ASCE STANDARD

ASCE/SEI

7-16

Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

SEI
ASCE
STRUCTURAL
ENGINEERING
INSTITUTE

ASCE STANDARD

ASCE/SEI

7-16

Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

SEI
ASCE
STRUCTURAL
ENGINEERING
INSTITUTE

PUBLISHED BY THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Library of Congress Cataloging-in-Publication Data

Names: American Society of Civil Engineers.
Title: Minimum design loads and associated criteria for buildings and other structures.
Other titles: Minimum design loads for buildings and other structures. | ASCE standard, ASCE/SEI 7-16, minimum design loads and associated criteria for buildings and other structures
Description: Reston, Virginia : American Society of Civil Engineers, [2017] | Earlier versions of the standard have title: Minimum design loads for buildings and other structures. | "ASCE standard, ASCE/SEI 7-16." | Includes bibliographical references and index.
Identifiers: LCCN 2017018275| ISBN 9780784414248 (softcover : alk. paper) | ISBN 9780784479964 (PDF)
Subjects: LCSH: Structural engineering–Standards–United States. | Buildings–Standards–United States. | Strains and stresses. | Standards, Engineering–United States.
Classification: LCC TH851 .M56 2017 | DDC 624.102/1873–dc23 LC record available at https://lccn.loc.gov/2017018275

Published by American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia, 20191-4382
www.asce.org/bookstore | ascelibrary.org

This standard was developed by a consensus standards development process that has been accredited by the American National Standards Institute (ANSI). Accreditation by ANSI, a voluntary accreditation body representing public and private sector standards development organizations in the United States and abroad, signifies that the standards development process used by ASCE has met the ANSI requirements for openness, balance, consensus, and due process.

While ASCE's process is designed to promote standards that reflect a fair and reasoned consensus among all interested participants, while preserving the public health, safety, and welfare that is paramount to its mission, it has not made an independent assessment of and does not warrant the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed herein. ASCE does not intend, nor should anyone interpret, ASCE's standards to replace the sound judgment of a competent professional, having knowledge and experience in the appropriate field(s) of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the contents of this standard.

ASCE has no authority to enforce compliance with its standards and does not undertake to certify products for compliance or to render any professional services to any person or entity.

ASCE, its affiliates, officers, directors, employees, and volunteers disclaim any and all liability for any personal injury, property damage, financial loss, or other damages of any nature whatsoever, including without limitation any direct, indirect, special, exemplary, or consequential damages, resulting from any person's use of, or reliance on, this standard. Any individual who relies on this standard assumes full responsibility for such use.

ASCE and American Society of Civil Engineers—Registered in U.S. Patent and Trademark Office.

Photocopies and permissions. Permission to photocopy or reproduce material from ASCE publications can be requested by sending an e-mail to permissions@asce.org or by locating a title in ASCE's Civil Engineering Database (http://cedb.asce.org) or ASCE Library (http://ascelibrary.org) and using the "Permissions" link.

Errata: Errata, if any, can be found at https://doi.org/10.1061/9780784414248.

ISBN 978-0-7844-1424-8 (soft cover)
ISBN 978-0-7844-7996-4 (PDF)
Online platform: http://ASCE7.online
Manufactured in the United States of America.

24 23 22 21 20 19 18 17 1 2 3 4 5

ASCE STANDARDS

In 2014, the Board of Direction approved revisions to the ASCE Rules for Standards Committees to govern the writing and maintenance of standards developed by ASCE. All such standards are developed by a consensus standards process managed by the ASCE Codes and Standards Committee (CSC). The consensus process includes balloting by a balanced standards committee and reviewing during a public comment period. All standards are updated or reaffirmed by the same process every five to ten years. Requests for formal interpretations shall be processed in accordance with Section 7 of ASCE Rules for Standards Committees, which are available at www.asce.org. Errata, addenda, supplements, and interpretations, if any, for this standard can also be found at https://doi.org/10.1061/9780784414248.

