



Rain Loads

*Guide to the Rain Load Provisions
of ASCE 7-16*

Michael O'Rourke, Ph.D., P.E.
Aaron Lewis, P.E.

ASCE
PRESS

This is a preview. [Click here to purchase the full publication.](#)

Rain Loads

Other Titles of Interest

ASCE 7 Hazard Tool

Delivers a quick, efficient way to look up key design parameters specified by the standards ASCE/SEI 7-10 and 7-16 through a web-based application that retrieves load data for each of seven hazards, visualizes them on a map, and generates a unified report of results. (ASCE 2016) (<http://ascetools.online>)

Minimum Design Loads and Associated Criteria for Buildings and Other Structures, ASCE/SEI 7-16

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. (ASCE 2016) (ISBN 978-0-7844-1424-8)

Significant Changes to the Minimum Design Load Provisions of ASCE 7-16

BY GARY CHOCK, P.E., D.CE., S. K. GHOSH, PH.D., MICHAEL O'ROURKE, PH.D., P.E., AND T. ERIC STAFFORD, P.E.

Describes the revisions to the minimum design load requirements set forth in the standard ASCE/SEI 7-16. (ASCE Press 2018) (ISBN 978-0-7844-1457-6)

Wind Loads: Guide to the Wind Load Provisions of ASCE 7-16

BY WILLIAM L. COULBOURNE, P.E., AND T. ERIC STAFFORD, P.E.

Sets forth a detailed and authoritative interpretation of the wind load provisions of the standard ASCE/SEI 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. (ASCE Press 2020) (ISBN 978-0-7844-1526-9)

Snow Loads: Guide to the Snow Load Provisions of ASCE 7-16

BY MICHAEL O'ROURKE, PH.D., P.E.

Supplies a detailed, authoritative explanation of the snow load provisions contained in the standard *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, ASCE/SEI 7-16. (ASCE Press 2017) (ISBN 978-0-7844-1456-9)

Seismic Loads: Guide to the Seismic Load Provisions of ASCE 7-16

BY FINLEY A. CHARNEY, PH.D., P.E., THOMAS F. HEAUSLER, P.E., S.E., AND JUSTIN D. MARSHALL, PH.D., P.E.

Provides clear, authoritative explanations of the seismic design provisions contained in the standard *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, ASCE/SEI 7-16. (ASCE Press 2020) (ISBN 978-0-7844-1550-4)

Rain Loads

Guide to the Rain Load Provisions of ASCE 7-16

Michael O'Rourke, Ph.D., P.E.
Aaron R. Lewis, P.E.



This is a preview. [Click here to purchase the full publication.](#)

LCCN 2019055358

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

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process, or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document. ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefor. The information contained in these materials should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing such information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

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

Photocopies and permissions. Permission to photocopy or reproduce material from ASCE publications can be requested by sending an email to permissions@asce.org or by locating a title in the ASCE Library (<https://ascelibrary.org>) and using the “Permissions” link.

Errata: Errata, if any, can be found at <https://doi.org/10.1061/978078441553>.

Copyright © 2020 by the American Society of Civil Engineers.
All Rights Reserved.
ISBN 978-0-7844-4155-3 (print)
ISBN 978-0-7844-8276-6 (PDF)
ISBN 978-0-7844-8277-3 (ePub)
Manufactured in the United States of America.

26 25 24 23 22 21 20 1 2 3 4 5

Contents

Preface *ix*

Acknowledgments *ix*

Unit Conversions *xi*

Chapter 1 Introduction 1

- 1.1 Unique Aspects 2
- 1.2 Rain Load Losses 3
- 1.3 This Guide 4

Chapter 2 Rain Load Hazard 5

- Example 2-1. Rain Load Hazard: Table 13
- Example 2-2. Rain Load Hazard: Website 14
- Example 2-3. Rain Load Hazard: Pacific Northwest 14
- Example 2-4. Time to Overflow: Table 15
- Example 2-5. Time to Overflow: Equation 15
- Example 2-6. Time to Overflow: Derivation 15

