



INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

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TO: All Design, Operations, and District Personnel, and Consultants

FROM: /s/ Katherine Smutzer
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SUBJECT: Elastomeric Bearing Pads

REVISES: *Indiana Design Manual (IDM) Sections 409-7.03(03), 409-7.04, 409-7.05, Figures 409-7F, 409-7J, 409-7K (deleted), 409-7L, and 409-7M*

EFFECTIVE: Stage 3 Submittal on or after August 6, 2020

The referenced sections of the IDM have been revised to provide guidance on the use of tapered load plates or shims, and to require that elastomeric bearing pads be mechanically secured in place. Steep longitudinal grades and high beam end rotations may result in elastomeric bearings that require tapered plates to minimize the bearing rotation in order to satisfy AASHTO LRFD elastomeric bearing design requirements. Designers should be aware that each variation in elastomeric bearing pads within a contract will require a separate random test, including differences in load plates that are vulcanized to the pad. Tapered load plates should only be used where required by design, and tapered shim plates should be used in lieu of tapered load plates for steel superstructures.

INDOT has observed several instances where elastomeric bearing pads have shifted out of their plan location while in service. In severe cases, the elastomeric pad has moved so far out of position that it no longer adequately supports the beam above. The most common and preferred method of securing an elastomeric bearing is by vulcanizing the elastomeric pad to a steel load plate, which can be bolted or welded to the superstructure. All elastomeric bearing pads should be mechanically secured in place, even when calculations indicate there is sufficient frictional resistance to keep the bearings in place, and the method of securing the bearings should be shown on the plans.

IDM Revisions

409-7.03(03) Determining Standard Bearing-Device Type [Rev. May. 2013, Aug. 2020]

The procedure for determining the applicable standard elastomeric bearing device is the same for each structural-member type.

Determine the dead-load plus live-load reaction, and calculate the maximum expansion length for the bridge at the support for which the device is located. Then enter Figure [409-7B](#), [409-7C](#), [409-7D](#), or [409-7E](#), Elastomeric Bearing Pad or Assembly Types, Properties, and Allowable Values, for the appropriate structural-member type, with the reaction and maximum expansion length. The required bearing-device size is that which corresponds to the reaction and expansion-length values shown in the figure which are less than or equal to those determined. If the reaction or expansion length is greater than the figure's value, use the next larger device size. If the reaction or expansion length is greater than the maximum value shown on the figure, the pad must be properly resized and designed.

The maximum service limit state rotation due to total load, Θ_s , shall be calculated in accordance with *LRFD* 14.4.2.1.

The requirement for a tapered plate shall be determined in accordance with *LRFD* 14.8.2. See Figure [409-7F](#) for a typical elastomeric bearing pad with tapered steel plate. In order to minimize the number of bearings that are required to be randomly tested on a contract, load plates which are required to be vulcanized to the pads should be of a consistent size and thickness whenever feasible. Variations in taper rates should be accommodated by using tapered shims between the load plate and bottom flange on steel superstructure bridges, and tapered load plates on prestressed beam superstructure bridges. Plates should not be tapered when the calculated difference in thickness between the parallel edges is less than 1/8 in. Stainless steel should be considered only when located beneath an expansion joint. When a stainless steel tapered plate is specified, the steel plate cast with the beam, steel stud, and welds must also be specified as stainless steel.

409-7.04 Nonstandardized Elastomeric Bearing Device [Rev. Aug. 2020]

The design shall be based on *LRFD* 14.7.6, Method A.

Each pad or assembly shall be sized according to the load capacities and expansion lengths that it can accommodate.

An elastomeric bearing device not shown on the INDOT *Standard Drawings* may be used if its parameters check, or its design is in accordance with *LRFD* 14.7.6. *LRFD* defines certain limitations in terms of allowable stresses, movements, or minimum dimensions. These limitations are as follows.

