED CALCULATE INCREASED BEARING HEIGHT ACCORDININGLY.

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS - GUIDED
30% HORIZONTAL LOAD (ENGLISH)

DESIGN TABLES FOR GUIDED POT BEARINGS (30% HORIZONTAL LOAD) - METRIC UNITS

VERTICAL LOAD(KN)	HORIZONTAL LOAD(KN)	ROTATION (RADS.)	MASONRY PLATE						ANCHOR BOLT		SOLE PLATE				POT						ELASTOMERIC DISC			PISTON				GUIDE PLATE	
			A	B	C	D	E	F	QTY	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
890	267	0.03	51	327	683	284	106	-	4	32	21	PER DESIGN (BEVELED SOLE PLATE)	413	454	55	289	40	15	6	32	25	225	10	32	224	9	6	53	289
1112	334	0.03	54	359	727	306	122	-	4	32	21		445	498	55	321	41	13	6	35	25	251	10	35	250	10	6	60	321
1334	400	0.03	60	387	800	333	127	-	4	38	21		473	533	61	349	46	15	6	38	29	273	10	35	272	11	6	63	349
1557	467	0.03	60	425	835	351	146	-	4	38	21		502	568	64	378	50	14	6	41	32	295	10	38	294	11	6	66	378
1779	534	0.03	64	441	870	368	154	-	4	38	21		527	603	67	403	51	16	6	44	32	314	10	38	313	12	6	69	403
2002	600	0.03	70	467	940	394	157	-	4	44	24		552	635	74	429	56	18	6	48	35	333	10	41	332	13	6	72	429
2224	667	0.03	70	505	872	410	176	-	4	44	24		575	667	74	451	57	17	6	51	35	349	10	41	348	14	7	75	451
2446	734	0.03	76	508	997	422	178	-	4	44	27		594	692	80	470	61	19	6	51	38	368	10	41	367	14	7	80	470
2669	801	0.03	83	530	1064	446	179	-	4	51	27		616	721	86	492	65	22	6	54	41	384	10	48	383	15	7	80	492
2891	867	0.03	83	552	1095	462	191	-	4	51	30		638	752	86	514	66	21	6	57	41	400	10	48	399	16	8	86	514
3114	934	0.03	83	565	1114	471	197	-	4	51	30		651	772	86	527	66	20	6	57	41	413	10	51	412	16	8	86	527
3336	1001	0.03	83	600	1143	486	214	-	4	51	30		673	800	93	549	70	22	6	60	44	429	10	51	428	17	8	93	549
3558	1068	0.03	82	610	1133	491	229	-	6	44	33		692	829	93	568	71	22	7	64	44	441	10	54	440	18	8	93	568
3781	1134	0.03	82	622	1146	497	235	-	6	44	33		705	841	99	581	75	24	7	64	48	454	10	54	453	18	9	93	581
4003	1201	0.03	88	641	1210	519	235	-	6	51	33		724	867	99	600	76	23	7	67	48	467	10	54	466	19	9	99	600
4226	1268	0.03	88	673	1232	530	251	-	6	51	37		737	889	103	613	80	23	7	67	51	479	13	57	478	19	9	99	613
4448	1334	0.03	88	714	1260	545	271	-	6	51	37		756	918	103	632	80	22	7	70	51	492	13	57	491	20	9	105	632
4893	1468	0.03	94	714	1299	564	271	-	6	51	40		787	956	109	664	85	24	8	73	54	518	13	57	517	21	10	105	664
5338	1601	0.03	94	749	1337	583	289	94	8	51	40		816	994	112	692	86	26	8	76	54	540	13	57	539	22	10	112	692
5782	1735	0.03	100	768	1375	602	298	98	8	51	43		841	1032	122	718	91	31	8	79	57	559	13	64	558	23	11	115	718
6227	1868	0.03	99	800	1413	621	314	103	8	51	43		870	1070	122	746	95	27	9	83	60	581	13	64	580	23	11	122	746
6672	2002	0.03	99	848	1445	637	338	108	8	51	46		895	1102	133	772	96	37	9	86	60	600	13	67	599	24	12	122	772



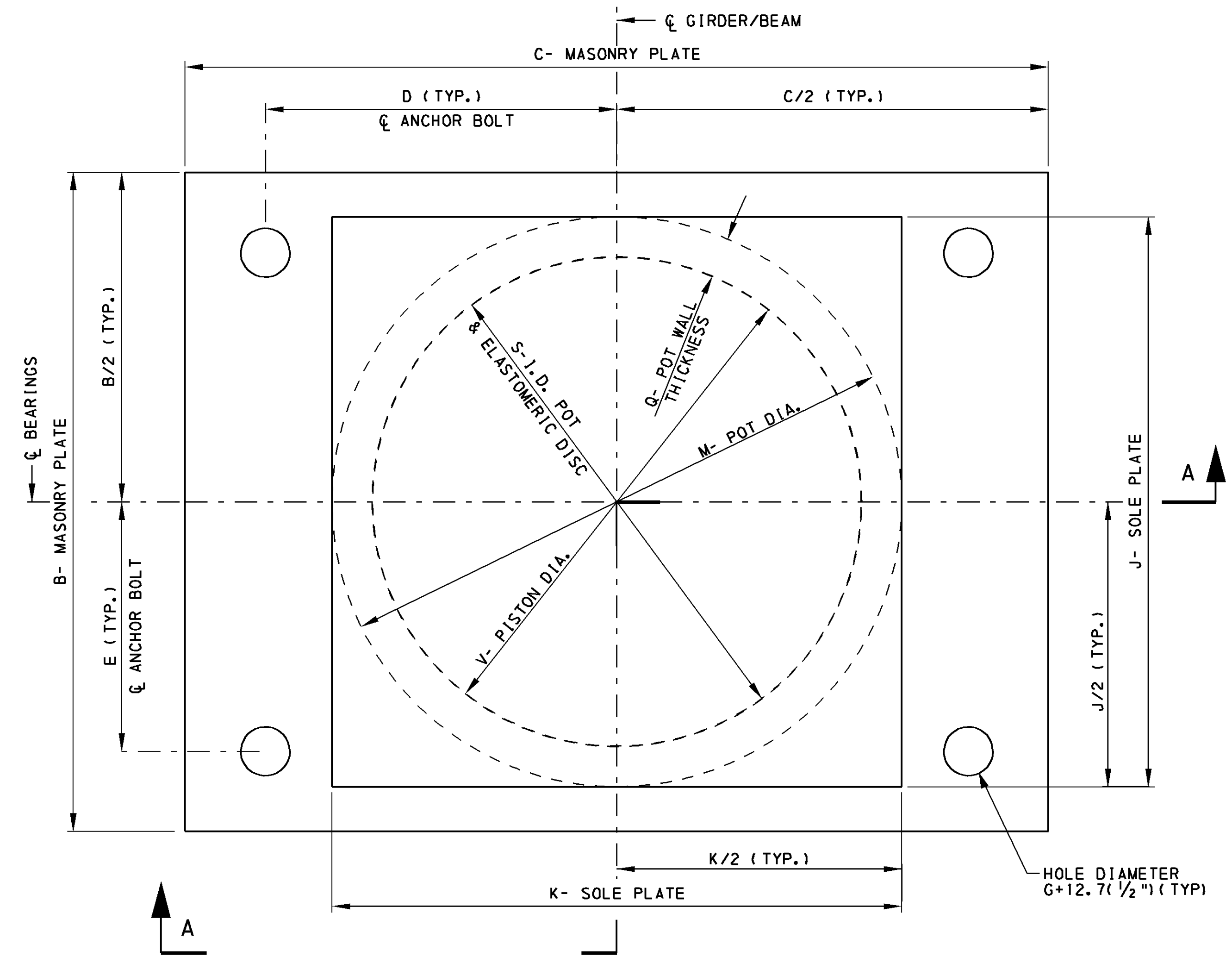
BEVELED SOLE PLATE DETAIL

VERTICAL LOAD(KN)	HORIZONTAL LOAD(KN)	GUIDE BARS							PTFE				STAINLESS STEEL				BEARING * HEIGHT
		AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP
890	267	60	60	413	8	12	8	150.724	194	5	41	283	410	219	410	48	199
1112	334	67	67	445	8	12	8	166.599	216	5	48	314	441	241	441	54	210
1334	400	70	70	473	8	12	8	180.873	238	5	51	343	470	264	470	57	225
1557	467	73	73	502	8	11	8	195.174	257	5	54	371	498	283	498	60	233
1779	534	76	76	527	10	13	10	207.874	273	5	57	397	524	298	524	64	242
2002	600	79	79	552	10	13	10	220.574	289	5	60	422	549	314	549	67	262
2224	667	83	83	575	11	14	11	231.673	305	5	64	445	572	330	572	70	263
2446	734	86	86	594	11	14	11	241.198	321	5	67	464	591	346	591	73	282
2669	801	89	89	616	11	14	11	252.324	333	5	70	486	613	359	613	76	302
2891	867	92	92	638	13	16	13	263.423	349	5	73	508	635	375	635	79	309
3114	934	95	95	651	13	16	13	269.773	362	5	76	521	648	387	648	83	311
3336	1001	98	98	673	13	16	13	280.899	375	5	79	543	670	400	670	86	323
3558	1068	102	102	692	14	17	14	290.424	387	5	83	562	689	413	689	89	328
3781	1134	102	102	705	14	17	14	296.774	397	5	83	575	702	422	702	89	333
4003	1201	105	105	724	14	17	14	306.299	410	5	86	594	721	435	721	92	344
4226	1268	108	108	737	16	19	16	312.649	419	5	89	606	733	445	733	95	354
4448	1334	111	111	756	16	19	16	322.961	432	6	92	625	752	457	752	98	359
4893	1468	114	114	787	16	19	16	338.836	451	6	95	657	784	476	784	102	372
5338	1601	117	117	816	17	21	17	353.111	473	6	98	686	813	498	813	105	381
5782	1735	125	125	841	17	21	17	365.811	492	6	105	711	838	518	838	111	407
6227	1868	127	127	870	19	22	19	380.111	511	6	108	740	867	537	867	114	412
6672	2002	130	130	895	19	22	19	392.811	527	6	111	765	892	552	892	117	427

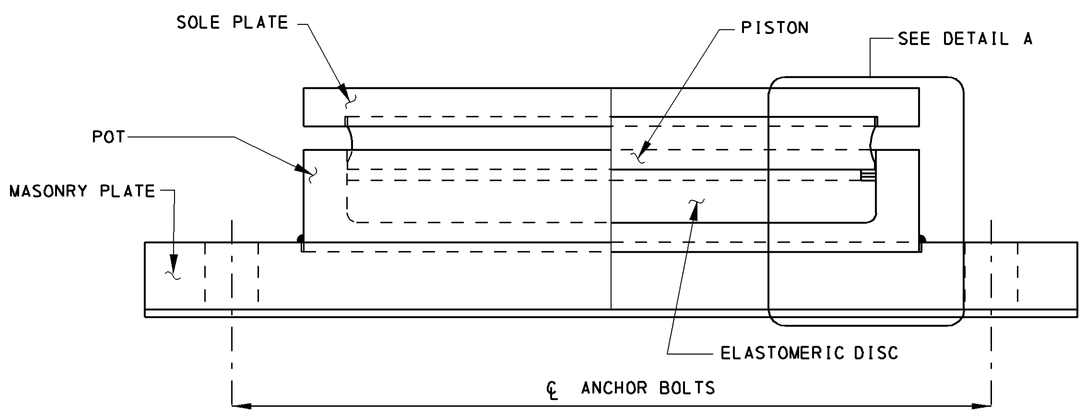
*- BEARING HEIGHT INCLUDES 3.2 BEDDING MATERIAL. EFFECTS OF BEVELED SOLE PLATE ARE NOT INCLUDED. IF BEVELED SOLE PLATE IS USED CALCULATE INCREASED BEARING HEIGHT ACCORDINGLY.