Chapter 3 Drainage Area 17

- 3.1 Low-Sloped Roof Drainage Areas 18
- 3.2 Flat (Zero-Slope) Roof Drainage Areas 24
- 3.3 Complicating Factors 25
- 3.4 Steep Roofs 30
- Example 3-1. Determine Drainage Areas for Inverted Pyramid Roof 30
- Example 3-2. Determine Height of Crickets between Roof Areas for Dual Pitched Roof 31
- Example 3-3. Drainage Area for Flat Roof 33
- Example 3-4. Drainage Area for Roof with Rising Walls 33

Chapter 4	Head Discharge Capacity of Outlets	35
4.1	Types of Outlets	37
4.2	Clogged Primary Drainage System	40
4.3	Capacity of Secondary Drain Outlets	43
4.4	Geometry-Based Adjustment	49
4.5	Capacity of Scupper Outlets	50
4.6	Free Discharge Off Roof Edge	55
4.7	Outlets in Cold Regions	56
	Example 4-1. Determine Static Head Load and Ballast Load with and without Ballast for Same Depth of Water	57
	Example 4-2. Hydraulic Head from Table	58
	Example 4-3. Hydraulic Head with Weir Adjustment	58
	Example 4-4. Hydraulic Head with Orifice Adjustment	59
	Example 4-5. Hydraulic Head Load for Closed Scupper	59
	Example 4-6. Hydraulic Head Load for Open-Top Rectangular Scupper	60
	Example 4-7. Hydraulic Head Load for Circular Scuppers	61
	Example 4-8. Hydraulic Head for Grated “Scupper Drain”	61
	Example 4-9. Determine Length of Free Drainage Edge Required	62
Chapter 5	Estimation of Rain Load	65
5.1	Equilibrium Approach	66
5.2	Additional Consideration: $t_e > 15$ min	69
5.3	Additional Consideration: $t_e < 15$ min	73
	Example 5-1. Inflow Rate Table	77
	Example 5-2. Inflow Rate Equation	78
	Example 5-3. Static Head	78
	Example 5-4. Hydraulic Head: Dam	78
	Example 5-5. Hydraulic Head: Standpipe	78
	Example 5-6. Rain Load	79
	Example 5-7. Rain Load: V-Shaped Drainage Area	79
	Example 5-8. Maximum Accumulation: Single-Slope Drainage Area	80
	Example 5-9. Maximum Accumulation: V-Shaped Drainage Area	80
	Example 5-10. Maximum Accumulation: Inverted Pyramid Drainage Area	81
	Example 5-11. Maximum Accumulation: Flat Drainage Area	81
	Example 5-12. Time to Overflow	82

Chapter 6 Ponding 83

6.1 Slope to Free Drainage 84

6.2 Internally Drained Flat Roofs 87

Example 6-1. Minimum Roof Slope Table 90

Example 6-2. Minimum Roof Slope Equation 90

Example 6-3. Minimum Purlin Spacing 91

Example 6-4. AISC Ponding Check 91

Example 6-5. Denavit and Fisher Ponding Check 92

Example 6-6. Ponding Bending Moment 92

References 95

Index 97

About the Authors 101

This page intentionally left blank

Preface

This guide provides practicing structural engineers with a detailed description of the rain load provisions of Standard ASCE/SEI 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, published by ASCE. The intent of this guide is to describe the key parameters that underpin the provision and to illustrate the application of the provisions through numerous examples. Readers and users of this guide will know how to use the provisions as well as the concepts behind them. In this fashion, users may be able to address nonroutine rain loading issues that are not explicitly covered in ASCE 7-16.

Every effort has been made to make the illustrative example problems in this guide correct and accurate. The authors welcome comments regarding inaccuracies, errors, or different interpretations. The views expressed and the interpretation of the rain load provisions made in this guide are those of the authors and not of the ASCE Standards Committee or the ASCE organization.

Acknowledgments

The authors would like to acknowledge the past and present members of the Snow and Rain Loads Subcommittee of ASCE 7. Without their comments, questions, and discussions, the development of Chapter 8 in ASCE 7-16, and subsequently this guide, would not have been possible.

As with any document of this type, many individuals have contributed their hard work and effort. The authors acknowledge the work and effort extended by the administrative staff of the Department of Civil and Environmental Engineering at Rensselaer Polytechnic Institute, who assisted in the word processing and preparation of this narrative. The authors would also like to acknowledge the review work of Sean Homem of SGH. Finally, the authors would like to acknowledge Anthony Longabard and Jen-uwe Thalheim of FM Global for providing detailed information on rain load losses.