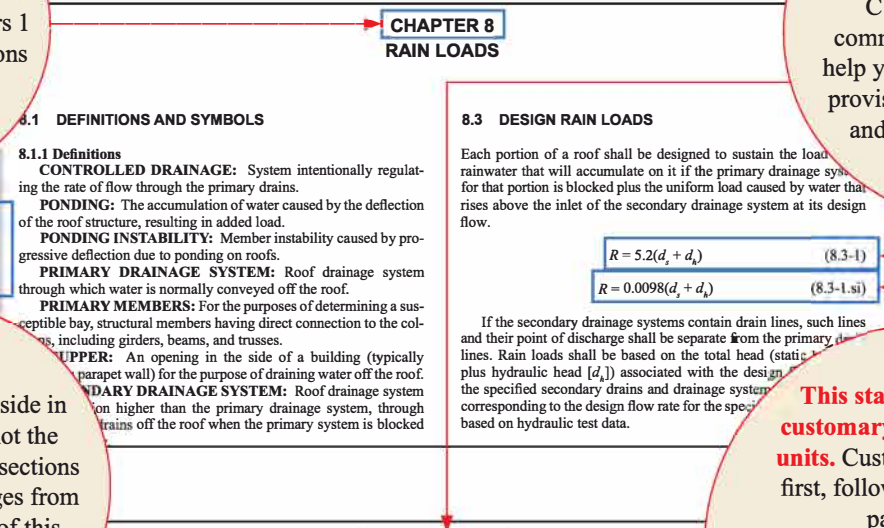
This standard has been prepared in accordance with recognized engineering principles and should not be used without the user's competent knowledge for a given application. The publication of this standard by ASCE is not intended to warrant that the information contained therein is suitable for any general or specific use, and ASCE takes no position respecting the validity of patent rights. The user is advised that the determination of patent rights or risk of infringement is entirely his or her own responsibility.

A complete list of current standards is available in the ASCE Library (http://ascelibrary.org/page/books/s-standards).

Tips for Using This Standard

The **standard provisions** are contained in chapters 1 to 31. Standard provisions are mandatory.

The **standard commentary** is contained in chapters C1 to C31. Standard commentary is intended to help you understand how the provisions were determined and how to apply them.



CHAPTER 8
RAIN LOADS

8.1 DEFINITIONS AND SYMBOLS

8.1.1 Definitions

CONTROLLED DRAINAGE: System intentionally regulating the rate of flow through the primary drains.

PONDING: The accumulation of water caused by the deflection of the roof structure, resulting in added load.

PONDING INSTABILITY: Member instability caused by progressive deflection due to ponding on roofs.

PRIMARY DRAINAGE SYSTEM: Roof drainage system through which water is normally conveyed off the roof.

PRIMARY MEMBERS: For the purposes of determining a susceptible bay, structural members having direct connection to the columns, including girders, beams, and trusses.

UPPER: An opening in the side of a building (typically parapet wall) for the purpose of draining water off the roof.

NDARY DRAINAGE SYSTEM: Roof drainage system on higher than the primary drainage system, through trains off the roof when the primary system is blocked

8.3 DESIGN RAIN LOADS

Each portion of a roof shall be designed to sustain the load rainwater that will accumulate on it if the primary drainage sys for that portion is blocked plus the uniform load caused by water that rises above the inlet of the secondary drainage system at its design flow.

$$R = 5.2(d_s + d_h) \quad (8.3\text{-}1)$$

$$R = 0.0098(d_s + d_h) \quad (8.3\text{-}1.si)$$

If the secondary drainage systems contain drain lines, such lines and their point of discharge shall be separate from the primary d lines. Rain loads shall be based on the total head (static plus hydraulic head [d_h]) associated with the design the specified secondary drains and drainage system corresponding to the design flow rate for the spec based on hydraulic test data.

Gray bars down the side in the provisions (but not the commentary) indicate sections with substantive changes from the previous edition of this standard, ASCE/SEI 7-10, Third Printing.

This standard uses both customary and metric (S.I.) units. Customary units appear first, followed by S.I. units in parentheses.
When numbered display equations have customary and S.I. versions, the one in customary units is numbered like this: (Eq. 8.3-1). The one in S.I. units is numbered like this: (Eq. 8.3-1.si).

CHAPTER C8
RAIN LOADS

C8.1 DEFINITIONS AND SYMBOLS

A = Tributary roof area, plus one-half of the wall area that diverts rainwater onto the roof, serviced by a single drain outlet in the secondary drainage system, in ft² (m²).

D = Drain bowl diameter for a primary roof drain, or overflow dam or standpipe diameter for a secondary roof drain, in in. (mm).

Design rainfall intensity, in/h (mm/h).

rate out of a single drainage system, in gal./min (m³/s).

h of level roof edge that allows for free overflow drainwater when the roof edge is acting as the secondary m, in ft (m).

NAGE

re not always designed to handle all the flow short-duration rainfall events. For example, ing Code (ICC 2012) uses a 1-h duration m period for the design of both the primary

The National Oceanic and Atmospheric Ad National Weather Service Precipitation Freque drometeorological Design Studies Center provid data in inches per hour for the 15-min duration/1 currence interval (http://hdsc. nws.noaa.gov/hdsc/pf Precipitation intensity (i in Eq. [C8.3 1]) is in the units o hour; if precipitation depth is provided, a conversion to inten required.