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

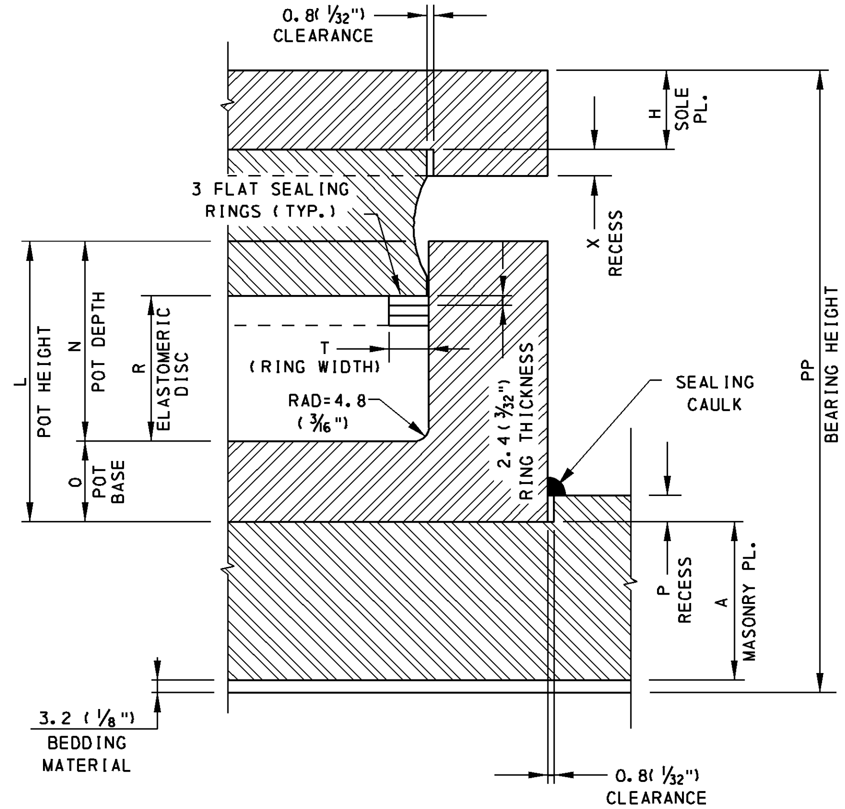
NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS - GUIDED
30% HORIZONTAL LOAD (METRIC)



FIXED POT BEARING PLAN

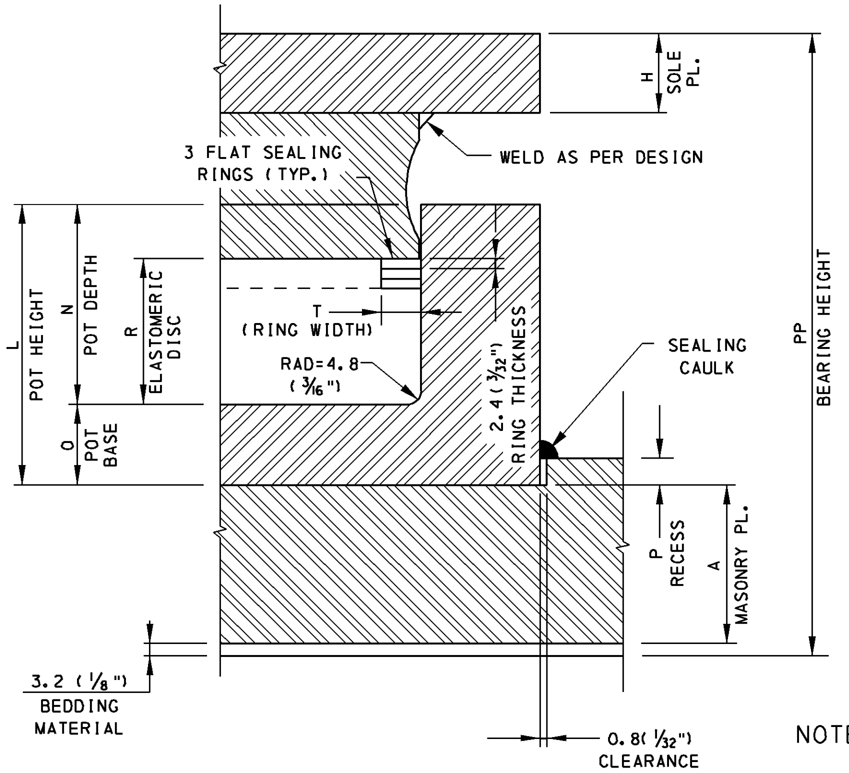


SECTION A-A



DETAIL A

NOTE: FLAT SEALING RINGS ARE SHOWN. FOR ROUND SEALING RINGS SEE DETAIL A, SHEET 13.

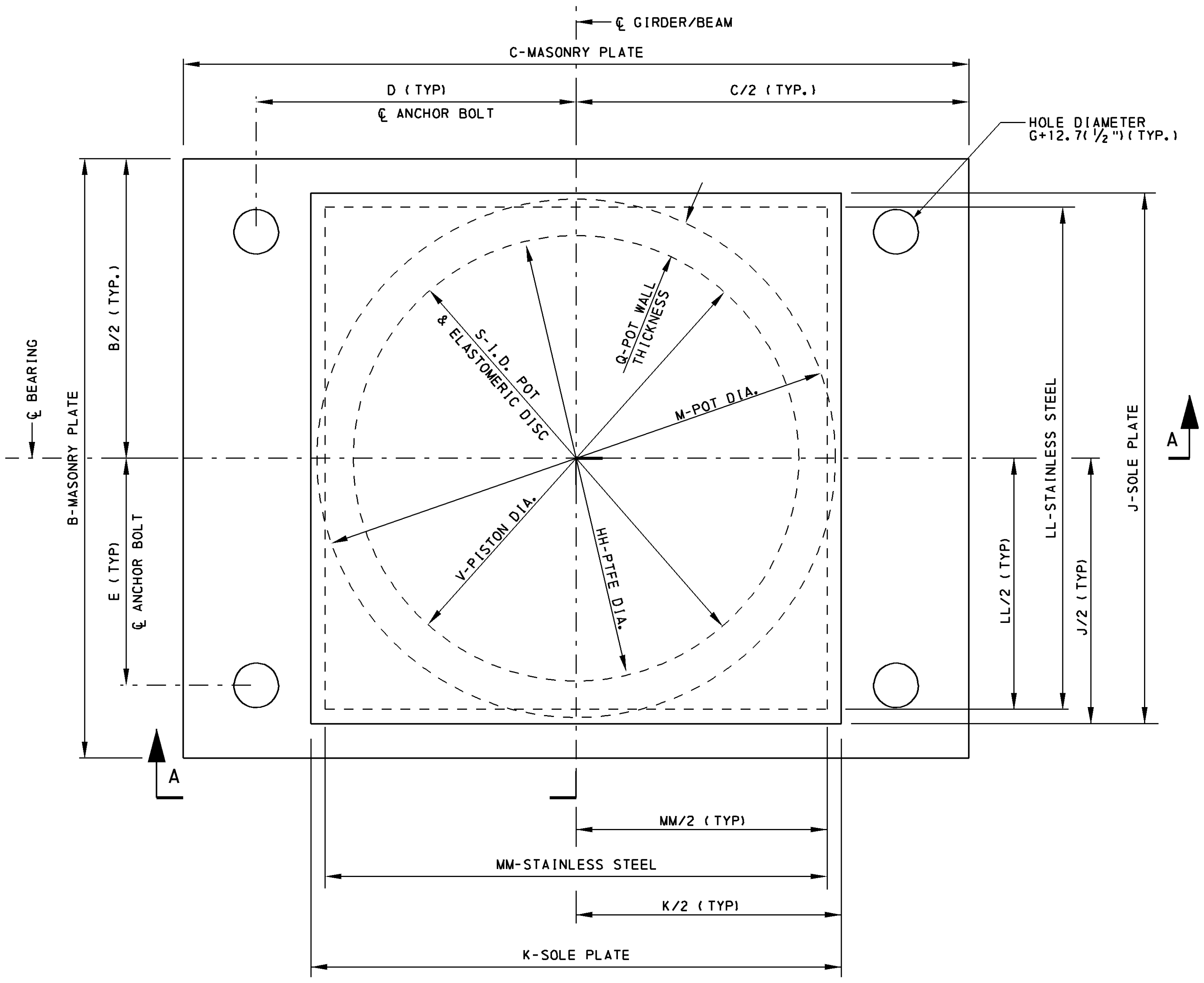


ALTERNATE SOLE PLATE ATTACHMENT FOR FIXED BEARINGS ONLY

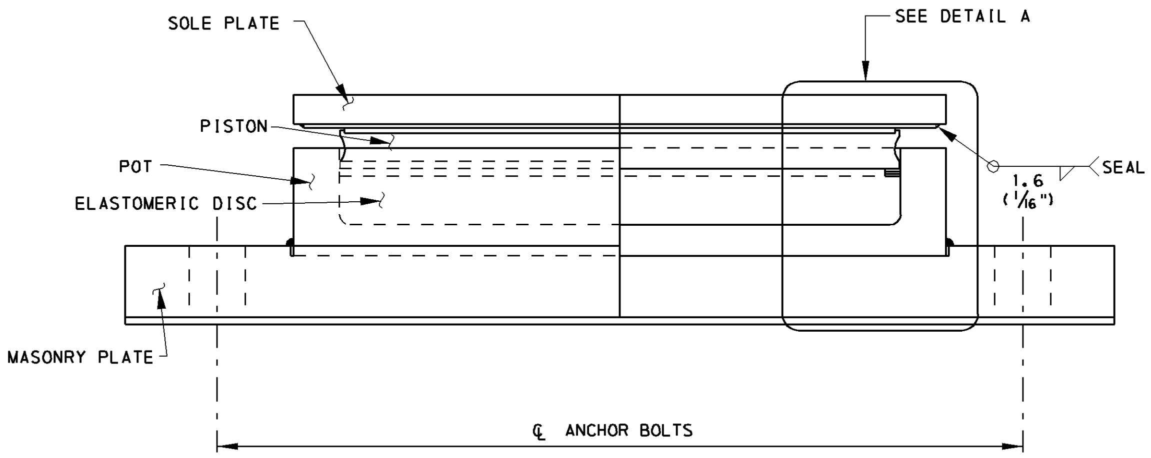
NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS - FIXED
DETAILS

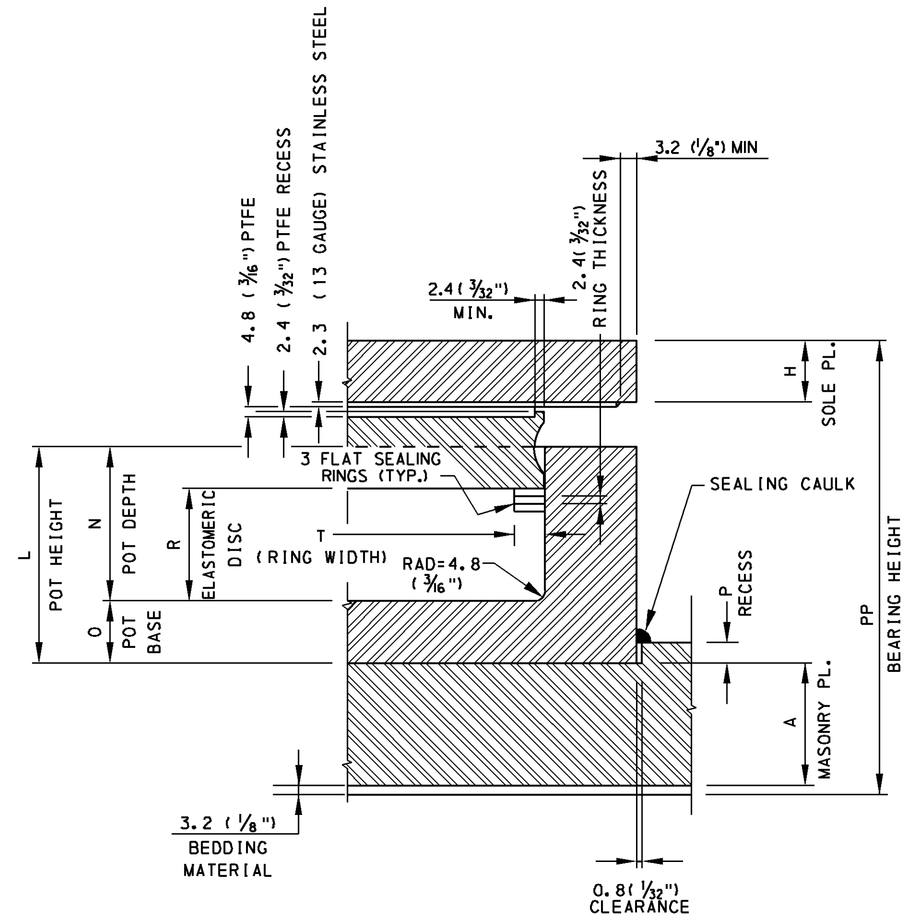
FOR ADDITIONAL DETAILS, SEE SHEETS 14 AND 15.



