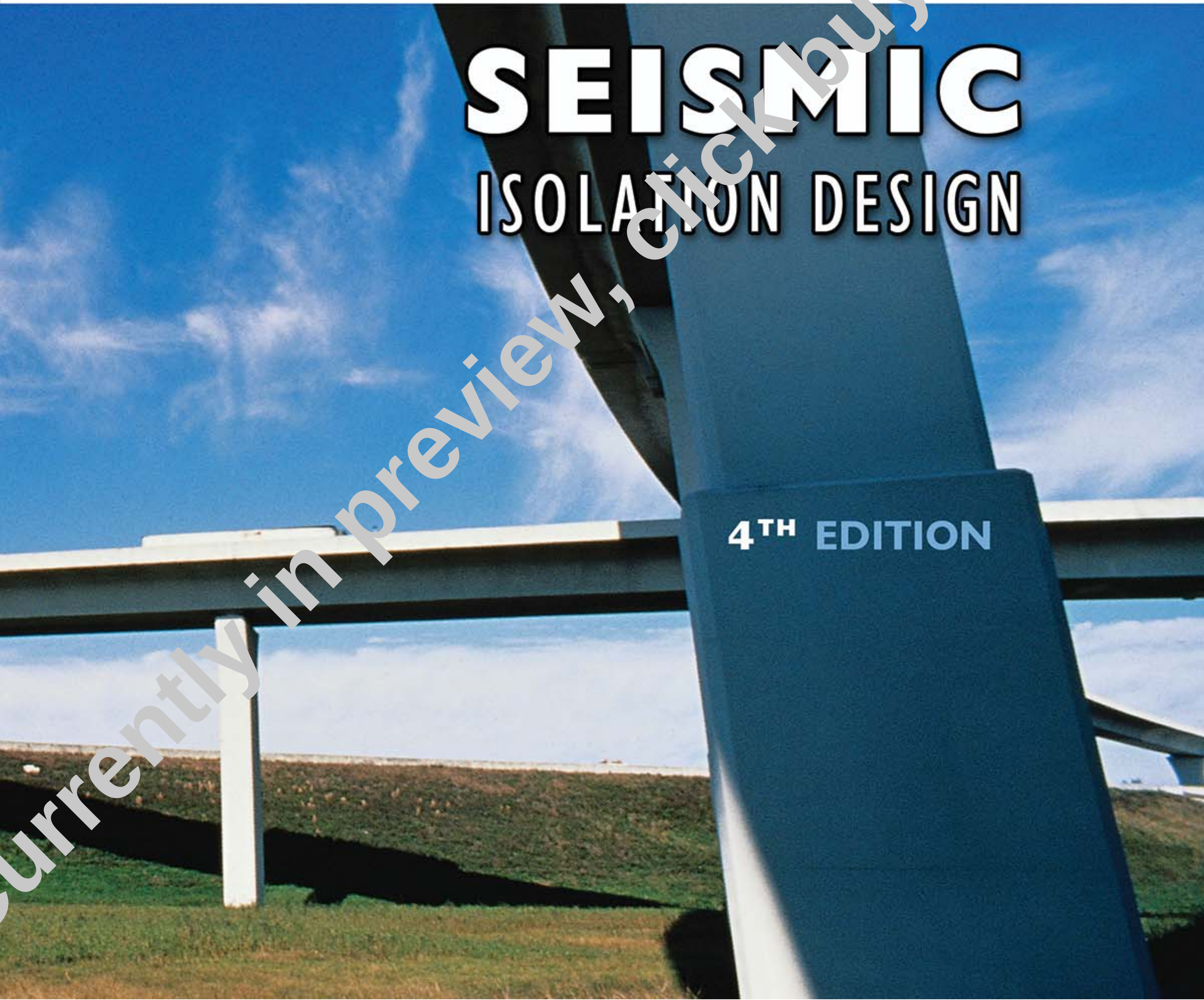
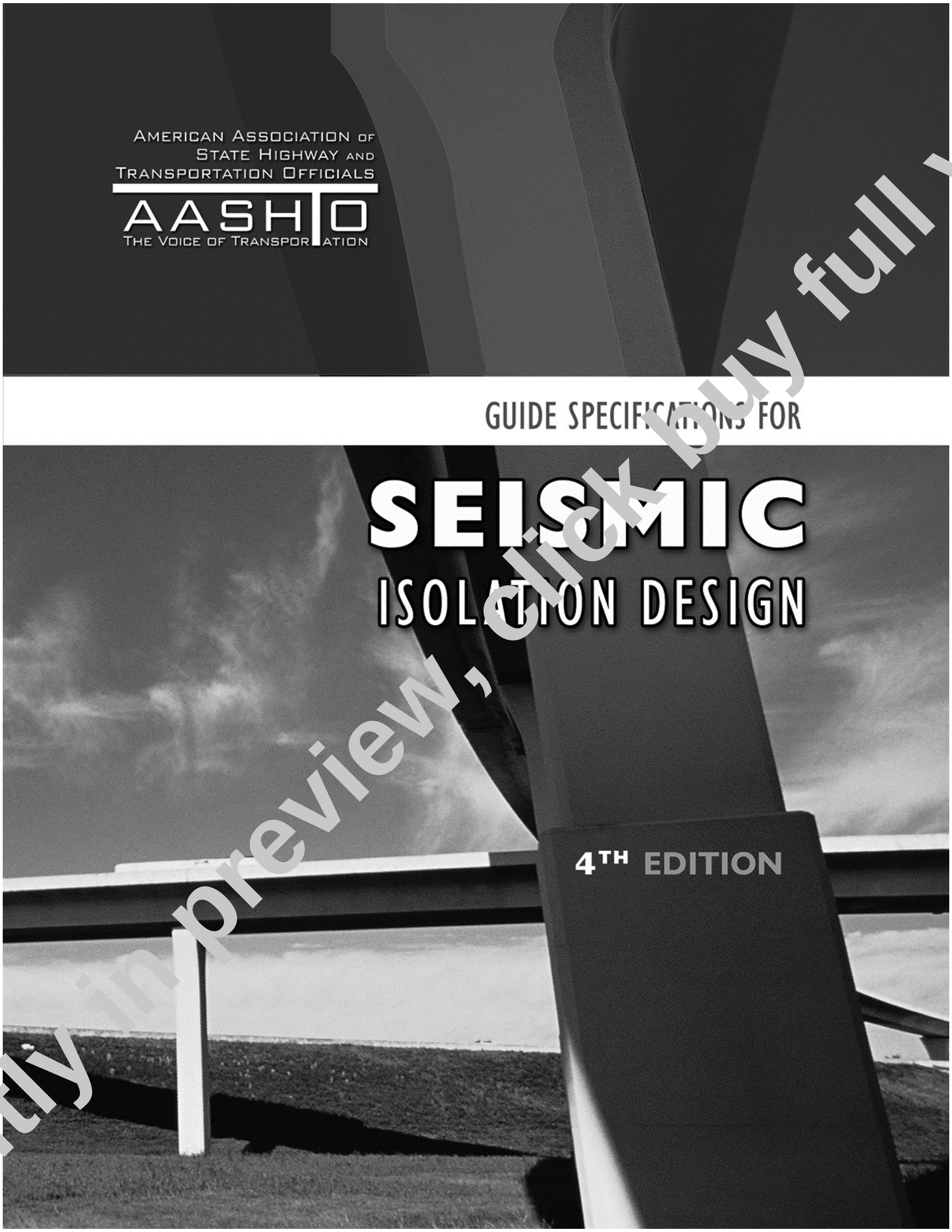
American Association of State Highway and Transportation Officials
AASHTO
The Voice of Transportation