The following roof conditions adversely affect the critical duration, or increase the peak flow rate, and should be avoided or appropriately considered by the designer when determining the desi rain load:

1. Roofs with internal gutters that have limited s and quickly fill with rainwater. Gutters are for 2- to 5-min duration storms since thei much shorter than the critical duration scuppers or internal drains.
2. Architecturally complex roofs with in nificant gutter slopes. Significant gutt

Referenced consensus standards are listed at the end of each chapter of provisions, where they are listed by number with title, publisher, year of publication (and the sections that cite them). In text, they are mentioned only by number: ACI 318, ANSI/AISI S100, ASTM D1536.

Reference citations are listed at the end of each chapter of commentary, where they are listed by author and date with accompanying bibliographic information. In the text, these references are called out by author and date: ASHRAE (2000); Bachman and Dowty (2008); NEHRP (2009).

CONSENSUS STANDARDS AND OTHER REFERENCED DOCUMENTS

This section lists the consensus standards and other documents that shall be considered part of this standard to the extent referenced in this chapter.

ACI 318, *Building code requirements for structural concrete and commentary*. American Concrete Institute, 2014.

ANSI/AISI S100, *North American specification for the design of cold-formed steel structural members*. American Iron and Steel Institute, 2009.

ASTM D1536, *Method of test for color difference using the colormaster differential calorimeter*, 1964.

REFERENCES

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). (2000). *Practical guide to seismic restraint, RP-812*.ASHRAE, Atlanta, GA.

Bachman, R. E., and Dowty, S. M. (2008). "Nonstructural component or nonbuilding structure?" *Bldg. Safety J.* (April–May).

National Earthquake Hazards Reduction Program (NEHRP). (2009). NEHRP recommended provisions for seismic regulations for new buildings and other structures, NEHRP, Washington, DC.

Supplements, errata, and interpretations may become available in the future.
Please check for important new materials at https://doi.org/10.1061/9780784414248.

BRIEF CONTENTS

CONTENTS

COMMENTARY TO STANDARD ASCE/SEI 7-16

Commentary contents appear in second book

ACKNOWLEDGMENTS

The American Society of Civil Engineers (ASCE) acknowledges the work of the Minimum Design Loads on Buildings and Other Structures Standards Committee of the Codes and Standards Activities Division of the Structural Engineering Institute. This group comprises individuals from many backgrounds, including consulting engineering, research, construction industry, education, government, design, and private practice.

This revision of the standard began in 2011 and incorporates information as described in the commentary.

This standard was prepared through the consensus standards process by balloting in compliance with procedures of ASCE's Codes and Standards Activities Committee. The individuals who serve on the Standards Committee are listed as follows.

Minimum Design Loads on Buildings and Other Structures Standards Committee

Voting Members

Ronald O. Hamburger, P.E., S.E., SECB, F.SEI, *Chair*
J. Gregory Soules, P.E., S.E., P.Eng, SECB, F.SEI, F.ASCE, *Vice-Chair*
Donald O. Dusenberry, P.E., SECB, F.SEI, F.ASCE, *Past-Chair*
Iyad M. Alsamsam, Ph.D., P.E., S.E., M.ASCE
Robert E. Bachman, P.E., S.E., F.SEI, M.ASCE
David G. Brinker, P.E., S.E., M.ASCE
Ray A. Bucklin, Ph.D., P.E., M.ASCE
Charles J. Carter, Ph.D., S.E., P.E., M.ASCE
Gary Y. K. Chock, S.E., D.CE, F.SEI, Dist.M.ASCE
Ronald A. Cook, Ph.D., P.E., F.SEI, F.ASCE
Bradford K. Douglas, P.E., M.ASCE
John F. Duntemann, P.E., M.ASCE
Gary J. Ehrlich, P.E., M.ASCE
Bruce R. Ellingwood, Ph.D., P.E., NAE, F.SEI, Dist.M.ASCE
James M. Fisher, Ph.D., P.E., Dist.M.ASCE
Michael S. Fraser, P.E.
Satyendra K. Ghosh, Ph.D., F.SEI, F.ASCE
Ramon E. Gilsanz, P.E., S.E., F.SEI, F.ASCE
Lawrence G. Griffis, P.E., F.SEI, M.ASCE
Robert D. Hanson, Ph.D., P.E., F.ASCE
James R. Harris, P.E., Ph.D., F.SEI, F.ASCE, NAE
John D. Hooper, P.E., S.E., F.SEI, F.ASCE
Daniel G. Howell, P.E., M.ASCE
Edwin T. Huston, P.E., F.SEI, M.ASCE
Christopher P. Jones, P.E., M.ASCE
Mohammad R. Karim, P.E., S.E., M.ASCE
Jason J. Krohn, P.E., CAE, BSCP, F.SEI, F.ASCE
Marc L. Levitan, A.M.ASCE
Bonnie E. Manley, P.E., F.SEI, M.ASCE
Therese P. McAllister, P.E., F.SEI, M.ASCE
Michael J. O'Rourke, Ph.D., P.E., F.SEI, M.ASCE
Frank K.H. Park, P.E.
Robert B. Paullus Jr., P.E., S.E., F.SEI, M.ASCE (*deceased*)
Alan B. Peabody, P.E., M.ASCE
Robert G. Pekelnicky, P.E., S.E., M.ASCE
Timothy A. Reinhold, P.E., M.ASCE
Scott A. Russell, P.E., M.ASCE
Donald R. Scott, P.E., S.E., F.SEI, F.ASCE
William N. Scott, P.E., S.E., SECB, M.ASCE
Matthew R. Senecal, P.E., M.ASCE
William L. Shoemaker, Ph.D., P.E., F.SEI, F.ASCE
Jonathan C. Siu, P.E., S.E., M.ASCE
Thomas D. Skaggs, P.E.
Harold O. Sprague, Jr., P.E., F.ASCE
John G. Tawresey, P.E., F.SEI, F.ASCE
Harry B. Thomas, P.E., F.SEI, M.ASCE
Brian E. Trimble, P.E., M.ASCE

