## 1.1.19 Bearings

Design – General

Provide provisions for bearing replacement, including temporary jacking and support for all manufactured bridge bearings. There is a potential of bearing failure during the service life of a bridge, which requires that provisions for bearing replacement be provided in the design drawings. Providing temporary jacking support (design, detailing and construction) on existing structures is complex and increases the maintenance cost and life cycle cost of a bridge. Including consideration of jacking and temporary support in the original design will reduce future rehab cost and ease future bearing replacement. This work may require pilecap or crossbeam widening, or widening under each girder. Show grout pad locations in the contract drawings for temporary jacking support and a bearing replacement sequence and minimum jacking loads. Check the adequacy of all affected structural elements during bearing replacement and stability of the structure.

**Deleted:** and need

**Deleted:** C

**Deleted:** shall be given to

**Deleted:** to

**Deleted:** s

**Deleted:** s

### 1.1.19.1 Elastomeric Bearing Pads

Elastomeric bearings are used to accommodate movements on short to medium-span structures. The three types of pads include:

- plain pads
- laminated pads reinforced with fabric (fiberglass)
- laminated pads reinforced with steel.

Plain pads are made from elastomer molded or extruded into large sheets, vulcanized and then cut to size.

Do not use cotton duck pads or random Oriented Fiber Pads bearing for slabs and box beams construction. Use plain elastomeric (neoprene) pads instead.

Fabric reinforced pads are made from alternate layers of elastomer and fabric (usually fiberglass) in large sheets, vulcanized and then cut to size. Fabric reinforced pads are restricted to short to medium spans with little or no skew.

Steel reinforced pads are made from alternate layers of elastomer and steel cut to size and then vulcanized. A thin cover layer of elastomer encapsulates the steel to prevent corrosion. The exposed edge voids in the pads caused by the steel laminate restraining devices are shop sealed with an appropriate caulking material.

### 1.1.19.1 Elastomeric Bearing Pads – (continued)

Use Method "A" to design elastomeric bearings. Where there is a need to use Method "B", specify in the Special provisions and contract drawing that the Method "B" was used. Elastomeric bearings designed using Method "B" require extra testing.

Use the following movements for pad thickness design:

$$ES + LF_1*(CR+SH) + LF_2*(TF \text{ or } TR)$$

Where:

ES = elastic shortening movement
CR = creep movement CR = (ES)(CF)
SH = shrinkage movement
TF = temperature fall movement
TR = temperature rise movement
CF = creep coefficient
$LF_1$ = from Article 3.4.1
$LF_2$= TU, Load Factor from table 3.4.1-1

Use proper signs and the Load Factor that produces the largest movement in each load combination.

**Deleted:** $LF_1 = \gamma_{TG}$ from Article 3.4.1¶
$LF_2$= Load Factor from table 3.4.1-3¶

The final elastomer thickness is 2 times the thickness of the elastomer required to accommodate the design movement. Nominal pad thickness should be multiples of ½", from ½" to 6" maximum. The actual finished thickness will vary depending on the type of reinforcement. Fabric has a negligible thickness. Steel plate thickness may vary with the manufacturer, but should be a minimum of 14-gauge.

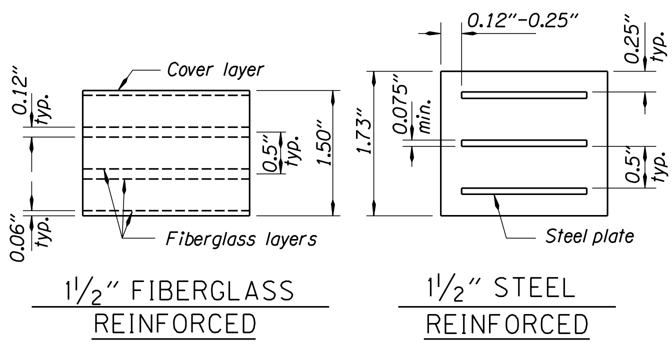
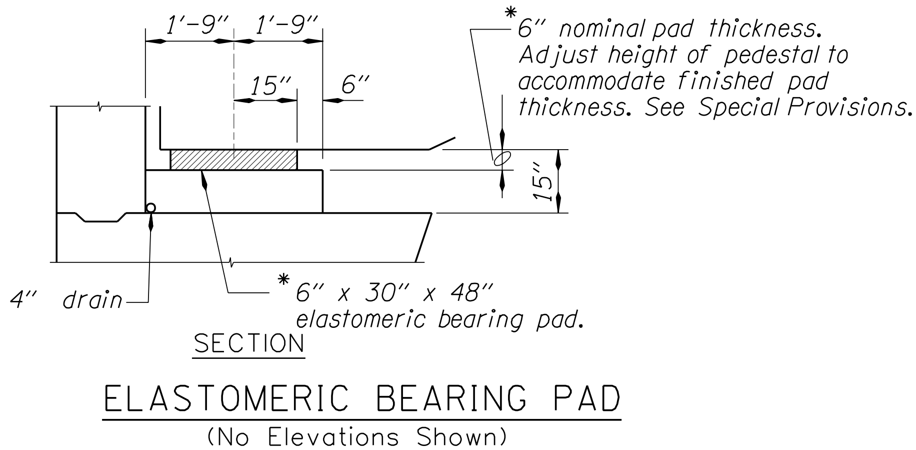



