Seismic Loads

Guide to the Seismic Load Provisions of ASCE 7-05

Finley A. Charney, Ph.D., P.E.

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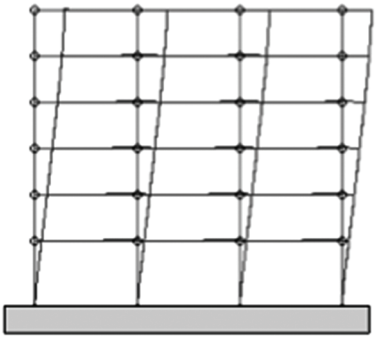


Seismic Loads

Other Titles of Interest

Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-05. (ASCE Standard, 2006). Provides requirements for general structural design and includes means for determining dead, live, soil, flood, wind, snow, rain, atmospheric ice, and earthquake loads and their combinations that are suitable for inclusion in building codes and other documents. A detailed commentary of explanatory and supplementary information is included. (ISBN 978-0-7844-0809-4)

Books Related to ASCE 7-05

***Snow Loads: Guide to the Snow Load Provisions of ASCE 7-05*, by Michael O'Rourke, Ph.D., P.E.** (ASCE Press, 2007). Presents a detailed, authoritative interpretation of the snow load provisions of ASCE 7-05 by a respected engineering professional, plus three complete design examples. (ISBN 978-0-7844-0857-5)

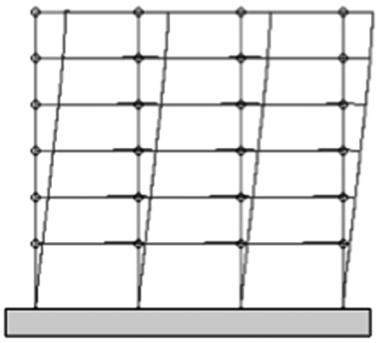
***Wind Loads: Guide to the Wind Load Provisions of ASCE 7-05*, by Kishor C. Mehta, Ph.D., P.E., and William Coulbourne, P.E.** (ASCE Press, 2010). Presents a detailed, authoritative interpretation of the wind load provisions of ASCE 7-05 by respected engineering professionals. (ISBN 978-0-7844-0858-2)

Books on Seismic Engineering

Earthquake-Actuated Automatic Gas Shutoff Devices, ANSI/ASCE/SEI 25-06. (ASCE Standard, 2008). Provides current minimum functionality requirements for earthquake-actuated automatic gas shut-off devices and systems. (ISBN 978-0-7844-0877-3)

Seismic Rehabilitation of Existing Buildings, ASCE/SEI 41-06. (ASCE Standard, 2007). Describes the latest generation of performance-based seismic rehabilitation methodologies in a new national consensus standard. (ISBN 978-0-7844-0884-1)

Seismic Evaluation of Existing Buildings, ASCE/SEI 31-03. (ASCE Standard, 2002). Instructs design professionals, code officials, and building owners on how to evaluate whether existing buildings are adequately designed and constructed to resist seismic forces (ISBN 978-0-7844-0670-0)



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Preface

The purpose of this guide is to provide the reader with a set of examples related to the use of ASCE Standard 7, *Minimum Design Loads for Buildings and Other Structures* (ASCE/SEI 7-05). The guide is also pertinent to users of the *2006 International Building Code* (ICC 2006) because IBC refers directly to ASCE 7.

Sections of ASCE 7 Pertinent to the Guide

The guide has examples pertinent to the following chapters of ASCE 7:

Chapter 1: General
Chapter 2: Combinations of Loads
Chapter 11: Seismic Design Criteria
Chapter 12: Seismic Design Requirements for Building Structures
Chapter 16: Seismic Response History Procedures
Chapter 20: Site Classification Procedure for Seismic Design
Chapter 22: Seismic Ground Motion and Long Period Transition Maps

Seismic material excluded from the guide are Chapters 13 (Seismic Design Requirements for Nonstructural Components), Chapter 14 (Material-Specific Design and Detailing Requirements), Chapter 15 (Seismic Design Requirements for Nonbuilding Structures), Chapter 17 (Seismic Design Requirements for Seismically Isolated Structures), Chapter 18 (Seismic Design Requirements for Structures with Damping Systems), Chapter 19 (Soil Structure Interaction for Seismic Design), and Chapter 21 (Site-Specific Ground Motion Procedures for Seismic Design).