Guide Specifications for Seismic Isolation Design

4th Edition

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GUIDE SPECIFICATIONS FOR
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ISOLATION DESIGN
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PREFACE TO THE THIRD EDITION, 2010

This 2010 Edition of the *Guide Specifications for Seismic Isolation Design* updates the 1999 Edition by addressing major changes in the way seismic hazard is now defined in the United States, as well as changes in the state of the art of seismic isolation design for highway bridges. This Edition is based on the work of NCHRP Project 20-7, Task 262.

In summary, this revised edition reflects (a) changes in the definition of the seismic hazard as now defined in the AASHTO *LRFD Bridge Design Specifications* (hereafter referred to as the Design Specifications) and the *Guide Specifications for LRFD Seismic Bridge Design* (hereafter referred to as LRFD Seismic); (b) designer experience in the last 10 yr with the implementation of the current specifications; (c) industry trends in the design and construction of isolators; (d) the sun-setting of the AASHTO *Standard Specifications for Highway Bridges*; and (e) provisions in the Design Specifications that impact the design and testing of isolation bearings, such as in Section 14, Bearings and Expansion Joints. Major changes therefore include:

1. The seismic hazard section has been updated to be compatible with the Design Specifications and LRFD Seismic. Previous Section 3, Acceleration Coefficient, and Section 5, Site Effects and Site Coefficients have been collapsed into a new Section 3, Seismic Hazard, to make way for a new Section 4, Design Response Spectrum, after moving seismic performance categories to Section 5. This new section presents the design spectrum in a new figure (taken from the Design Specifications and LRFD Seismic), and is used to define spectral accelerations S_{DS} and S_{D1}. There is one exception to the general rule of compatibility with the Design Specifications. Design Specifications, Article 3.10.2 requires a site-specific procedure be used if "long-duration effects are expected in the region." This provision is not in LRFD Seismic and has not been included in these Guide Specifications (Article 3.1).
2. The requirement that the acceleration coefficient (A) for the design of isolated bridges shall not be less than 0.1 has been deleted (Article 3.1).
3. Eq. 3 for displacement, d, (now Eq. 7.1-4) has been changed to be a function of S_1 rather than peak ground acceleration (A) since maps of S_1 are now available. At the same time, the site coefficient in the expression for d was updated from S_i to F_v, and the dual units expression was replaced with one that is independent of the unit of measurement.
4. The previous Table 7.1-1 for the Damping Coefficient, B (now labeled B_L), has been replaced by an expression directly relating B_L to the viscous damping ratio ξ. The values for B_L given by this expression are almost identical to those in Table 7.1-1 over the full range of ξ. The advantage of the expression, however, is that it avoids linear interpolation to find B_L for values of ξ that are not listed in the Table.
5. Eqs. 20 and 21 for the shear strain in a bonded layer of elastomer due to a compressive load have been replaced by a single equation (Eq. 14.2.1-1) that is applicable over the full range of shape factors. This equation is consistent with the recently revised provisions in the Design Specifications for steel-reinforced elastomeric bearings (Design Specifications, Article 14.7.5). Likewise, the expression for shear strain due to rotation in Eq. 24 (now Eq. 14.2.1-1) has been updated to be consistent with the Design Specifications provisions.
6. The non-seismic requirements for elastomeric bearings (i.e., service limit states) in Design Specifications, Section 14 have recently been updated and the corresponding provisions in these Guide Specifications (Article 14.3) now reference the Design Specifications.
7. Some testing requirements for isolation hardware have been deleted or relaxed if they were judged to be redundant, no longer necessary based on experience with current isolator manufacturers, or unrealistically burdensome and no longer serving a useful purpose.
8. Additional commentary is given to clarify such terms as *design displacement*, which is used for calculating the effective stiffness of an isolator, and *total design displacement* (TDD), which is used for design and specifying the testing requirements for an isolator.
9. Editorial updates/corrections have been made to ensure compatibility with the style and format of the Design Specifications as far as possible. All references to the Standard Specifications have been replaced by corresponding references to the Design Specifications and, where appropriate, to LRFD Seismic.
10. The uniform load method of analysis (Article 7.1) has been renamed the simplified method to better reflect the nature of the method and avoid confusion with the uniform load method given in the Design Specifications and LRFD Seismic.
11. Portions of Article C7 have been determined to be more appropriate to Article 8.1.2 and have been moved accordingly. Portions of Article C7.1 contain mandatory language and have been moved to Article 7.1 in this edition of the Guide Specifications.

PREFACE TO THE FOURTH EDITION, 2014

This Fourth Edition (2014) of the *Guide Specifications for Seismic Isolation Design* updates the Third Edition (2010) principally by the addition of a set of design examples in Appendix B.

Today, about 200 bridges have been designed and constructed in the U.S. using the AASHTO *Guide Specifications for Seismic Isolation Design* but this figure is a fraction of the potential number of applications and falls far short of the number of isolated bridges in other countries.

One of the major barriers to implementation is that isolation is a significant departure from conventional seismic design and one that is not routinely taught in university degree courses. Furthermore, very few text books on this topic have been published and those that are available focus on applications to buildings rather than bridges. The absence of formal instruction and lack of reference material mean that many designers are not familiar with the approach and uncomfortable using the technique, despite the potential for significant benefits.

In an effort to correct this situation, fourteen design examples were developed to illustrate the design process and the design of related isolation hardware in accordance with the Guide Specifications. This work was funded under NCHRP 20-7, Task 262.

These design examples are included in Appendix B and illustrate the application of seismic isolation to a range of bridges for varying seismic hazard, site classification, isolator type, and bridge type. In general, each example illustrates the suitability of the bridge for isolation (or otherwise), and presents calculations for preliminary design using the Simplified Method of analysis, preliminary and final isolator design, and detailed analysis using the Multimode Spectral Analysis procedure. However, design of the superstructure, substructure (piers), and foundations is not covered.

In addition to the inclusion of a new Appendix B, a number of editorial corrections have been made to the Guide Specifications, to improve readability and correct typographical errors.

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