ASCE STANDARD

ASCE/SEI

7-16

Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

SEI STRUCTURAL ENGINEERING INSTITUTE

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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 col…ns, 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 …ion higher than the primary drainage system, through …rains 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.

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

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

If the secondary drainage systems contain drain lines, such lines and their point of discharge shall be separate from the primary dr… 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 speci… 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 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).

…th of level roof edge that allows for free overflow drain… water when the roof edge is acting as the secondary … em, in ft (m).

…NAGE

…re not always designed to … the flow … short-duration rainfa… For example, …ing Code (ICC 2012) … a 1-h duration …rn 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… current … http://hdsc. nws.noaa.gov/hdsc/pfd… Precipitation intensity (i in Eq. [C8.3 1]) is in the units o… hour precipitation depth is provided, a conversion to inten… require…

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 design rain load:

1. Roofs with internal gutters that have limited s… and quickly fill with rainwater. Gutters are t… for 2- to 5-min duration storms since their … much shorter than the critical duration f… 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.

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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

COMMENTARY TO STANDARD ASCE/SEI 7-16

CONTENTS

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Commentary contents appear in second book

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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.

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IN MEMORIAM

Robert B. Paullus Jr., P.E., S.E., F.SEI, F.ASCE

1959–2015

Mr. Paullus served on the ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures Standard Committee for several cycles. During the 2017 cycle, he served on the Main Committee, the Subcommittee on Seismic Loads, and the Subcommittee on Wind Loads. Mr. Paullus was a tireless advocate for improvement of seismic design practices and requirements in Tennessee and surrounding regions at risk from severe shaking from the New Madrid fault zone.

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CHAPTER 1
GENERAL

1.1 SCOPE

This standard provides minimum loads, hazard levels, associated criteria, and intended performance goals for buildings, other structures, and their nonstructural components that are subject to building code requirements. The loads, load combinations, and associated criteria provided herein are to be used with design strengths or allowable stress limits contained in design specifications for conventional structural materials. Used together, they are deemed capable of providing the intended performance levels for which the provisions of this standard have been developed. Procedures for applying alternative means to demonstrate acceptable performance are also described.

1.2 DEFINITIONS AND SYMBOLS

1.2.1 Definitions. The following definitions apply to the provisions of the entire standard.

ALLOWABLE STRESS DESIGN: A method of proportioning structural members such that elastically computed stresses produced in the members by nominal loads do not exceed specified allowable stresses (also called "working stress design").

AUTHORITY HAVING JURISDICTION: The organization, political subdivision, office, or individual charged with the responsibility of administering and enforcing the provisions of this standard.

BUILDINGS: Structures, usually enclosed by walls and a roof, constructed to provide support or shelter for an intended occupancy.

DESIGN STRENGTH: The product of the nominal strength and a resistance factor.

DESIGNATED NONSTRUCTURAL SYSTEM: A nonstructural component or system that is essential to the intended function of a Risk Category IV structure or that is essential to Life Safety in structures assigned to other Risk Categories.

ESSENTIAL FACILITIES: Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow, or earthquakes.

FACTORED LOAD: The product of the nominal load and a load factor.

HIGHLY TOXIC SUBSTANCE: As defined in 29 CFR 1910.1200, Appendix A, with Amendments as of February 1, 2000.

IMPORTANCE FACTOR: A factor that accounts for the degree of risk to human life, health, and welfare associated with damage to property or loss of use or functionality.

LIMIT STATE: A condition beyond which a structure or member becomes unfit for service and is judged either to be no longer useful for its intended function (serviceability limit state) or to be unsafe (strength limit state).

LOAD EFFECTS: Forces and deformations produced in structural members by the applied loads.

LOAD FACTOR: A factor that accounts for deviations of the actual load from the nominal load, for uncertainties in the analysis that transform the load into a load effect, and for the probability that more than one extreme load will occur simultaneously.

LOADS: Forces or other actions that result from the weight of all building materials, occupants and their possessions, environmental effects, differential movement, and restrained dimensional changes. Permanent loads are loads in which variations over time are rare or of small magnitude. All other loads are variable loads (see also "nominal loads").

NOMINAL LOADS: The magnitudes of the loads specified in this standard for dead, live, soil, wind, snow, rain, flood, and earthquake loads.

NOMINAL STRENGTH: The capacity of a structure or member to resist the effects of loads, as determined by computations using specified material strengths and dimensions and formulas derived from accepted principles of structural mechanics or by field tests or laboratory tests of scaled models, allowing for modeling effects and differences between laboratory and field conditions.

OCCUPANCY: The purpose for which a building or other structure, or part thereof, is used or intended to be used.

OTHER STRUCTURES: Structures, other than buildings, for which loads are specified in this standard.

P-DELTA EFFECT: The second-order effect on shears and moments of frame members induced by axial loads on a laterally displaced building frame.

PERFORMANCE-BASED PROCEDURES: An alternative to the prescriptive procedures in this standard characterized by project-specific engineering analysis, optionally supplemented by limited testing, to determine the computed reliability of an individual building or structure.

RESISTANCE FACTOR: A factor that accounts for deviations of the actual strength from the nominal strength and the manner and consequences of failure (also called "strength reduction factor").

RISK CATEGORY: A categorization of buildings and other structures for determination of flood, snow, ice, and earthquake loads based on the risk associated with unacceptable performance. See Table 1.5-1.

SERVICE LOADS: Loads imparted on a building or other structure because of (1) self-weight and superimposed dead load, (2) live loads assumed to be present during normal occupancy or use of the building or other structure, (3) environmental loads that are expected to occur during the defined service life of a building or other structure, and (4) self-straining forces and effects. Service live loads and environmental loads for a