# Guide Specifications for Seismic Isolation Design

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# PREFACE

In 1995, the American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Bridges and Structures charged the new T-3 Seismic Design Technical Committee with the task of modifying the 1991 *Guide Specifications for Seismic Isolation Design*. To perform this task, the T-3 Seismic Design Technical Committee formed a task group of three state bridge engineers, three industry representatives, three professors, and one Federal Highway Administration representative. The task group developed the new specifications by considering the current state of practice, results of completed and ongoing technical efforts, and research activities in the field of seismic isolation.

The new *Guide Specifications for Seismic Isolation Design* contains the following modifications:

1. Numerous stylistic changes and additional commentary that make these guide specifications consistent with those presented in AASHTO's *Standard Specifications for Highway Bridges, 16th Edition* (hereafter referred to as *Standard Specifications*).

2. Changes in the methods of analysis and, in particular, the uniform load method. This method now accounts for the substructure flexibility. Moreover, some guidelines are provided for analyzing of isolated bridges with added viscous damping devices.

3. The single requirement for sufficient lateral restoring force has been changed to two requirements. Of these, the first (lateral force at the design displacement must be at least $W/80$ greater than the lateral force at 50 percent of the design displacement) is provided in order to accommodate imperfections in isolator installation. The second (a requirement on the period based on the tangent stiffness at the design displacement) is provided in order to prevent (1) extreme sensitivity of the displacement response to the seismic input details, (2) the development of cumulative displacements and of significant permanent displacement, and (3) the development of negative stiffness due to column rotations.

4. The response modification factors (R-Factors) have been reduced to values between 1.5 and 2.5. This implies that the ductility-based portion of the R-Factor is unity or close to unity. The remainder of the factor accounts for material overstrength and structural redundancies inherent in most structures. The specification of lower R-Factors has been based on the following considerations:

   (i) Proper performance of the isolation system.

   (ii) Variability in response given the inherent variability in the characteristics of the design-basis earthquake.

The lower R-Factors ensure, on average, essentially elastic substructure response in the design-basis earthquake. However, they do not necessarily ensure either proper behavior of the isolation system or acceptable substructure performance in the maximum capable earthquake (e.g., described as an event with 10-percent probability of being exceeded in 250 years). Owners may opt to consider this earthquake for the design of important bridges. The California Department of Transportation currently uses this approach for the design of isolated bridges.

5. Details are provided for the design of sliding isolation bearings. The increasing number of applications of sliding bearings since the publication of the 1991 guide specifications made this addition necessary.

6. A procedure for determining bounding values of isolator properties for analysis and design is included. This procedure is based on determining system property modification factors, termed the l-factors, which multiply the nominal design values of isolator properties. The system property modification factors account for the effects of temperature, aging, travel, contamination, and other conditions.

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