SECTION 9
BEARINGS

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9.1 GENERAL *(REV. 12/19)*

Bearings are structural devices that transmit loads from the superstructure to the substructure. Bearings may also be required to allow for horizontal movement due to temperature and time dependent causes, allow rotation due to loads on the superstructure, and transmit seismic forces from the superstructure to the substructure. The selection and layout of bearings shall be consistent with the proper functioning of the bridge.

Bearings may be fixed or movable as required for the bridge design. Movable bearings may include guides to control the direction of translation. Fixed and guided bearings shall be designed to resist all loads and restrain unwanted translation. Keeper blocks may also be used to restrain some of these loads. When anchor bolts are required at bearings, stainless steel bolts shall not be used.

Combinations of bearing types should not be used at the same line of bearing. Differing deflection and rotational characteristics may result in damage to the bearings or structure.

Several bearing types are recommended below for different situations. Other bearing devices may be used, provided that they have been approved by the **CTDOT**.

9.1.1 Skew Effects

Provisions shall be made in the bearing design for both lateral and longitudinal movement based on the geometry of the deck, the layout of the deck expansion joints and keeper assemblies. For bridges with complicated deck configurations, a thermal expansion analysis of the deck should be done in order to determine the thermal movements relative to the bridge bearings. The geometry of the deck, not the structural framing, should be the basis for the expansion analysis. For narrow bridges where the effects are minimal, transverse expansion may be neglected.

9.1.2 Curvature Effects

For curved superstructures, provisions shall be made in the alignment of bearing guides and keeper blocks for both lateral and longitudinal movement based on the geometry of the deck and the layout of the deck expansion joints. Generally, the direction of movement of the superstructure may be assumed to be parallel to the chord of the deck centerline taken from the joint to the neutral point of the superstructure. The neutral point is defined as the point where no thermal movement occurs.

9.1.3 Temperature Range

The temperature range used for the calculation of thermal movement at bearings shall be 120°F. This temperature range is based on a mean low temperature of -10°F and a mean high temperature of +110°F. The median temperature for design of bearings shall be +50°F.

9.1.4 Coefficient of Thermal Expansion

For the design of bearings, a coefficient of thermal expansion (α) shall be taken as $6.4x10^{-6}$ inches per ºF. This equates to approximately 2.75-inch total movement for a 300 foot long bridge.

9.1.5 Seismic

If the bridge is designed for seismic events, the bearings may be designed to transmit seismic forces from the superstructure to the substructure. The movement due to seismic forces shall be accommodated in the design of the bearings. It is important that the bearing remain stable under the maximum anticipated bridge displacement during the seismic event. For requirements for the design of seismic isolation bearings, see **BDM** [3].

Rocker type bearings should not be used due to the high susceptibility of overturning during seismic events.

9.1.6 Single Span Bridges

The design of single span bridges may be based on providing elastomeric expansion bearings at both ends of the superstructure if the grade of the roadway is less than 5%. The designer should incorporate keeper assemblies in order to maintain alignment of the superstructure. Designs of this nature will reduce the amount of expansion at the bearings and deck joints. For simple span bridges, with a fixed and an expansion bearing, the fixed bearing should be located at the low end of the structure.

9.1.7 Multi-Span Bridges

The design and layout of bearings in multi-span bridges should be based on the design of the deck expansion joints, the capacity of the bearings to accommodate the anticipated loads and movement, and the seismic design of the substructure where applicable.

9.2 BEARING SPECIFIC DESIGN REQUIREMENTS

9.2.1 Steel Reinforced Elastomeric Bearings *(Rev. 12/19)*

Steel reinforced elastomeric bearings shall be the first bearing of choice for any bridge bearing due to the low initial cost and the low future maintenance costs. These bearings should be considered for low to moderate load situations.

Steel reinforced elastomeric bearings may be designed as either rectangular or round. Round elastomeric bearings should be considered where significant movement occurs in both the longitudinal and transverse direction.

If the shearing force in the bearing is less than 20% of the minimum vertical load on the bearing, the interface of the bearing and the concrete bearing seat should not be attached or bonded. For cases where the shearing force is greater, the following possibilities should be investigated:

a. The bearing should be redesigned to attempt to reduce the shearing force.

b. The bearing should be shop vulcanized under heat and pressure to a bottom steel plate that is anchored to the substructure.

c. A PTFE slider type bearing can be considered.

Steel reinforced elastomeric bridge bearings shall only be designed with virgin neoprene not natural rubber.

Elastomeric bearings shall be unanchored to the substructure. When anchor bolts are required, holes for anchor bolts shall not pass through the elastomeric bearing. If anchor bolts are required, then the bolts shall be located outside the limits of the bearing.

9.2.1.1 Steel Bridge Beams

For the design of steel bridge beams, the top of the bearing should be vulcanized under heat and pressure to a steel top plate to facilitate installation. The top plate should be bolted to a beveled sole plate. Field welding should be avoided due to the possibility of damage to the elastomer during welding.

9.2.1.2 Prestressed Concrete Bridge Beams

For prestressed concrete bridge beams without steel sole plates, if the grade of the roadway is less than 5% the bearings may be manufactured with a sloping top surface provided that the internal steel reinforcement plates are parallel and level.

9.2.2 Cotton Duck Reinforced Bearings with PTFE Slider

Cotton Duck fabric reinforced elastomeric bearings should be considered for locations with low to moderate loads combined with moderate to high movement.

The movement due to expansion is accommodated between the PTFE and the slider plate. The PTFE material should be bonded to the top surface of the bearing. The slider plate shall be welded to a top plate or the beveled sole plate.

9.2.3 High Load Multi-Rotation Bearings

High Load Multi-Rotational bearings should be considered for locations with moderate to high loads combined to moderate to high movement. The designer should not completely design high load multi-rotational bearings for each location; however, a preliminary design should be done to determine the rough overall dimensions of the bearing. The specifications for high load multi-rotational bearings require that the Contractor or his Fabricator design the specific bearings based on the type of bearing that is supplied.

The sealing rings used to secure the elastomer disc within the pot shall be round in cross section. Flat rings will not be allowed due to problems with leakage of the elastomer.

9.2.4 Steel Fixed Bearings

Steel bearings may be used where no movement is necessary and where the only rotation is in the transverse axis of the bridge. A 0.125-inch thick, 90 durometer random fabric pad should be used to seat the steel masonry plate on the concrete substructure bearing pad. For steel bridge beams, the anchor bolts for the bearing should not pass through the flange of the beam.