NON-GUIDED POT BEARING PLAN



SECTION A-A



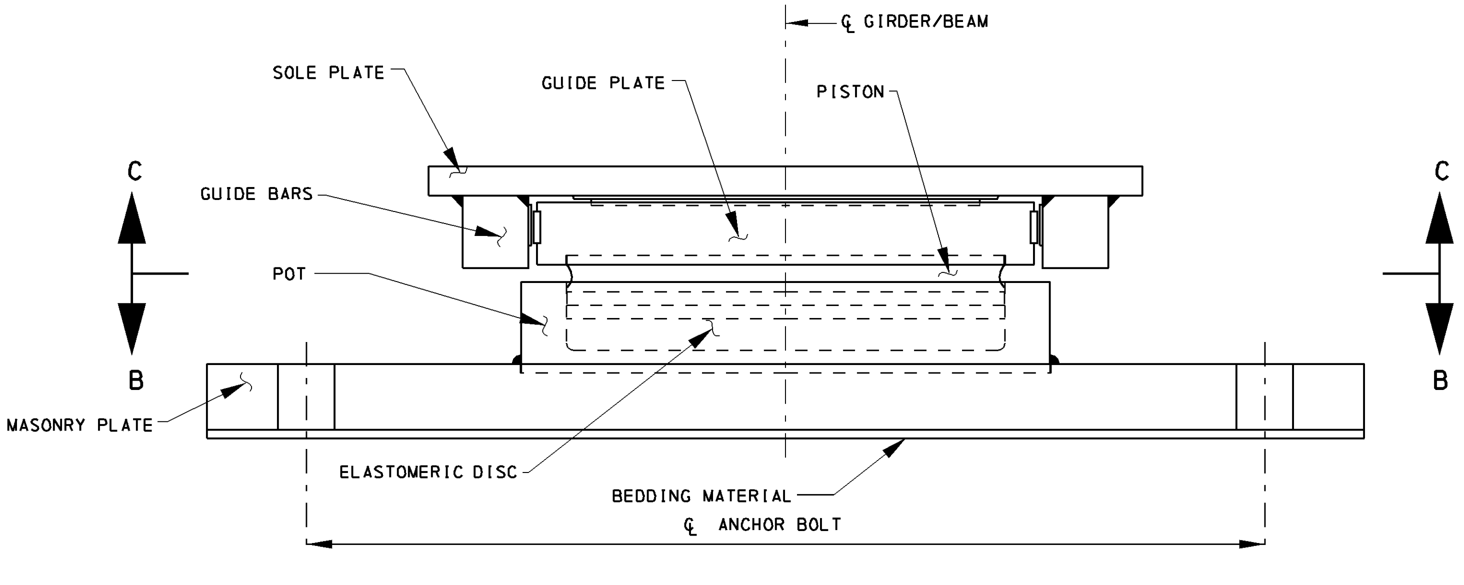
DETAIL A

NOTES: FLAT SEALING RINGS ARE SHOWN. FOR ROUND SEALING RINGS SEE DETAIL A, SHEET 13.

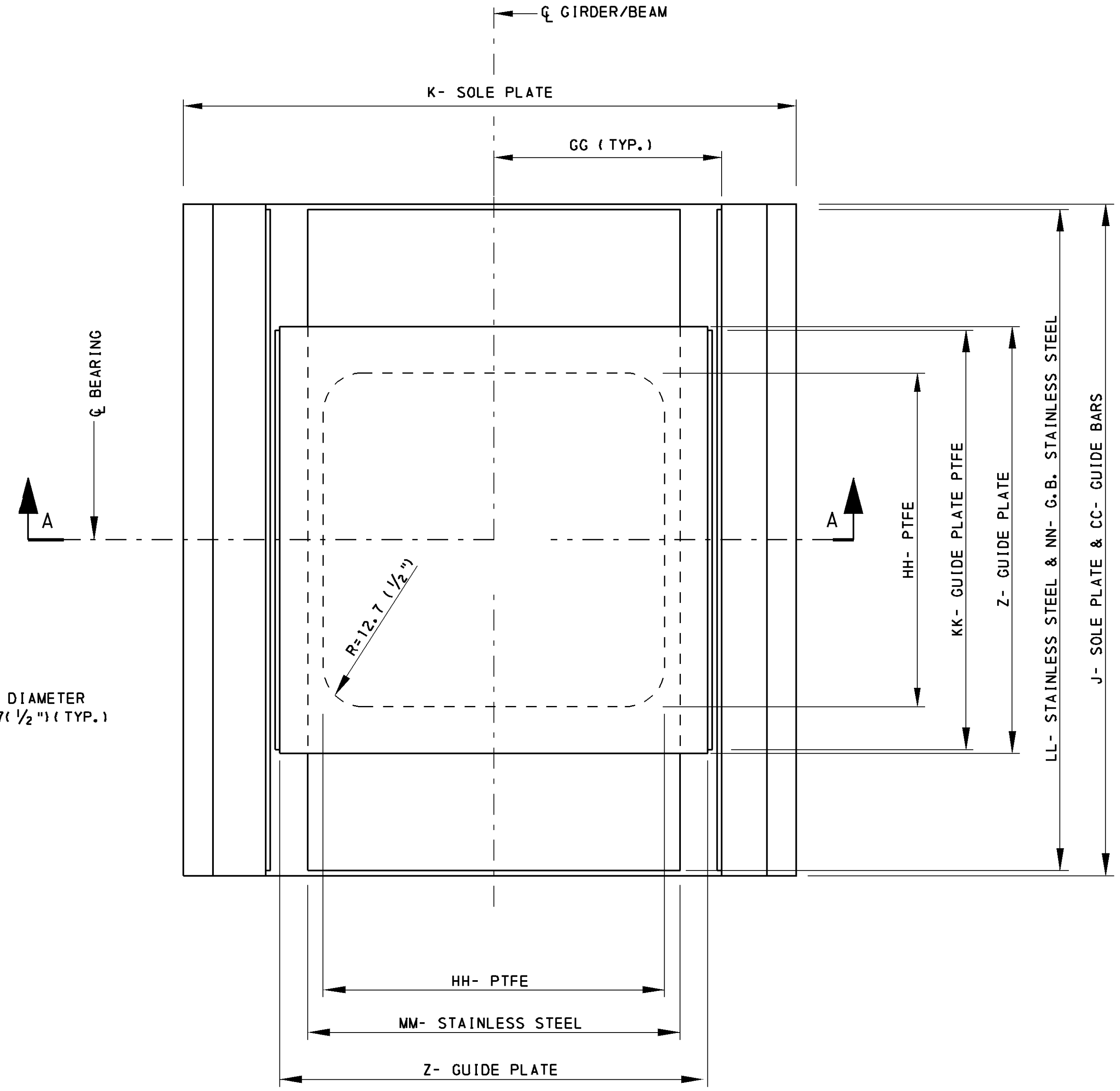
FOR ADDITIONAL DETAILS, SEE SHEETS 14 AND 15

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS - NON-GUIDED
DETAILS

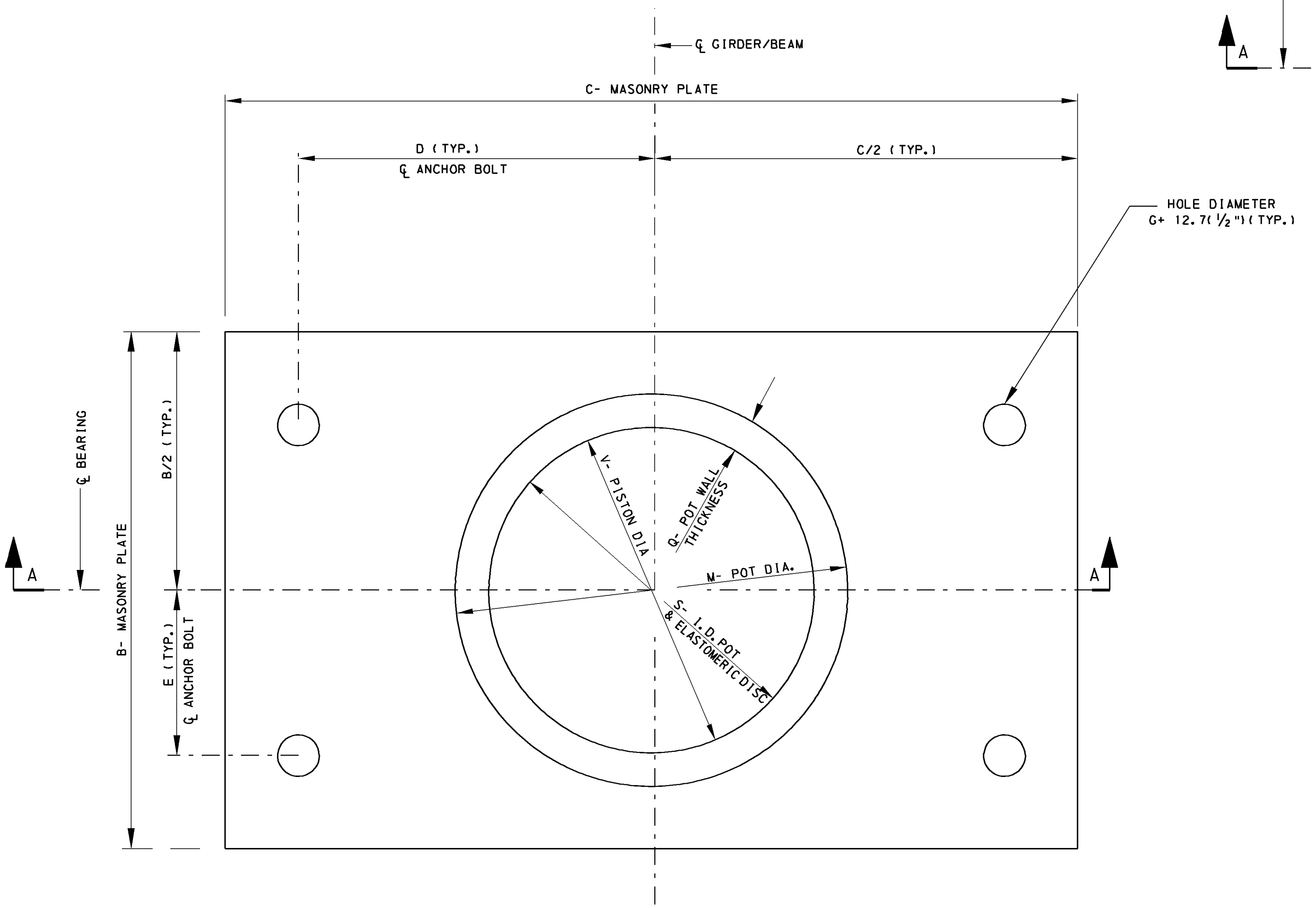


ELEVATION



SECTION C-C

(NOTE: PISTON NOT SHOWN FOR CLARITY)