1. Shear Modulus. See *LRFD* 14.7.6.2. The design of an elastomeric bearing pad shall include, but shall not be limited to, the consideration of increased G at a temperature below 73 °F; see *LRFD* 14.6.3.1.
2. Design Shear Force. The elastomer with the lowest temperature tolerance shall be used. The total elastomer thickness shall be sufficient to resist twice the design shear force.
3. Relationship of Device Dimensions. Both the width and the length of the device shall be at least three times the total thickness of the pad. For a circular pad, the diameter of the pad shall be at least four times the total thickness of the pad.
4. Stress Due to Dead Load Plus Live Load without Impact. This stress shall be less than or equal to the lesser of 1.25 ksi or 1.25 GS .
5. Rotational Deflection. Sufficient pad thickness or a tapered plate/shim shall be provided to prevent a liftoff condition on the leading edges of the device. Tapered plates should not be used where the calculated difference in thickness between parallel edges is less than 1/8 in.
6. Anchorage. The pad or assembly shall be secured against seismic or other extreme-event resistant anchorage to defy the horizontal movement in excess of that accommodated by shear in the pad, unless it is intended to act as a fuse as required by *LRFD* 14.7.6.3.8. The calculations are performed in the Strength-Limit state. The load modifiers for ductility (*LRFD* 1.3.3), redundancy (*LRFD* 1.3.4), and importance (*LRFD* 1.3.5) must be accounted for.

409-7.05 Connections for Elastomeric Bearing or PTFE Bearing [Rev. Aug. 2020]

Elastomeric and PTFE bearings are to be vulcanized to a steel load plates in order to mechanically secure the bearing pad in place. This requirement should be followed even where design calculations indicate that there is sufficient frictional resistance to hold the bearing pad in place under longitudinal and transverse movements and loadings. In situations where it may not be

feasible to vulcanize the bearing pad to a load plate, such as adjacent box beam bridges, other methods of securing the bearing pad should be provided, such as recesses formed in the bearing seats. Vulcanization and other connection details should be shown on the plans. The minimum thickness for a steel load plate should be 1 ¼ in. where the plate is tapped for bolted connections, and 3/4 in. for all other cases.

An elastomeric bearing or PTFE bearing shall be provided with adequate seismic-resistant anchorage to resist the transverse horizontal forces in excess of those accommodated by shear in the bearing. The restraint may be provided by one of the methods as follows:

1. steel side retainers with anchor bolts;
2. concrete shear keys placed in the top of the pier cap, or channel slots formed into the top of the cap or mudwall at the end bent; or
3. concrete channels formed in the top of the end bent cap or expansion pier cap.

Steel side retainers and anchor bolts shall be designed to resist the minimum transverse seismic force for the seismic category in which the bridge is located. The number of side retainers shall be as required to resist the seismic forces. They shall be placed symmetrically with respect to the cross section of the bridge. Side retainers will often be required on each side of the girder flange of each beam line. The strength of the beams and diaphragms shall be sufficient to transmit the seismic forces from the superstructure to the bearings. A minimum of two anchor bolts of 1 in. diameter shall be provided for each side retainer. The gap between the side retainer and the top plate or edge of flange should be determined by design so that the retainers are not engaged during routine service loads, including thermal movements. However, the gap should be at least 1/4 in. to allow for construction tolerances.

Concrete channels formed around each beam in the top of the end bent cap or expansion pier cap represent an acceptable alternative to steel side retainers. The top of the top shoe shall be set a minimum of 4 in. below the top of the concrete channel. If a top shoe is not present, the bottom of the beam shall be placed 4 in. below the top of the channel. The minimum depth of the channel shall be 6 in. The horizontal clearance from the side of the top shoe or edge of the beam to the side wall of the channel shall be at least 1 in.

Integral end bents are an effective way of accommodating horizontal seismic forces. An integrally-designed end bent will inherently resist the transverse seismic forces.

Updated Figures