

TO: All Design Section Staff
FROM: Bijan Khaleghi
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SUBJECT: Use of isolation Bearings for WSDOT Bridges

This design memorandum defines WSDOT general design criteria for use of seismic isolation bearings for new and existing bridges. The seismic design of new bridges and existing bridges shall conform to the AASHTO LRFD Bridge Design Specifications (LRFD), AASHTO Guide Specifications for LRFD Seismic Bridge Design (LRFD SGS), AASHTO Guide Specifications for Seismic Isolation Design (ISOLATION), WSDOT Bridge Design Manual (BDM), and as modified by this memorandum. This memorandum applies to seismic isolation design of conventional normal, essential and critical bridges. The seismic design and use of isolation bearings for nonconventional bridges shall be based on a project specific seismic design criterion, in consultation with WSDOT State Bridge and Structures Engineer and Bridge Design Engineer.

WSDOT BDM Revisions: Bridge Design Manual Section 9.3.3 and Design-Build Section 15.9.2.E.7 shall be revised as follows: (Revisions are shown in red)

BDM 9.3.3 General Design Criteria

Seismic isolation bearings shall be designed in accordance with the requirements of the AASHTO Guide Specifications for Seismic Isolation Design, AASHTO LRFD Bridge Design Specifications (LRFD), AASHTO Guide Specifications for LRFD Seismic Bridge Design (LRFD SGS), AASHTO Guide Specifications for Seismic Isolation Design (ISOLATION), WSDOT Bridge Design Manual (BDM). The response modification factors (R-factors) contained in ISOLATION Article 6 shall not be used if the provisions of the LRFD SGS are being followed for the design of the bridge.

Expansion joints shall accommodate seismic movements in order for seismic isolation bearings to function properly. Adequate clearance for the seismic displacement shall be provided between the girders and abutment to limit the damage at top of backwall. After a major earthquake, damage is easily inspected and repaired.

Performance requirements:

The isolated bridges shall meet the same seismic hazard, seismic design requirements and performance criteria used to design the conventional bridge.

Combinations of isolation bearings and conventional bridge column fixity to the superstructure are not allowed.

The following target values to optimize the performance of isolated structures shall be considered:

<u>Parameter</u>	<u>Transverse</u>	<u>Longitudinal</u>
<u>Seismic Total Design Displacement range (TDD)</u>	<u>6 to 24 inches</u>	<u>6 to 24 inches</u>
<u>Isolated Structure Effective Period (T)</u>	<u>2 to 3 seconds</u>	<u>2 to 3 seconds</u>

Isolated bridge system shall meet the following requirements:

1. Superstructure unseating shall be prevented if the displacement demand exceeds the 125% of the bearing total design displacement demand (TDD). For existing bridges, prevention strategies include large platform seats and/or catcher blocks. Any drop of the superstructure onto the catcher or seat shall be made as small as possible to prevent damage from impact.
2. The column shear capacity shall meet or exceed the lateral isolator force at 125% of the bearing total design displacement $F_{1.25TDD}$.
3. Isolated bridge system shall be designed for a minimum local displacement ductility capacity for columns, shafts and piles of 3.0. Local displacement ductility capacity is based on an equivalent member that approximates a fixed base cantilever elements. Fixed-Free and Fixed-fixed columns are idealized as one and two cantilever elements.
4. The displacement capacity of the isolation devices shall be determined from the manufacturer's recommendation, but not less than the 125% of the bearing total design displacement.

BDM 15.9.2.E.7: (Design-Build Chapter)

Type 3 ERS may be considered only if Type 1 strategy is not suitable and Type 3 strategy has been deemed necessary for accommodating seismic loads. Isolation bearings shall be designed in accordance with the requirements of the AASHTO LRFD Bridge Design Specifications (LRFD), AASHTO Guide Specifications for LRFD Seismic Bridge Design (LRFD SGS), AASHTO Guide Specifications for Seismic Isolation Design (ISOLATION), and WSDOT Bridge Design Manual (BDM). Isolation bearings shall conform to Section 9.3.3 General Design Criteria

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