SECTION B-B

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

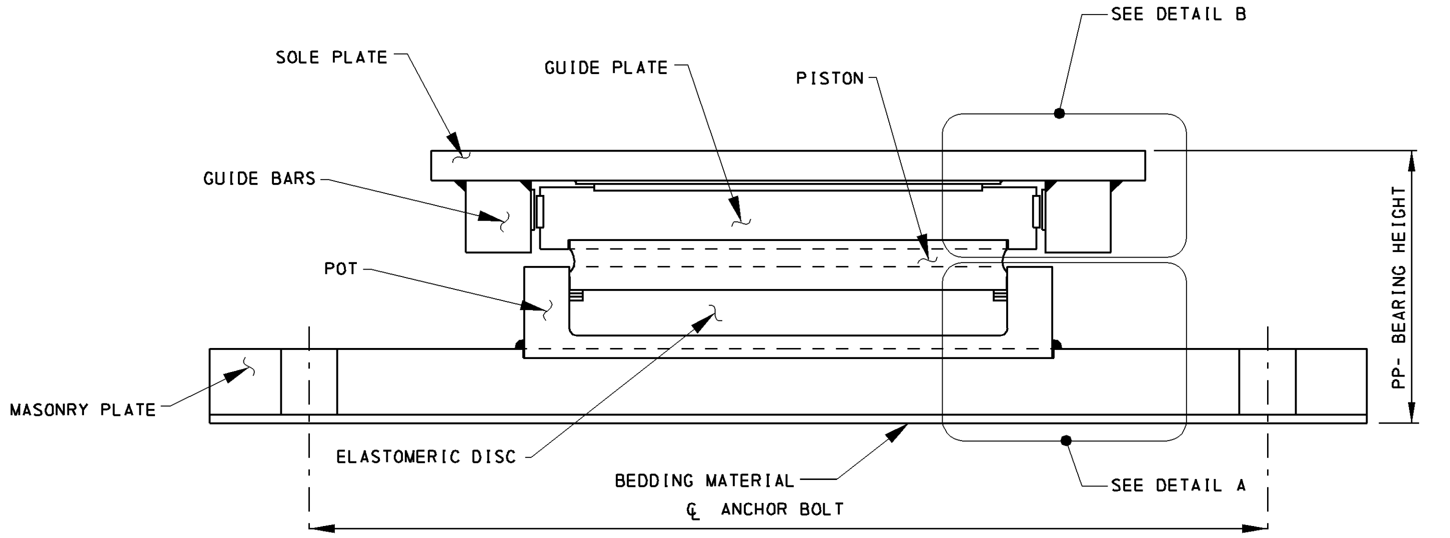
NOTE: FOR ADDITIONAL DETAILS, SEE SHEETS 13, 14 AND 15

NATIONAL STANDARD

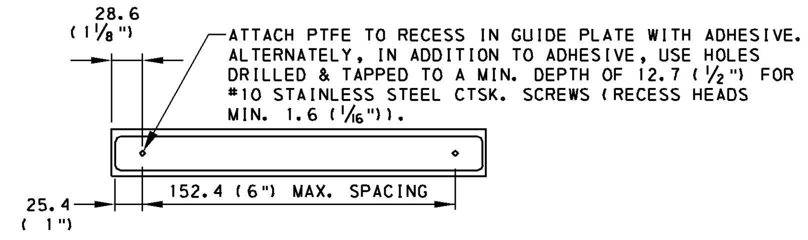
HIGH LOAD MULTI-ROTATIONAL

POT BEARINGS - GUIDED

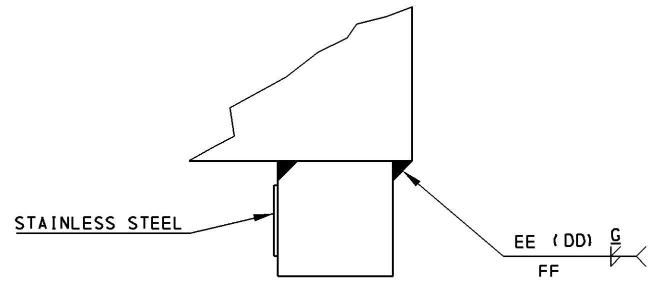
DETAILS - 1



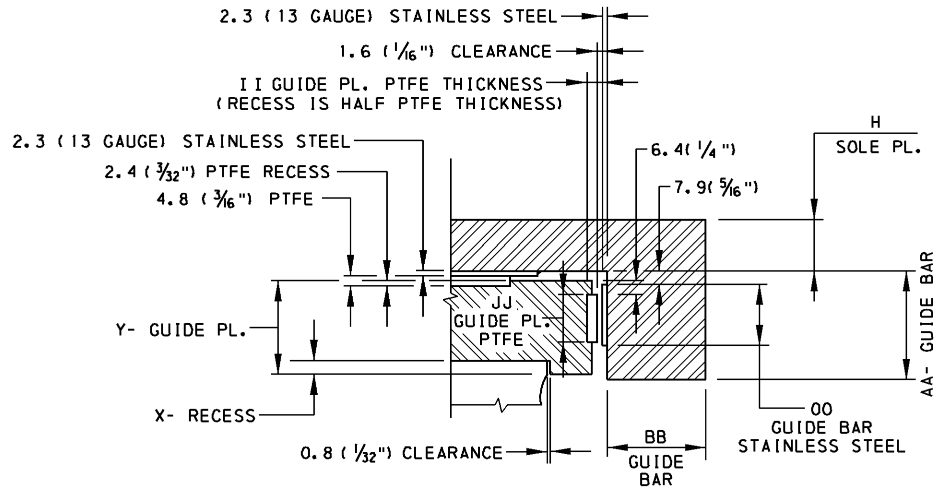
SECTION A-A



GUIDE PLATE PTFE DETAIL

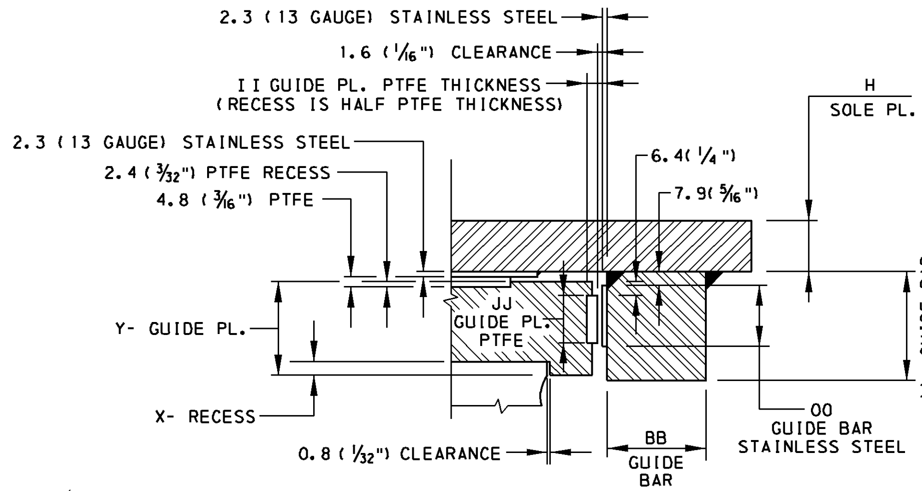


GUIDE BAR WELD DETAIL

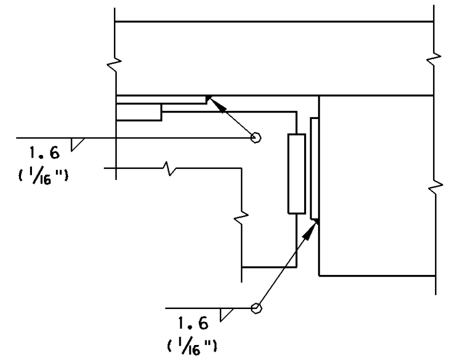


ALTERNATE GUIDE BAR FABRICATION DETAIL

(GUIDE BAR FABRICATED FROM SINGLE PLATE)

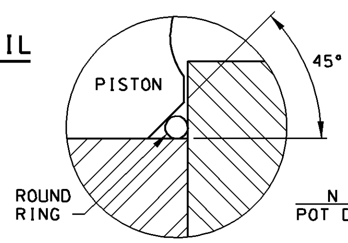


DETAIL B



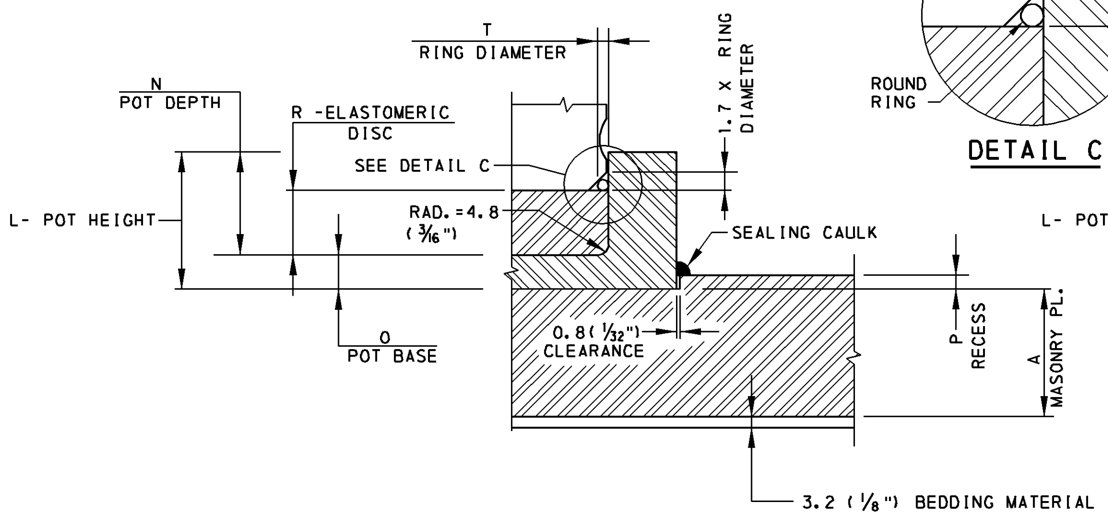
STAINLESS STEEL WELD DETAIL

NOTE: FOR ADDITIONAL DETAILS, SEE SHEETS 14 AND 15.

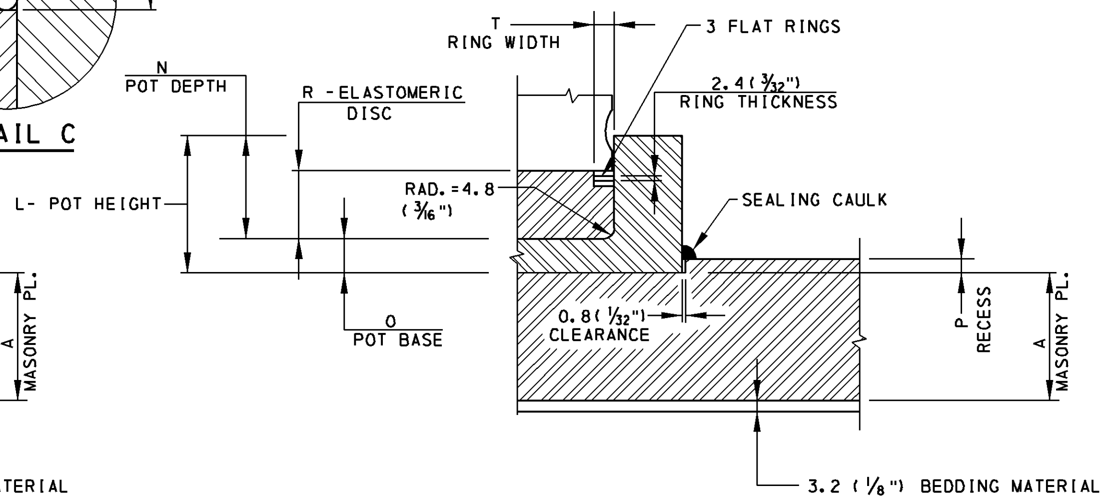


DETAIL C

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.



