Index 400-510 Composite Elastomeric Bearing Pads-Prestressed Florida-I and AASHTO Type II Beams

Design Criteria

AASHTO LRFD Bridge Design Specifications; ***Structures Design Guidelines (SDG)***

Design Assumptions and Limitations

This standard depicts details and notes for elastomeric bearing pads for prestressed concrete Florida-I and AASHTO Type II Beams with or without skewed end conditions.

This standard is intended for use with prestressed concrete Florida-I and AASHTO Type II Beams, but may be used for steel girder or other bridge types with the appropriate notes and cross references.

This standard may be used with Indexes 450-010, 450-036, 450-045, 450-054, 450-063, 450-072, 450-078, 450-084, 450-096, 450-120, 450-511 and 450-512.

Beveled Bearing Plates B are required for beams on grades greater than 2%, see instructions for Index 450-511 and/or 450-512.

LIMITING PARAMETERS FOR COMPOSITE ELASTOMERIC BEARING PADS USED WITH FDOT STANDARD FLORIDA-I AND AASHTO TYPE II BEAMS

Pad Type	Maximum Service Live Load (kips)	Maximum Service Dead Load (LL = Actual Service Live Load)	Bearing Skew Angle (degrees)	Maximum Shear Deflection (in)	Shear Modulus, G (Psi)
AA	65	DL=85+1.75(65-LL)	0-15	0.75	110
AB	85	DL=95+1.75(85-LL)	0-30	1.0	150
D	135	DL=147+1.75(135-LL)	0 - 5	0.75	110
	110	DL=120+1.75(110-LL)	0 - 15		
E	150	DL=233+1.75(150-LL)	0 - 5	0.75	110
	110	DL=113+1.75(110-LL)	0 - 20		
F	150	DL=290+1.75(150-LL)	0 - 5	1.0	110
	120	DL=139+1.75(120-LL)	0 - 30		
G	145	DL=230+1.75(145-LL)	0 - 30	1.0	150
	95	DL=98+1.75(95-LL)	0 - 45		
H	180	DL=268+1.75(180-LL)	0 - 35	1.25	150
	135	DL=230+1.75(135-LL)	0 - 45		
J	145	DL=227+1.75(145-LL)	0 - 45	1.5	150
K	200	DL=383+1.75(200-LL)	0 - 45	1.5	150

Skew angle for Bearing Pad design is based on the direction of rotation with respect to the centerline of the Bearing Pad; and is usually taken as the angle between the centerline of the beam and the longitudinal centerline of the Bearing Pad, except on curved bridges.

The Service Live Load (including impact) and Service Dead Load Reactions can be determined from the beam design. The Shear Deflection is the product of the coefficient of thermal expansion, 65% of the thermal gradient and the length of bridge contributing to movement, plus the contributing beam creep and shrinkage at the bottom of beam. Assume beam creep and shrinkage from day 120 to day 240 (this value can be determined from data in the beam design output).

Standard Elastomeric bearing pads have been designed in accordance with the ***AASHTO LRFD Bridge Design Specifications***, Method "B", for a maximum static rotation (beam grade, camber and dead load rotation) of 0.0125 radians and a cyclic rotation (live load) of 0.004 radians. Live load rotations are assumed to be in the opposite direction to static rotations. Rotation does not need to be checked for standard prestressed beams provided that the top of the beveled bearing plates (when required) or the bearing seats (pedestals) are finished approximately parallel to the slope of the beam. The effects of camber (at day 120) from prestressing and dead load deflection may be neglected when determining the slope at the ends of the beam, unless the sum of these effects exceeds 0.0125 radians (1.25%). Bearing seats may be finished level for beam grades less than 0.5%, or when the combined effects of beam grade, camber and dead load rotation do not exceed 1.25%. Whenever possible, the bearing seats at each end of the beam should be detailed with the same slope. See also instructions for Index 450-511.

For design values exceeding the limiting parameters shown on this sheet, the designer must develop custom designs and details. For skew angles greater than 45°, consider round pads with elastomer and plate thicknesses similar to those shown in Index 400-510.

Plan Content Requirements

In the Structures Plans:

Complete the "BEARING PAD DATA TABLE" and include the table on the supplemental sheets. See ***FDM*** **115** for more information regarding use of Data Tables.

The "BEARING PAD DATA TABLE" is intended for use with prestressed beam bridges, but may be modified for steel girder or other bridge types. Supplement this table with additional columns or notes as required to clearly identify the location and type of bearing pads.

For beam grades greater than 2%, provide beveled bearing plates in accordance with Index 450-511 and include a "BEARING PLATE DATA TABLE" in the plans.