Emeritus Members

James R. Cagley, P.E., M.ASCE
Theodore V. Galambos, Ph.D., P.E., NAE, F.EWRI, F.SEI, Dist.M.ASCE
Neil M. Hawkins, Ph.D., F.SEI, Dist.M.ASCE
James A. Rossberg, F.SEI, M.ASCE

Associate Members

Farid Alfawakhiri, Ph.D., P.E., M.ASCE
Leonel I. Almanzar, Ph.D., P.E., F.SEI, F.ASCE
Richard M. Bennett, Ph.D., P.E., M.ASCE
Russell A. Berkowitz
Craig W. Bursch, P.E., M.ASCE
Alexander Bykovtsev, Ph.D., P.E.
Damayanti Chaudhuri, P.E., M.ASCE
Robert N Chittenden, P.E., F.ASCE
William L. Coulbourne, P.E., M.ASCE
Jay H. Crandell, P.E., M.ASCE
Mukti L. Das, Ph.D., P.E., F.ASCE
Richard M. Drake, P.E., S.E., M.ASCE
Mohammed M. Ettouney, Ph.D., P.E., D.Sc, F.AEI, Dist.M.ASCE
David A. Fanella, Ph.D., P.E., F.ASCE
Lawrence Fisher, P.E., M.ASCE (*deceased*)
Donna L.R. Friis, P.E., F.SEI, F.ASCE
Amir S.J. Gilani, P.E., S.E., M.ASCE
Jennifer L. Goupil, P.E., F.SEI, M.ASCE, *Secretary*
John O. Grieshaber, P.E., S.E., F.SEI, F.ASCE
Wael M. Hassan, P.E., S.E., M.ASCE
Todd R. Hawkinson, P.E., M.ASCE
Mark A. Hershberg, P.E., S.E., M.ASCE
Xiapin Hua, P.E., S.E., M.ASCE
Y. Henry Huang, P.E., M.ASCE
Tony Ingratta
Mohammad Iqbal, Esq., Ph.D., P.E., S.E., F.ASCE
Omar A. Jaradat, Ph.D., P.E., D.P.E., M.ASCE
Hongping Jiang, P.E., M.ASCE
Richart Kahler, P.E., M.ASCE
Charles W. Kilper, P.E., M.ASCE
Charles A. Kircher, Ph.D., P.E., M.ASCE
Raymond W. Kovachik, P.E., M.ASCE
James S.J. Lai, P.E., F.ASCE
Eric J. Letvin, P.E., M.ASCE, *Liaison Member*
Scott A. Lockyear, A.M.ASCE
John V. Loscheider, P.E., M.ASCE
Mustafa A. Mahamid, Ph.D., P.E., S.E., F.SEI, F.ASCE
Sanjeev R. Malushte, Ph.D., P.E., S.E., F.ASCE
Lance Manuel, Ph.D., P.E., F.SEI, F.ASCE
Jorge F. Meneses, Ph.D., P.E., G.E., D.GE, F.ASCE