ROUND RING DETAIL



FLAT RING DETAIL

DETAIL A

NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS
GUIDED DETAILS - 2

SHEET 13 OF 15

NOTES: DESIGNER TO INCLUDE THE FOLLOWING NOTES TO THE CONTRACT DRAWINGS

A. GENERAL NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED. U.S. CUSTOMARY UNITS ARE SHOWN IN ( ) PARENTHESIS.
2. PROVIDE MATERIALS AND WORKMANSHIP IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATIONS, ANSI/AASHTO/AWS/D1.5 BRIDGE WELDING CODE AND CONTRACT SPECIAL PROVISIONS.
3. SANDBLAST IN ACCORDANCE WITH SSPC-SP10 TO REMOVE MILL SCALE FROM BEARINGS.
4. GRIND SMOOTH ALL STEEL SURFACES AND EDGES AND REMOVE ANY SHARP PROTRUSIONS. FABRICATION TOLERANCES AND THE LIMITATIONS ON SURFACE FINISH WILL BE IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATIONS.
5. METALLIZE AND/OR PAINT ALL STEEL SURFACES IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATIONS. APPLY ALL COATS IN THE FABRICATION SHOP ONLY. DO NOT COAT PTFE, STAINLESS STEEL OR THE INSIDE OF THE POT. APPLY ONLY PRIME COAT TO THE CONTACT AREA BETWEEN BEAM BOTTOM FLANGE AND SOLE PLATE AND TO THE BOTTOM SIDE OF THE MASONRY PLATE.
6. ROUND ALL PTFE CORNERS TO ACCOMMODATE THE MACHINED RECESS IN STEEL GUIDE PLATE / PISTON.
7. ETCH PTFE ON ONE SIDE FOR BONDING INTO THE MACHINED RECESS.
8. PTFE ON THE SIDE OF GUIDE PLATE MUST BE PIGMENTED.
9. PRIOR TO THE APPLICATION OF ADHESIVE CLEAN ALL MATING STEEL AND PTFE SURFACES BY GRIT BLASTING AND DEGREASING. APPLY ADHESIVE AS PER THE MANUFACTURER'S RECOMMENDATION.
10. LUBRICATE ALL SURFACES OF ELASTOMERIC DISC WITH SILICONE GREASE IN ACCORDANCE WITH MILITARY SPECIFICATION MIL-S-8660.
11. SOLDER ROUND BRASS SEALING RING ENDS TOGETHER. CUT FLAT BRASS SEALING RING ENDS AT 45° ANGLE WITH A MAXIMUM GAP OF 1.27mm (0.05"). STAGGER THE OPENINGS IN THE BRASS RINGS 120° APART.
12. MARK THE THICKER EDGE OF THE SOLE PLATE AS SUCH FOR THE PURPOSE OF FIELD IDENTIFICATION. PLACE MARK ON THE EDGE OF SOLE PLATE SO THAT IT WILL BE VISIBLE AFTER BEARING INSTALLATION. IN THE CASE OF A SOLE PLATE WITH A COMPOUND BEVEL PLACE THE MARK ON EITHER EDGE OF THE THICKEST SOLE PLATE CORNER.
13. MARK CENTERLINE OF GUIDED AND NON-GUIDED POT BEARINGS ON THE SIDES OF MASONRY PLATE AND SOLE PLATE. THE CENTERLINE IDENTIFICATION MARKS WILL BE USEFUL TO LOCATE OFFSET DISTANCES IN THE FIELD. USE INDELIBLE INK TO PLACE ALL MARKS.
14. MARK EACH BEARING WITH THE NAME OF THE MANUFACTURER AND TYPE OR MODEL NUMBER. PLACE THE IDENTIFICATION MARK IN A PERMANENT MANNER AND LOCATION SO THAT IT IS VISIBLE AFTER ERECTION.
15. WHEN THE POT IS RECESSED INTO THE MASONRY PLATE SEAL AROUND THE POT PERIMETER WITH AN APPROVED CAULKING COMPOUND IN THE SHOP AFTER PAINT COATING HAS DRIED.
16. DIMENSIONS IN THE METRIC DESIGN TABLES ARE ROUNDED TO NEAREST MILLIMETER (EXCEPT FOR SOME PISTON AND GUIDE BAR DIMENSIONS WHICH ARE SHOWN TO MORE EXACT DIMENSIONS). THE CONTRACTOR IS RESPONSIBILE TO NOTIFY THE ENGINEER OF ANY PROPOSED VARIATION DURING FABRICATION.
17. ENSURE ALL BEARING SURFACES INCLUDING THE BEARING SEAT ARE LEVEL PRIOR TO INSTALLATION OF POT BEARINGS IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATIONS.
18. TEST ONE BEARING PER TYPE OR PER LOT SIZE OF 25 FOR A HORIZONTAL FORCE CAPACITY PRIOR TO SHIPMENT.

B. MATERIALS:

1. STRUCTURAL STEEL: MATERIAL 4" THICK OR LESS AASHTO M270/ M 270M (ASTM A709/ A709M), GRADE 345 (GRADE 50) MATERIAL GREATER THAN 4" THICK ASTM A572/A572M MODIFIED (GRADE 50).
2. ANCHOR BOLTS: ASTM F1554, GRADE 379 (GRADE 55)
3. NUTS: ASTM A563/ A 563M, GRADE DH
4. WASHERS: ASTM F436/ F436M, TYPE 1
5. GALVANIZE ANCHOR BOLTS, NUTS AND WASHERS IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATIONS.
6. STAINLESS STEEL: ASTM A240, GRADE 205 (GRADE 30), TYPE 304 WITH AN ANSI 0.4 um (0.02 mil) SURFACE FINISH OR LESS.
7. FLAT BRASS SEALING RINGS: ASTM B36 (HALF-HARD) SPECIFICATION. ROUND BRASS SEALING RINGS: ASTM B16 (HALF-HARD) SPECIFICATION.
8. ELASTOMERIC DISC: VIRGIN PLAIN NEOPRENE OR NATURAL RUBBER WITH HARDNESS OF 50 DUROMETER (+/- 10) PER AASHTO M251.
9. PTFE SHEET: MADE FROM VIRGIN TFE RESIN PER ASTM D4894.

   MAIN SLIDING SURFACE PTFE - UNFILLED, DIMPLED AND LUBRICATED. DIMPLES MUST HAVE A MINIMUM EDGE DISTANCE OF 12.7 (0.5") AND CONFORM TO 1998 AASHTO LRFD SECTION 14.7.2.

   GUIDE BAR SURFACE PTFE - PIGMENTED, FILLED OR UNFILLED.
10. CAULK FOR SEALING AROUND THE POT PERIMETER: SIKAFLEX IA OR APPROVED EQUAL.
11. BEDDING MATERIAL: NEOPRENE: ASTM D378 COTTON-DUCK: MIL-C882E

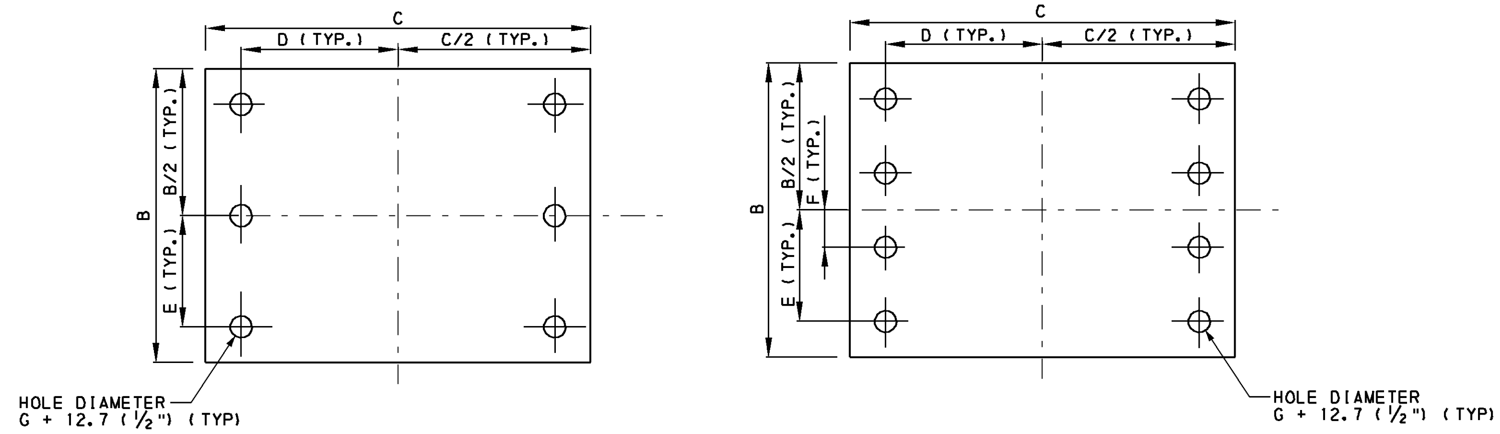
C. MATERIAL DESIGN PARAMETERS:

1. ALLOWABLE PRESSURE IN ELASTOMERIC AND PTFE:

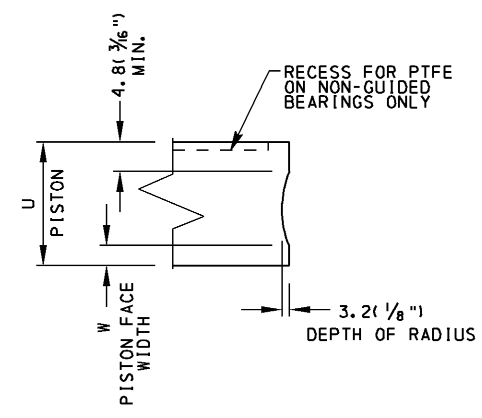
   MAXIMUM = 24 Mpa (3500 psi) ELASTOMERIC & PTFE
   MINIMUM = 4.8 Mpa (700 psi) ELASTOMERIC
2. COEFFICIENT OF FRICTION BETWEEN PTFE AND STAINLESS STEEL: 0.04
3. CONCRETE BEARING STRENGTH: f'c = 20.7 Mpa (3000 psi)

D. ANCHOR BOLT INSTALLATION:

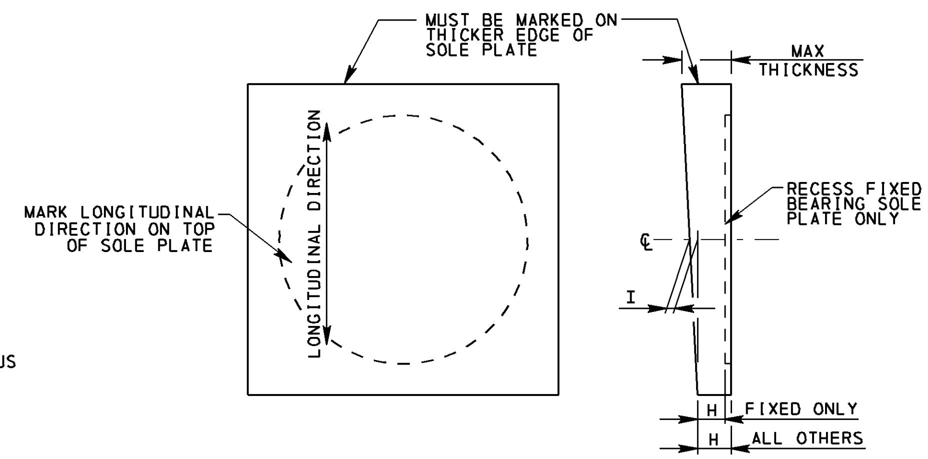
1. IF ANCHOR BOLTS ARE INSTALLED BEFORE THE MASONRY PLATE INSTALLATION, USE ANCHOR BOLT DETAIL 1. THE USE OF A BLOCKOUT FORM IS OPTIONAL.
2. IF ANCHOR BOLTS ARE INSTALLED AFTER THE BEARINGS ARE INSTALLED, USE ANCHOR BOLT DETAIL 2. RECESS BLOCKOUT AS NEEDED.
3. IF BLOCKOUTS ARE USED, REMOVE BLOCKOUT FORM AND DEBRIS FROM HOLE PRIOR TO GROUTING. INSTALL NON-SHRINK GROUT IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATIONS. DO NOT GROUT UNTIL ALL GIRDER UNITS ARE PROPERLY ALIGNED.
4. PREVENT WATER FROM ACCUMULATING IN THE PREFORMED ANCHOR BOLT HOLES AND ENSURE THE HOLES ARE COMPLETELY FILLED WITH GROUT.