**Figure 1.1.19.1A**

### 1.1.19.1 Elastomeric Bearing Pads - (continued)

Pad thickness called for on detail plans should be the total thickness of the elastomer required. If bearing pad elevations are shown, the assumed finished pad thickness should be listed. Use circular elastomeric bearing pads for curved steel girders.

Examples are shown below.



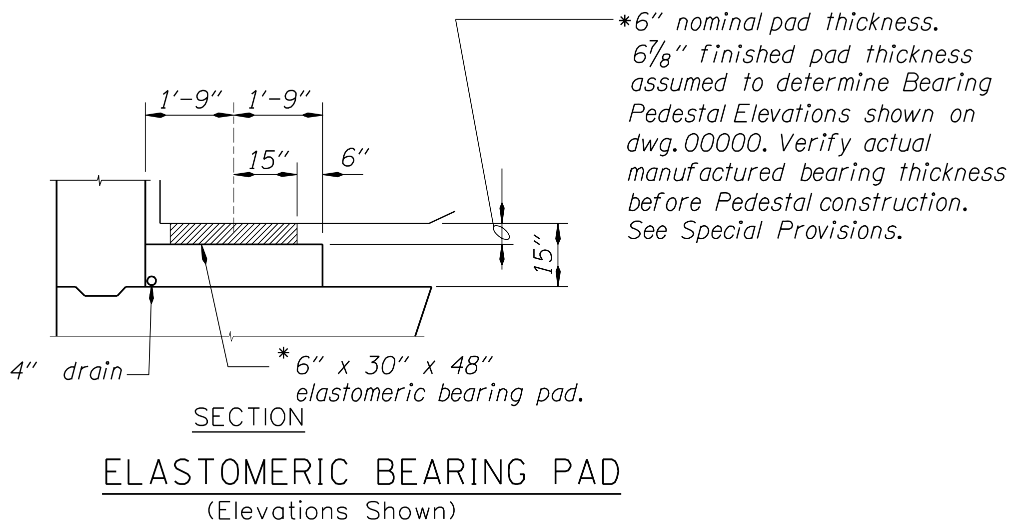




**Figure 1.1.19.1B**

For prestressed slab and box beam bearing pad sizes, use Figure A1.1.8.7D (end bents) or Figure A1.1.9.2C (interior bents).

### 1.1.19.2 Proprietary Pot, Disc, Slide, Radial, or Spherical Bearings

These bearings are normally used on long-span and post-tensioned concrete structures where the design movement cannot be accommodated with elastomeric bearings.

When provided to allow longitudinal movement for concrete superstructures, design bearings to accommodate the anticipated effects of shrinkage, creep and elastic shortening (where applicable) as well as temperature.

Use the following movements for proprietary bearings:

Shortening: $ES + LF_1*(CR + SH) + LF_2(TF)$
$ES + LF_1*(CR + SH) + LF_3(EQ)$
Lengthening: $LF_2*(TR)$
$ES + LF_1*(CR + SH) + LF_3(EQ)$

Where:

ES = elastic shortening movement
CR = creep movement CR = (ES)(CF)
SH = shrinkage movement
TF = temperature fall movement
TR = temperature rise movement
CF = creep coefficient
EQ = Maximum design earthquake displacement (movable bearings)
$LF_1$ = from Article 3.4.1
$LF_2$ = TU, Load Factor from table 3.4.1-1
$LF_3$ = Load Factor from table 3.4.1-1

Use proper signs and the Load Factor that produces the largest movement in each load combination.