BEARING PAD DATA TABLE				Table Date 7-01-13
SPAN NO(s).	BEAM NO(s).	PAD TYPE	BEAM TYPE	BEAM END *

NOTE [Notes Date 07-01-14]:
Work this table with Index 400-510 for Pad Types AA, AB, D, E, F, G, H, J & K, and/or any project specific bearing pads.
* END 1 = Begin Bridge end of beam (Back station).
END 2 = End Bridge end of beam (Ahead station).

Payment

Item number	Item Description	Unit Measure
400-147	Composite Neoprene Pads	CF

Examples

The following examples show the information required to determine the correct standard elastomeric bearing pad type to use. These examples do not assume any wind or braking loads are applied to the elastomeric bearing pads.

EXAMPLE 1

Given Information:

Superstructure Type - One Simple Span
45" Florida I Beams 101'-0" long, spaced at 9'-0" centers (99'-8" center to center bearing)
No longitudinal restraints except friction between the pad and the concrete substructure
Service Live Load Reaction = 106 kips
Service Dead Load Reaction = 109 kips
Coefficient of Thermal Expansion = 0.000006/°F
Thermal Gradient = 70°F
Creep and Shrinkage at the Bottom of Beam (from day 120 to day 240) = 0.28"
Shear Deflection = (0.000006/°F x 0.65 x 70°F x 99.67'/2 x 12"/') + 0.280"/2 = 0.30"
Beam Grade = 2.0%
Bearing Pad Skew Angle = 15°
Service Dead Load Rotation = 0.007 radians (0.7%)
Beam Camber Rotation @ 120 days = 0.012 radians (1.2%)
Net Beam Camber Rotation after Dead Load Deflection = 0.012 - 0.007 = 0.005 radians (0.5%)

Elastomeric Bearing Pad Type Determination:

Compare the design values to the Limiting Parameters Table, Pad Type D for Florida-I Beams.

Check Net Static Rotation (assuming sloped bearing seat) = 0.000+0.005 $\leq$ 0.0125 radians; therefore, OK

Limiting Parameters versus Design Values:

Maximum Service Live Load Reaction of 110 kips versus Design Value of 106 kips; therefore, OK

Maximum Service Dead Load Reaction of 120+1.75(110-106) = 127 kips versus Design Value of 109 kips; therefore, OK

Maximum Shear Deflection of 0.75" versus Design Value of 0.30"; therefore, OK

Skew Angle is between 0° and 15°; therefore, OK

Conclusion:

Use Elastomeric Bearing Pad Type D.

No beveled plate is required. Detail beam seat with a 2% slope along the centerline of beam.

Complete "BEARING PLATE DATA TABLE" for embedded bearing plate only, see instructions for Index 20511 and/or 20512.

EXAMPLE 2

Given Information:

Superstructure Type - Four Simple Spans with Continuous Deck
45" Florida I Beams 101'-0" long, spaced at 9'-0" centers
(99'-8" center to center bearing)
No longitudinal restraints except friction between the pad and the concrete substructure
Service Live Load Reaction = 106 kips
Service Dead Load Reaction = 109 kips
Coefficient of Thermal Expansion = 0.000006/°F
Thermal Gradient = 70°F
Creep and Shrinkage at the Bottom of each Beam (from day 120 to day 240) = 0.28"
Shear Deflection = (0.000006/°F x 65% x 70°F x 202' x 12"/') + 0.280"/2 = 0.80"
Beam Grade = 5%
Bearing Pad Skew Angle = 15°
Service Dead Load Rotation = 0.007 radians (0.7%)
Beam Camber Rotation @ 120 days = 0.012 radians (1.2%)
Net Beam Camber Rotation after Dead Load Deflection = 0.012 - 0.007 = 0.005 radians (0.5%)

Elastomeric Bearing Pad Type Determination:

Compare the design values to the Limiting Parameters Table, Pad Type F for Florida-I Beams.

Limiting Parameters versus Design Values:

Maximum Service Live Load Reaction of 120 kips versus Design Value of 106 kips; therefore, OK

Maximum Service Dead Load Reaction of 139+1.75(120-106) = 163.5 kips versus Design Value of 109 kips; therefore, OK

Maximum Shear Deflection of 1.0" versus Design Value of 0.80"; therefore, OK

Skew angle is between 0° and 30°; therefore, OK

Conclusion:

Use Elastomeric Bearing Pad Type F. Additionally, because beam end slope exceeds 2%, include a beveled bearing plate in the "BEARING PLATE DATA TABLE" and detail bearing seats level, see instructions for Index 450-511 and/or 450-512. Neglect the effects of net beam camber in the beveled bearing plate design since rotation is less than 0.0125 radians.