ANCHOR BOLT LOCATION PLAN - 6 AND 8 ANCHOR BOLTS

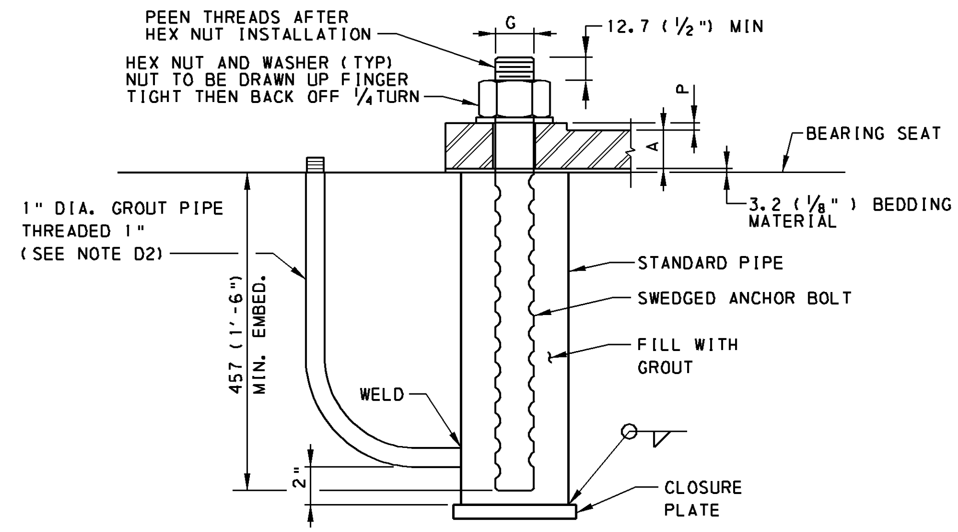


PISTON DETAIL

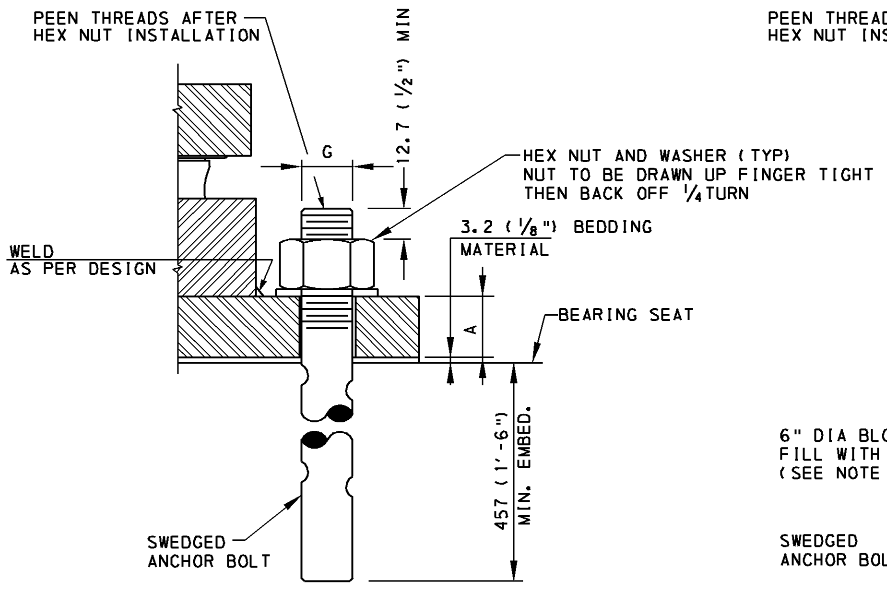


SOLE PLATE PLAN

SIDE VIEW

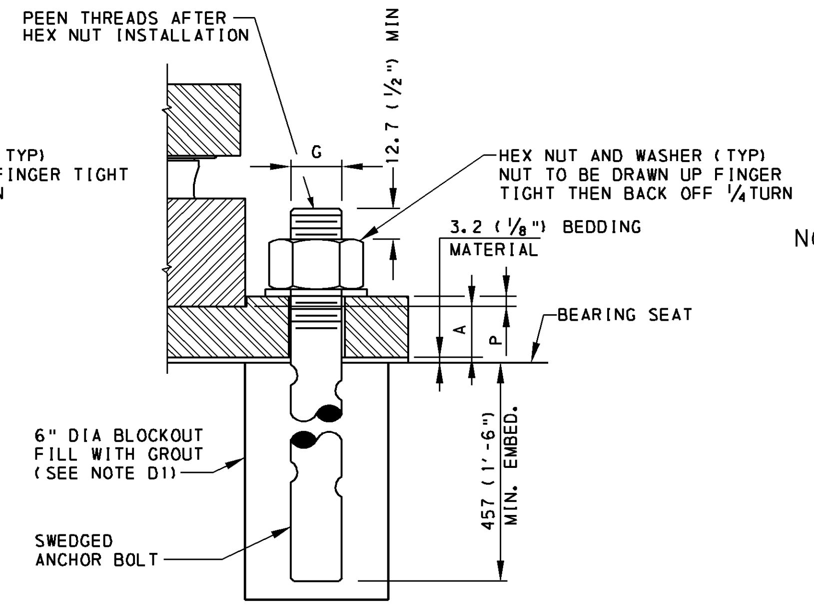


ANCHOR BOLT DETAIL 2



ALTERNATE POT PLATE ATTACHMENT

NOTE: CAN BE USED IN LIEU OF RECESSING POT PLATE.

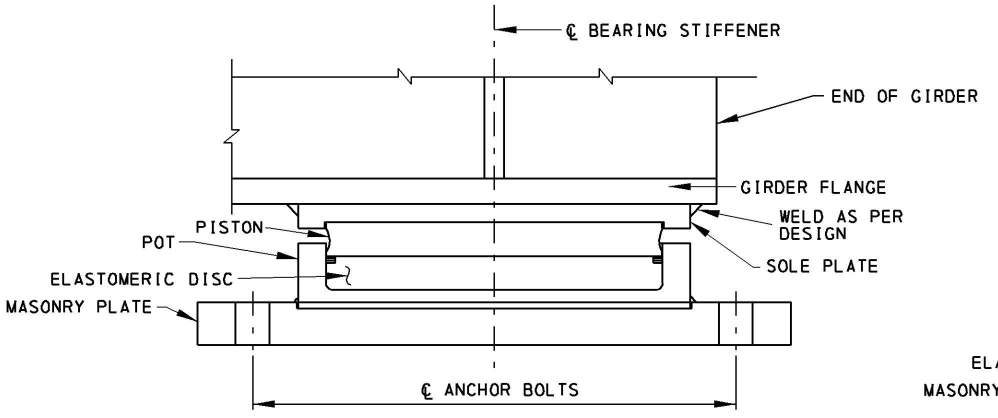


ANCHOR BOLT DETAIL 1

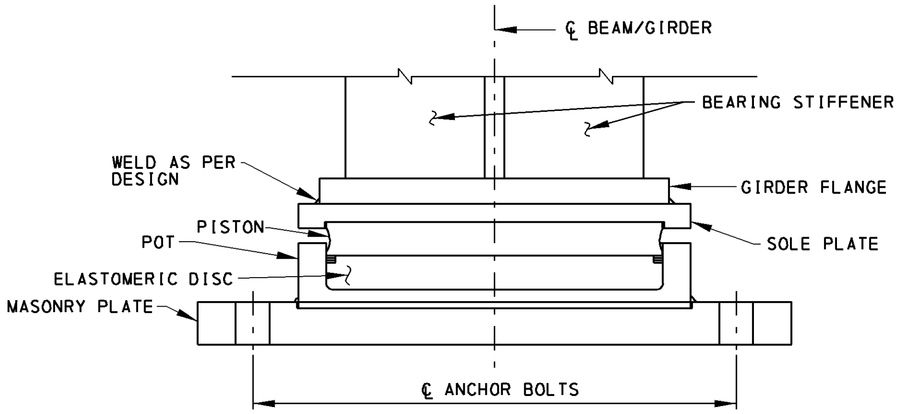
NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