Formatted: Font: 10 pt

Formatted: Font: 10 pt

Formatted: Font: 10 pt

The creep coefficient above is taken as 1.5 for both prestressed and post-tension concrete structures. Shrinkage movement is calculated using 0.0004 times the total length of the structure. For prestressed concrete structures 40% of this movement takes place within the first thirty days after manufacture. Therefore, the amount of creep and shrinkage movement for these structures, after placement, can normally be taken as 60% of the total.

Values for shortening of post-tensioned, cast-in-place concrete bridges have been determined by field measurements by the ODOT Bridge Section. Compare the design values with the field measured values and use the more conservative values.

The initial position of expansion bearings shall be detailed so that the bearing will behave satisfactorily after the design movement has taken place.

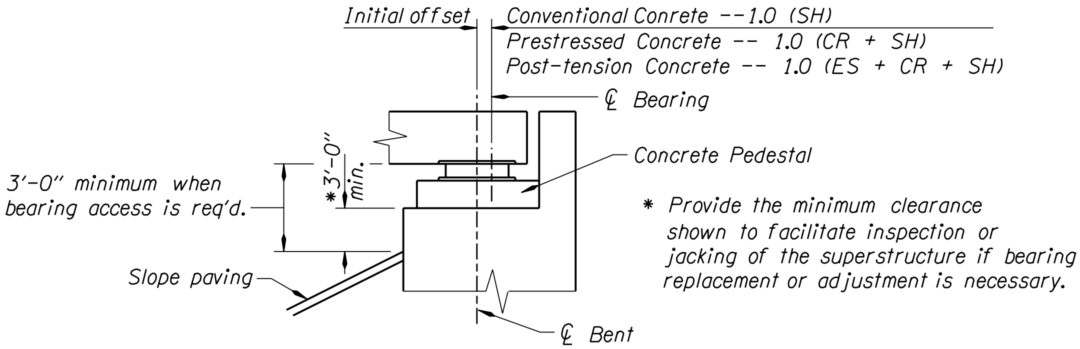



**Figure 1.1.19.2A**

Performance Specifications for Approved Proprietary Bridge Bearings are now covered by the Standard Specifications. Approved bearings are listed in the *Qualified Products List*, which is available on the ODOT website.

The designer must check the shop drawings, specified test results, and certifications for compliance with these specifications.

When proprietary bearings are used, show the following details and information in the contract plans:

<u>(1) Schematic Drawing</u> - A schematic drawing of the bearing showing the method of attachment of the upper and lower units to the superstructure and substructures, respectively. See Figure 1.1.19.2B for an example.

<u>(2) List design notes for:</u>

- Required clearance to edge of concrete support
- Maximum allowable concrete bearing stress
- Minimum rotational capacity of bearing (not less than 0.015 radian)
- Any restriction as to type of bearing (pot, disc or spherical)
- Reference to bearing schedule for load and movement capacity.
- Reference to standard specifications for painting.
- Reference to the *Qualified Products List* for approved bearings.

Paint all exposed surfaces of the bearing devices except teflon, stainless steel, machine finished or polished bearing surfaces, as set forth in 00594 of the Standard Specifications. Provide a primer coat only for portions to be in contact with concrete and for steel to steel contact surfaces.