The vast majority of the examples in the guide relate to Chapters 1, 2, 11, and 12 of ASCE 7; the principal subject covered is buildings. The materials on nonstructural components and on nonbuilding structures will be expanded in a later edition of this book or in a separate volume. The materials presented for Chapter 16 relate only to the selection and scaling of ground motions for response history analysis.

Chapter 14 of ASCE 7 is not included because the guide is focused principally on seismic load analysis, and not seismic design. The reader is referred to the reference section of the guide for resources containing design examples. The materials included in Chapters 17 through 19 are

considered advanced topics and may be included in a separate volume of examples.

The principal purpose of this guide is to illustrate the provisions of ASCE 7, and not to provide background on the theoretical basis of the provisions. Hence, theoretical discussion is held to a minimum. However, explanations are provided in a few instances. The reference section of this guide contains several sources for understanding the theoretical basis of the ASCE 7 seismic loading provisions. Specifically, the reader is referred to the commentary section to the *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures*. Also of interest to the reader is FEMA 451CD, the *NEHRP Recommended Provisions: Design Examples*.

How to Use the Guide

This guide is organized into a series of individual examples. With minor exceptions, each example stands alone and does not depend on information provided in other examples. This arrangement means that, in some cases, information is provided in the beginning of the example that requires some substantial calculations, but these calculations are not shown. For instance, in the example on drift and P-delta effects, the details for computing the lateral forces used in the analysis are not provided, and insufficient information is provided for the reader to backcalculate these forces. However, reference is made to other examples in the guide where similar calculations (e.g., finding lateral forces) are presented. The reader should always be able to follow and reproduce all new numbers (not part of the given information) that are generated in the example.

Table and Figure Numbering

The examples presented in the guide often refer to sections, equations, tables, and figures in ASCE 7. All such items are referred to directly, without specific reference to ASCE 7. For instance, a specific example might contain the statement "The response modification factor R for the system is provided by Table 12.2-1."

References to sections, equations, tables, and figures that are unique to the guide are always preceded by the letter G and appear in boldface. For example, the text may state that the distribution of forces along the height of the structure is listed in **Table G12-3** and illustrated in **Figure G12-5**. In this citation, the number 12 is the example number, and the number following the dash is the sequence number of the item (i.e., third table, fifth figure).

Notation and Definitions

The mathematical notation in the guide follows directly the notation provided in Chapter 11 of ASCE 7. A list of Abbreviations and Symbols provides definitions for symbols that have been introduced in the guide.

Computational Units

All of the examples in the guide are developed in the U.S. Customary (English) system, as follows (with the standard abbreviation in parentheses):

Length units:	inches (in.) or feet (ft)
Force units:	pounds (lb) or kips
Time units:	seconds (s)

All other units (e.g., mass) are formed as combinations of the above units.

A table with common unit conversions is provided.

Appendixes

The three appendixes provide additional detail that is not necessary in specific examples. Appendix A covers interpolation functions, Appendix B describes how to use the U.S. Geological Survey Seismic Hazards Mapping Utility, and Appendix C explains the use of the PEER Web site, from which ground motion acceleration histories may be obtained.

User Comments

The author invites users to comment on any ambiguities or errors that are found in this guide. Suggestions for improvement or additions are welcomed and will be considered for future versions of the guide, especially the one to accompany the forthcoming ASCE/SEI 7-10.

Disclaimer

The interpretations of ASCE 7 requirements, as well as all other opinions presented in this guide, are those of the author and do not necessarily represent the views of the ASCE 7 Standards Committee or the American Society of Civil Engineers.