NATIONAL STANDARD
HIGH LOAD MULTI-ROTATIONAL
POT BEARINGS
GENERAL NOTES AND DETAILS

SHEET 14 OF 15

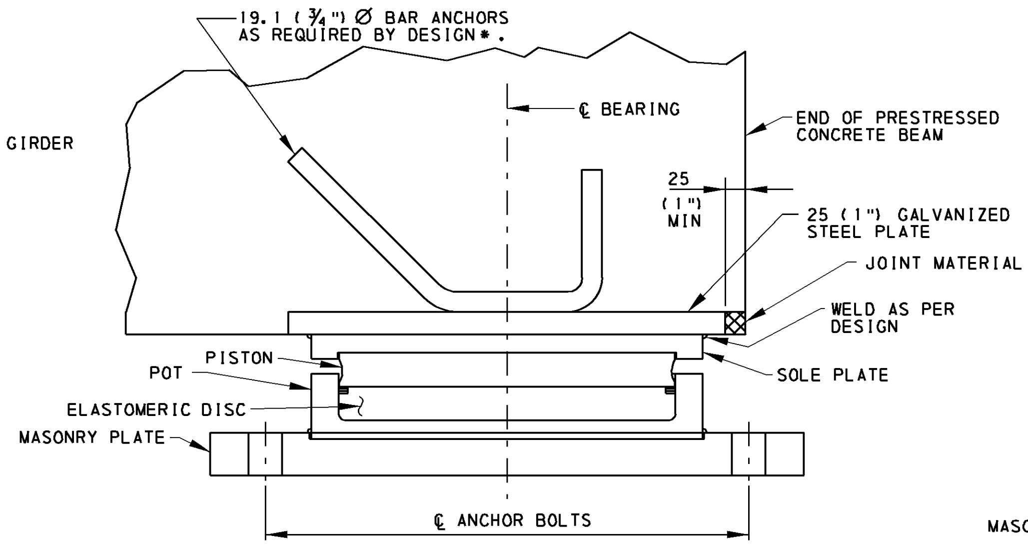


SIDE VIEW

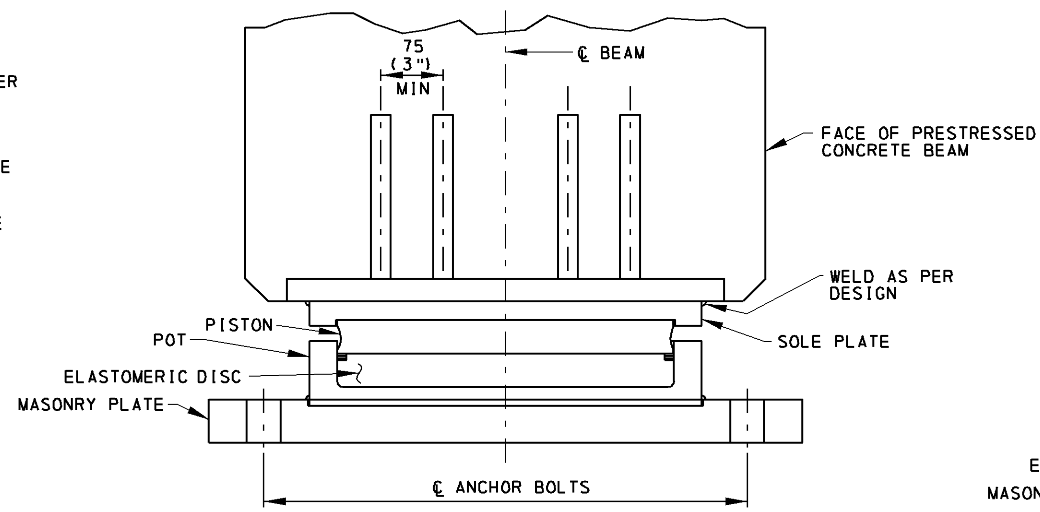


END VIEW

WELDED CONNECTION FOR STEEL BEAM

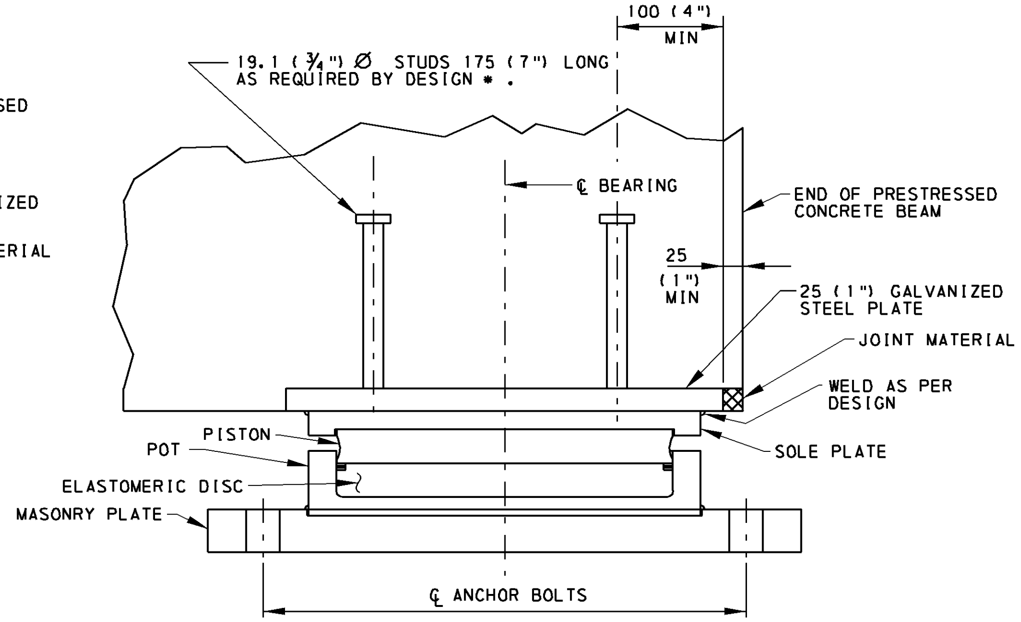


SIDE VIEW

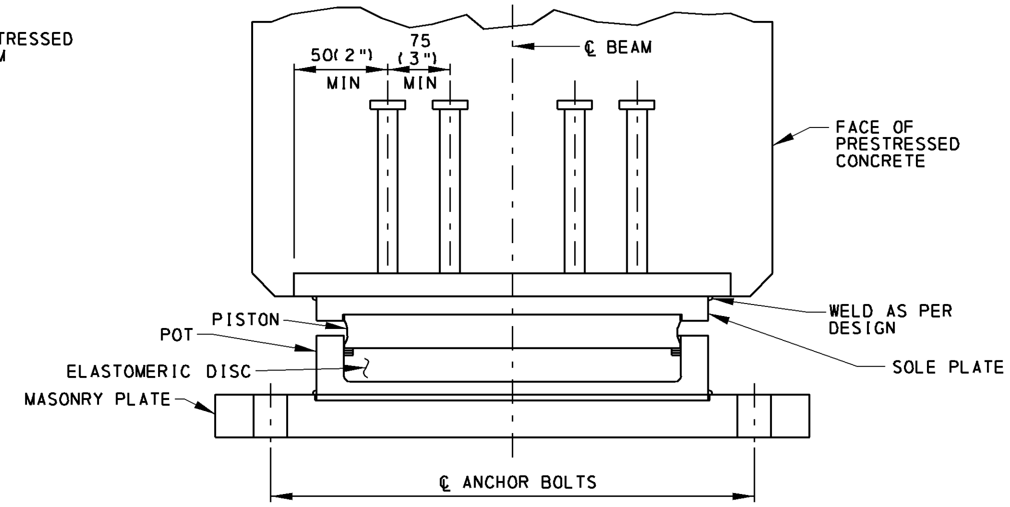


END VIEW

ANCHOR CONNECTION FOR PRESTRESSED CONCRETE BEAM



SIDE VIEW



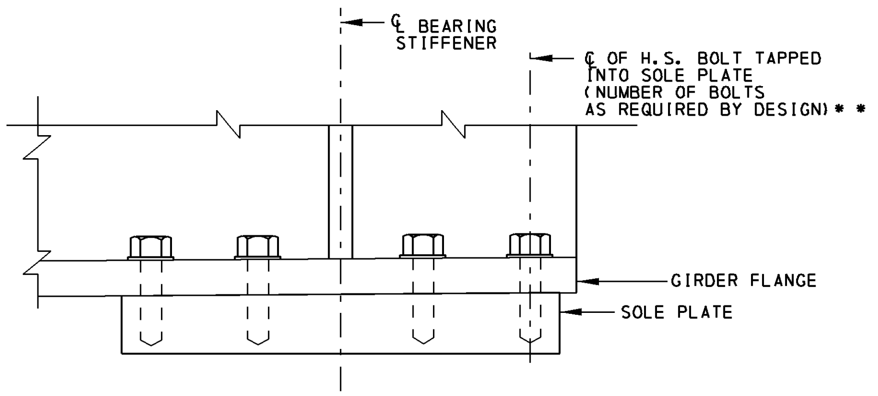
END VIEW

STUD CONNECTION FOR PRESTRESSED CONCRETE BEAM

* NUMBER OF STUDS OR ANCHORS AS REQUIRED BY DESIGN. SPACED AS REQUIRED TO MISS STRAND PATTERN

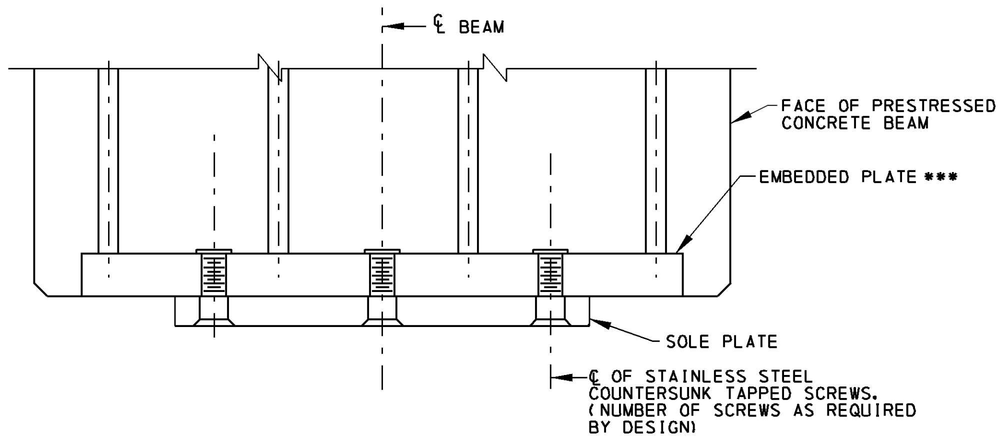
NOTE: FLAT SEALING RINGS ARE SHOWN. FOR ROUND SEALING RINGS SEE DETAIL A, SHEET 13.

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS. METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.



TAPPED BOLT CONNECTION FOR STEEL BEAM

* * THROUGH BOLT CONNECTIONS BETWEEN GIRDER AND SOLE PLATE ARE ACCEPTABLE PROVIDED ALL CLEARANCE REQUIREMENTS ARE SATISIFIED.



ALTERNATE TAPPED BOLT CONNECTION

*** FOR BEVELED SOLE PLATES, ENSURE THE THREADED HOLES IN THE EMBEDDED PLATE ARE ALIGNED PARALLEL TO THE CENTERLINE OF THE BOLTS.

NOTE:

THE CONNECTIONS SHOWN ARE FOR INFORMATION ONLY. THE DESIGN OF THE CONNECTION IS THE RESPONSIBILITY OF THE ENGINEER.

NATIONAL STANDARD

HIGH LOAD MULTI-ROTATIONAL

POT BEARINGS

CONNECTION OPTIONS

SHEET 15 OF 15

OS-2 (4-01)

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
www.dot.state.pa.us

400 North St., 7th Floor
Harrisburg, PA 17120-0094

October 18, 2005

Mr. Ralph E. Anderson, P.E.
Engineer of Bridges and Structures
Chairman, Technical Committee
Illinois Department of Transportation
2300 South Dirksen Parkway, Rm. 240
Springfield, IL 62764

Subject: AASHTO T-2 Committee
Section 14.7.4 Recommendations

Dear Mr. Anderson:

As you are aware, PENNDOT and our pooled fund study partners (FHWA, Florida Department of Transportation, and North Carolina Department of Transportation) are developing national pot bearing design and detailing standards. These standards will be an expanded version of PENNDOT's current pot bearing design standards.

At the AASHTO Bridge Subcommittee meeting in June of this year, Eric Martz of Michael Baker Jr. Inc. presented an update on the progress of the pooled fund study to the T-2 Committee. As part of this presentation, informal recommendations were made with regard to several equations in the 2004 AASHTO LRFD Bridge Design Specifications. At this time, we would like to provide formal recommendations to the T-2 Committee for consideration as ballot items.

In general, these recommendations are focused on modifying Section 14.7.4 to service limit state design which is consistent with previous editions of the AASHTO specification. The specific recommendations are as follows:

1. **Change Equation 14.7.4.7-1 from:**

$$t_w, t_b \geq \sqrt{\frac{25H_u\theta_u}{F_y}} \quad \text{to} \quad t_w \geq \sqrt{\frac{40H_s\theta_s}{F_y}}$$

where:
H_u = strength/extreme lateral load — H_s = service lateral load
θ_u = strength rotation — θ_s = service rotation

2. **Change Equation 14.7.4.7-2 from:**

$$h_w \geq \frac{1.5H_u}{D_pF_y} \quad \text{to} \quad w \geq \frac{2.5H_s}{D_pF_y}$$

where:
D_p = internal pot diameter
H_u = strength/extreme lateral load — H_s = service lateral load

3. **Revise the constants in the following equations to change the design rotation from a strength limit state value to a service limit state value:**

   - Equation 14.7.4.3-1
   - Equation 14.7.4.7-5
   - Equation C14.7.4.3-1
   - Equation C14.7.4.3-2

4. **In Section 14.4.2.2.1, change the maximum rotation caused by fabrication and installation tolerances from 0.005 radians to 0.01 radians. Also change the allowance for uncertainties from 0.005 radians to 0.01 radians.**

Implementing the recommendations listed above will offer the following advantages:

- Pot bearing design will be simplified if a single limit state is used for all load types (dead, live, wind, etc.).
- Using the service limit state will eliminate the need to factor the loads and generate several additional load combinations.
- Maximum/minimum load factors will not be needed if service limit state is used.
- Only one limit state load combination will be required for all design checks (e.g. elastomer stress vs. PTFE stress), which will eliminate confusion and potential design errors.
- Maintains consistency with past industry practice.
- Saves time and money.

We realize that the above recommendations do not address seismic loads at the extreme event limit state. The proposed national pot bearing standards instruct the designer to divide the horizontal seismic loads, derived from either the AASHTO Standard Specification or the AASHTO LRFD Specification, by 1.5 per AASHTO (1992) Standard Specification, Division I-A, Section 7.1. While we are not including this item as a formal recommendation, the T-2 committee may want to discuss this issue with regard to implementing the recommendations listed above.

We appreciate the committee's consideration of these recommendations. If you have any questions or comments, please contact Patricia Kiehl, P.E. of my staff at (717) 772-0568.

Sincerely,

HCRogers P.E.

Harold C. Rogers, P.E.
Acting Chief Bridge Engineer

DEVELOPMENT of NATIONAL POT BEARING STANDARDS

Presented by:
Eric L. Martz, P.E., Michael Baker Jr., Inc.
(on behalf of PENNDOT)

PENNDOT

Project Background

- Goal:
  Develop pot bearing standards that can be used nationwide.

- Pooled fund study managed by PENNDOT Bureau of Planning & Research

- Project Partners:
  - Federal Highway Administration – Vasant Mistry, P.E.
  - Florida DOT – Henry Bollmann, P.E.
  - North Carolina DOT – Tom Koch, P.E.
  - Michael Baker Jr., Inc. – Managing Consultant

PENNDOT Pot Bearing Standards

- Design Standards entitled “BD-613M: High Load Multi-rotational Pot Bearings”, initially released June 2002 (re-released on January 21, 2003)

- Intent of BD-613M Standards:
  - Provide uniform designs
  - Interpret design criteria for design engineers
  - Save time & money
  - Create fair bidding practices for fabricators
  - Eliminate the need for shop drawings (future enhancement)

BD-613M: Modification of 1998 AASHTO LRFD

- AASHTO PTFE contact stress (Table 14.7.2.4-1)
  - Strength Limit State
    - Confined sheet: 4 ksi permanent loads (6 ksi all loads)
- AASHTO Elastomer stress
  - Service Limit State
    - 3.5 ksi
- AASHTO PTFE coefficient of friction
  - Service Limit State
- Decided to use service limit state and 3.5 ksi

Recent AASHTO Section 14.7.4 Changes

- Pot Wall & Base Thickness
  - AASHTO Equation 14.7.4.7-1 (2004):

$$t_w, t_b \geq \sqrt{\frac{25 H_u \theta_u}{F_y}}$$

H_u = strength/extreme lateral load

θ_u = strength rotation

- Consider going back to service limit state as per 1998 AASHTO LRFD (Equation 14.7.4.7-1):

$$t_w \geq \sqrt{\frac{40 H_s \theta_s}{F_y}}$$

H_s = service lateral load

θ_s = service rotation

Recent AASHTO Section 14.7.4 Changes (cont.)