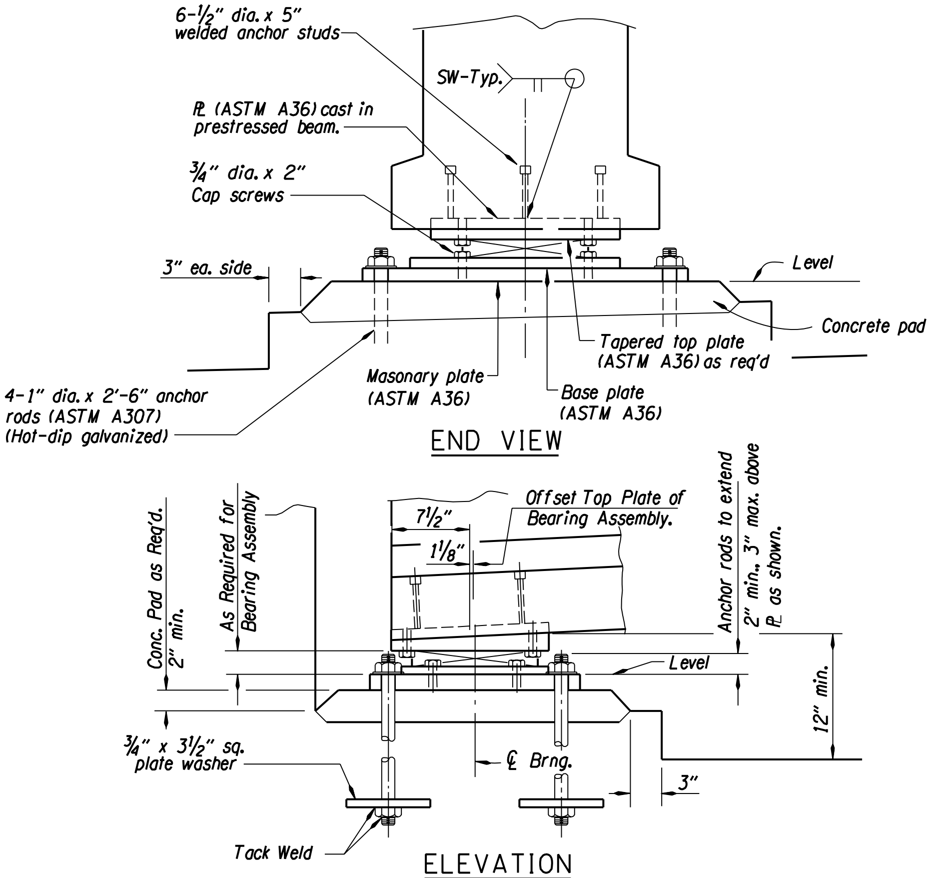



**Figure 1.1.19.2B**

(3) Bearing Schedule – Include the following items in the Bearing schedule:

- Location of bearing (bent number)
- Number of bearings required (number per bent)
- Bearing fixity (fixed, guided or non-guided)
- Final dead load (load/bearing)
- Vertical design capacity (dead load + live load + impact, load/bearing)
- Horizontal design capacity of fixed and guided bearings (not less than 10 percent of the vertical design capacity).

### 1.1.19.2 Proprietary Pot, Disc, Slide, Radial, or Spherical Bearings - (continued)

The specification requires each guided bearing to resist the entire horizontal load at any one bent. Use no more than two guided bearings per bent or hinge. Where more than two guided bearings are required, provide devices independent of the bearings to resist horizontal loads. Use non-guided bearings at these locations.

- Mean temperature

- Design movements for:

  - Temperature rise
  - Temperature fall
  - Creep, shrinkage and elastic shortening
  - Change in bearing centerline per specified temperature increment

Provide the top bearing plate dimensions shall be adequate to compensate for the initial bearing offset shown.

Provide additional bolted plates with the top and bottom plates of the bearing assembly to facilitate removal of bearing for repair or replacement and to provide a level surface for the bearing unit.

BEARING SCHEDULE

| Bent | No. Req'd | Type | Design Load Capacities in kips per Bearing | | | Initial Offset | Calculated movements | | | Movement per 10°F Temp. change | Minimum Movement Capacity from Initial Position | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Vertical | Lateral | Longit. | | 30°F Temp. Rise | 40° F Temp. Fall | Creep, shrinkage & Elastic shortening | | Temp. Rise Direction | Temp. Fall Direction | Total |
| 1 & 5 | 4 | Guided | 1000 | *600 | — | 3" | 7/8" | 1 1/4" | 4 1/2" | 5/16" | 1 1/2" | 7 1/2" | 9" |

* Reduce design load to 200 kips for PTFE surface only.

**Figure 1.1.19.2C**

### 1.1.19.3 Bearing Replacement

Consider the potential of expansion bearing replacement during the life of the structure in sizing of crossbeams and bents. Provisions may need to be made for jacking locations.

If a bent is accessible (close to the ground, out of traffic, etc.) it may be assumed that a falsework jacking bent can be constructed and no special provisions on the bent are required.

If the bent is not easily accessible, provision for jacking, such as a wider crossbeam or strengthened diaphragm beam should be provided.