- Height from top of piston rim to underside of piston
  - AASHTO Equation 14.7.4.7-2 (2004):

$$h_w \geq \frac{1.5H_u}{D_p F_y}$$

H_u = strength/extreme lateral load

D_p = internal pot diameter

- Consider going back to service limit state as per 1998 AASHTO LRFD (Equation 14.7.4.7-2):

$$w \geq \frac{2.5H_s}{D_p F_y}$$

H_s = service lateral load

Additional AASHTO Sect. 14.7.4 Considerations

- Design Rotation, θ_u - strength limit state as per Section 14.4.2
  - Equation 14.7.4.3-1, depth of elastomeric disc
  - Equation C14.7.4.3-1, pot cavity depth
  - Equation C14.7.4.3-2, piston-pot wall vert. clear.
  - Equation 14.7.4.7-5, piston rim to wall clear.

- Consider revising equations to service limit state rotations for ease and consistency of design, and revising the tolerance rotation back to 0.01 radians.

Justification for Service Limit State Design

- Pot bearing design is much more simplified if a single limit state is used for all load types (dead, live, wind, etc.).
- Using the service limit state eliminates the need to factor the loads and generate several additional load combinations.
- Max./min. load factors are not needed if only service limit state is used.
- Eliminates going back and forth between limit states for similar design checks (e.g. elastomer stress vs. PTFE stress).
- Maintains consistency with past industry practice.
- Project panel members and our main fabrication industry contact (D.S. Brown) agree with the service limit state only approach.

Summary of Suggestions to T-2 Committee

- Modify AASHTO Section 14.7.4 to Service Limit State Design
- Advantages:
  - Simplify design by using only service limit state (thus eliminating the need to calculate strength limit state loads)
  - Eliminate confusion & potential design errors
  - Save time and money
  - Consistency with past specifications & industry practice
- Formal recommendations will be made at a later date.

PENNDOT BD-613M Contents

- Design Methodology (service design using LFD* or LRFD)
  - modification of 1998 AASHTO LRFD
- Instructions for using design tables
- An LFD* & an LRFD design example
- Tables of dimensions for fixed, guided, & non-guided bearings (English & Metric Units)
- Details for each bearing type
- General Notes
- Beam/Girder connection details

***** LFD was included for curved girder bridges. LRFD is used for all other bridge types.***

BD-613M: Range of Design Criteria

- Vertical loads from 200 to 1500 kips
- Horizontal loads of 10% and 30% x vertical load*
- Total rotation of 0.03 radians *
- Maximum 3” longitudinal movement *
- Maximum ½” transverse movement *

These values were selected to encompass the majority of designs.

***** Standards still valid if parameters exceed these limits. Designer may increase component dimensions, choose a larger capacity bearing, or provide a beveled sole plate.**

BD-613M Sample Table of Dimensions

DESIGN TABLES FOR FIXED POT BEARINGS (30% HORIZONTAL LOAD)								
VERTICAL	HORIZONTAL	ROTATION	MASONRY PLATE			SOLE PLATE		PISTON
LOAD (KIPS)	LOAD (KIPS)	(RADS.)	A	B	C	J	K	V
200	60	0.03	1 3/8	12 7/8	20 3/8	11 3/8	11 3/8	8.855
250	75	0.03	1 3/8	14 1/8	21 5/8	12 5/8	12 5/8	9.855
…	…	…	…	…	…	…	…	…
900	270	0.03	2 3/16	25 1/4	37 1/8	23 5/8	23 5/8	18.355
950	285	0.03	2 3/16	25 7/8	37 5/8	24 1/8	24 1/8	18.855
1000	300	0.03	2 3/16	26 5/8	38 3/8	24 7/8	24 7/8	19.355
1100	330	0.03	2 3/16	28 5/8	39 5/8	26 1/8	26 1/8	20.355
1200	360	0.03	2 5/16	29 1/8	40 3/4	27 1/4	27 1/4	21.230
1300	390	0.03	2 1/4	30 1/4	41 3/4	28 1/4	28 1/4	21.980
1400	420	0.03	2 1/4	31 1/2	42 7/8	29 3/8	29 3/8	22.855
1500	450	0.03	2 1/4	33	43 7/8	30 3/8	30 3/8	23.605

BD-613M Example – Fixed Bearing

- Calculated Design Loads (service):

  Vertical: 1209 kips max., 704 kips min.

  Horizontal: 410 kips max. (34% of vertical)

DESIGN TABLES FOR FIXED POT BEARINGS (30% HORIZONTAL LOAD)								
VERTICAL LOAD (KIPS)	HORIZONTAL LOAD (KIPS)	ROTATION (RADS.)	MASONRY PLATE			SOLE PLATE		PISTON
			A	B	C	J	K	V
1100	330	0.03	2 3/16	28 5/8	39 5/8	26 1/8	26 1/8	20.355
1200	360	0.03	2 5/16	29 1/8	40 3/4	27 1/4	27 1/4	21.230
1300	390	0.03	2 1/4	30 1/4	41 3/4	28 1/4	28 1/4	21.980
1400	420	0.03	2 1/4	31 1/2	42 7/8	29 3/8	29 3/8	22.855
1500	450	0.03	2 1/4	33	43 7/8	30 3/8	30 3/8	23.605

- Check min. vertical load / vertical capacity

  = 704 / 1400 = 50% > 20% min. ⇒ OK

BD-613M Example – Guided Bearing

- Calculated Design Loads:

  Vertical: 364 kips max., 180 kips min.

  Horizontal: 44 kips max. (12% of vertical)

DESIGN TABLES FOR GUIDED POT BEARINGS (10% HORIZONTAL LOAD)								
VERTICAL	HORIZONTAL	ROTATION	MASONRY PLATE			SOLE PLATE		PISTON
LOAD (KIPS)	LOAD (KIPS)	(RADS.)	A	B	C	J	K	V
350	35	0.03	2 1/8	15 1/8	27 5/8	18 1/2	18 5/8	11.605
400	40	0.03	2 1/8	16 3/4	28 3/8	19 1/4	19 3/8	12.355
450	45	0.03	2 1/4	16 7/8	29 5/8	20 1/4	20 5/8	13.105

- Check min. vertical load / vertical capacity

  = 180/450 = 40% > 20% min. ⇒ OK

BD-613M Example – Guided *(continued)*

- Compare to 30% Table:

  Vertical: 364 kips max., 180 kips min.

  Horizontal: 44 kips max. (12% of vertical)

VERTICAL	HORIZONTAL	ROTATION	MASONRY PLATE			SOLE PLATE		PISTON
LOAD (KIPS)	LOAD (KIPS)	(RADS.)	A	B	C	J	K	V
350	105	0.03	2 3/8	16 3/4	32 7/8	19 3/4	23 3/8	11.605
400	120	0.03	2 1/2	17 3/8	34 1/4	20 3/4	23 3/4	12.355
450	135	0.03	2 3/4	18 3/8	37	21 3/4	25	13.105

- Check min. vertical load / vertical capacity

  = 180/400 = 45% > 20% min. ⇒ OK

Expansion of BD-613M for Pooled Fund Study

- Task 1: Review of BD-613M Standards (*completed*)
- Task 2: Literature Review Report (*completed*)
- Task 3: Research & Drafting of Expanded Standards
- Task 4: Proposed AASHTO Revisions
- Task 5: Draft Final Report
- Task 6: Final Report & Presentation

Task 1: BD-613M Review

- Distributed PENNDOT BD-613M standards for review
- Received review comments from panel members
- PENNDOT & Baker reviewed comments & sent responses
- Summary of design related comments/responses
- Summary of fabrication related comments/responses

Task 2: Literature Review

- Reviewed FHWA, FDOT, & NCDOT design, fabrication, and construction practices for pot bearings
- Developed a report which compared the agencies’ practices to the BD-613M standards
- Summary of differences in design practices
  - PENNDOT – LRFD (currently LFD for curved girders)
  - FDOT – LRFD (currently LFD for curved girders)
  - NCDOT – LFD (moving to LRFD in near future)
- Summary of differences in fabrication/construction practices
  - Guided bearing systems
  - Material specifications
  - Attachment methods

Scope of Remaining Tasks

- Project conference call held on May 26, 2005

- Issues for consideration:
  - Expansion to a construction standard
  - Possible inclusion of bearings w/central guide bars
  - Inclusion of round sealing rings
  - Alternate PTFE attachment methods
  - Alternate sole plate attachment methods
  - Additional anchor bolt details (pre-formed blockouts)
  - Alternate corrosion protection methods
  - Addition of alternate material specifications

Questions/Comments

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RFQ #: 03-03 (C07)
Project Title: Development of Pot Bearing Standards

PROBLEM STATEMENT

The purpose of this research is to expand the current PENNDOT bridge design standards for pot bearings so that other state departments of transportation can utilize the standards to streamline their pot bearing design process.

PROJECT DESCRIPTION

This project involved the participation of the Federal Highway Administration, Pennsylvania Department of Transportation, Florida Department of Transportation, North Carolina Department of Transportation, and was coordinated by Eric L. Martz, P.E., Project Manager, Michael Baker Jr., Inc. To complete the goal of developing regional or nationwide pot bearing design standards, the established project work plan consisted of six (6) tasks. The tasks focused on expanding PENNDOT's existing pot bearing design standards for use in other states and providing formal recommendations to AASHTO regarding specification changes to Section 14.7.4 of the *AASHTO LRFD Bridge Design Specifications*.

FINDINGS

Through a comparison of pot bearing design, material specifications, and construction practices among the participating agencies, the investigation found that there were more similarities between the agencies than differences with regard to pot bearings. The differences were compared and an initial list of twelve (12) revisions or additions to the existing PENNDOT pot bearing design standards were decided upon. During the revision process, a few of the items on the initial list of revisions were eliminated through research and discussion and a few additional items were added to correct minor errors in the existing standards. This review and coordination process yielded pot bearing design standards that can be utilized by the participating agencies to save time and money.

In addition to the development of the standards, a presentation was made to the AASHTO T-2 Bearing Committee at the 2005 AASHTO Bridge Subcommittee meeting held in June 2005 at Newport, Rhode Island. An overview of this project was presented as well as informal recommendations regarding design specification revisions to Section 14.7.4 of the AASHTO LRFD Bridge Design Specifications. In October 2005, formal recommendations were sent to the AASHTO T-2 Committee in a letter from PENNDOT's Chief Bridge Engineer.

RECOMMENDATIONS

This report recommends that the participating agencies, namely the Florida Department of Transportation and the North Carolina Department of Transportation, institute the pot bearing design standards within their agencies. AASHTO should consider the formal recommendations presented in the October 2005 letter that resulted from the findings of this project. In addition, other state DOT agencies should consider the use of the pot bearing design standards as developed through this project to save time and money within their agencies.

For More Information Contact:

Pennsylvania Department of Transportation
Bureau of Planning and Research
Internet: www.dot.state.pa.us/

References:

NCHRP Report 432, "High-Load Multi-rotational Bridge Bearings," 1999

AASHTO, "LRFD Bridge Design Specifications," 1998

PENNDOT Design Manual Part 4, 1998

PENNDOT Bridge Design Standard Drawing Number BD-613M, "High-Load Multi-rotational Pot Bearings," 2003

Military Specification Number MIL-C-882E, "Cloth, Duck, Cotton or Cotton-Polyester Blend, Synthetic Rubber Impregnated, and Laminated, Oil Resistant," 1989

ASTM Specification Number A572/A572M, "Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel," 1999

ASTM Specification Number D378, "Standard Test Methods for Rubber (Elastomeric) Belting, Flat Type," 2000

ASTM Specification Number ASTM B16/B16M, "Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines," 2005