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ASCE 7-98

# ASCE STANDARD

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American Society of Civil Engineers

# Minimum Design Loads for Buildings and Other Structures

Special Edition containing provisions  
referenced in the International Building Code

Revision of ANSI/ASCE 7-95



#### ABSTRACT

ASCE standard, *Minimum Design Loads for Buildings and Other Structures* (ASCE 7-98), gives requirements for dead, live, soil, flood, wind, snow, rain, ice, and earthquake loads, and their combinations, that are suitable for inclusion in building codes and other documents. ASCE 7-98 is a revision of ASCE 7-95. Substantial changes were made to the wind, snow, earthquake, and ice provisions. In addition, substantial new material was added regarding the determination of flood loads. The structural loading requirements provided by this standard are intended for use by architects, structural engineers, and those engaged in preparing and administering local building codes.

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## STANDARDS

In April 1980, the Board of Direction approved ASCE Rules for Standards Committees to govern the writing and maintenance of standards developed by the Society. All such standards are developed by a consensus standards process managed by the Codes and Standards Activities Committee. The consensus process includes balloting by the balanced standards committee, which is composed of Society members and nonmembers, balloting by the membership of ASCE as a whole, and balloting by the public. All standards are updated or reaffirmed by the same process at intervals not exceeding 5 years

The following standards have been issued.

- ANSI/ASCE 1-82 N-725 *Guideline for Design and Analysis of Nuclear Safety Related Earth Structures*
- ANSI/ASCE 2-91 *Measurement of Oxygen Transfer in Clean Water*
- ANSI/ASCE 3-91 *Specifications for the Design and Construction of Composite Slabs and Commentary on Specifications for the Design and Construction of Composite Slabs*
- ANSI/ASCE 4-86 *Seismic Analysis of Safety-Related Nuclear Structures*
- Building Code Requirements for Masonry Structures (ACI 530-95/ASCE 5-95/TMS402-95)*
- Specifications for Masonry Structures (ACI 530.1-95/ASCE 6-95/TMS602-95)*
- ANSI/ASCE 7-95 *Minimum Design Loads for Buildings and Other Structures*
- ASCE 7-98 *Minimum Design Loads for Buildings and Other Structures*
- ANSI/ASCE 8-90 *Specification for the Design of Cold-Formed Stainless Steel Structural Members*
- ANSI/ASCE 10-90 *Design of Latticed Steel Transmission Structures*
- ANSI/ASCE 11-90 *Guideline for Structural Condition Assessment of Existing Buildings*
- ANSI/ASCE 12-91 *Guideline for the Design of Urban Subsurface Drainage*
- ASCE 13-93 *Standard Guidelines for Installation of Urban Subsurface Drainage*
- ASCE 14-93 *Standard Guidelines for Operation and Maintenance of Urban Subsurface Drainage*
- ASCE 15-93 *Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SiDD)*
- ASCE 16-95 *Standard for Load and Resistance Factor Design (LRFD) of Engineered Wood Construction*
- ASCE 17-96 *Air Supported Structures*
- ASCE 18-96 *Standard Guidelines for In-Process Oxygen Transfer Testing*
- ASCE 19-96 *Structural Applications of Steel Cables for Buildings*
- ASCE 20-96 *Standard Guidelines for the Design and Installation of Pile Foundations*
- ASCE 21-96 *Automated People Mover Standards - Part I*
- ASCE 22-97 *Independent Project Peer Review*
- ASCE 23-97 *Specification for Structural Steel Beams with Web Openings*
- ASCE 24-98 *Flood Resistant Design and Construction*
- ASCE 25-97 *Earthquake Actuated Gas Shut-off Devices*

## FOREWORD

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# American Society of Civil Engineers Standard

## Minimum Design Loads for Buildings and Other Structures

### 1. General

**1.1 Scope.** This standard provides minimum load requirements for the design of buildings and other structures that are subject to building code requirements. Loads and appropriate load combinations, which have been developed to be used together, are set forth for strength design and allowable stress design. For design strengths and allowable stress limits, design specifications for conventional structural materials used in buildings and modifications contained in this standard shall be followed.

**1.2 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.

**Essential facilities:** buildings and other structures that are intended to remain operational in the event of extreme environmental loading from wind, snow or earthquakes.

**Factored load:** the product of the nominal load and a load factor.

**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 transforms 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 those 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 Sections 3 through 9 (dead, live, soil, wind, snow, rain, flood and earthquake) of this standard

**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

**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)

**Strength design:** a method of proportioning structural members such that the computed forces produced in the members by the factored loads do not exceed the member design strength (also called load and resistance factor design)

**Temporary facilities:** buildings or other structures that are to be in service for a limited time and have a limited exposure period for environmental loadings.

### 1.3 Basic Requirements

**1.3.1 Strength.** Buildings and other structures, and all parts thereof, shall be designed and constructed to support safely the factored loads in load combinations defined in this document without exceeding the appropriate strength limit states for the materials of construction. Alternatively,

buildings and other structures, and all parts thereof, shall be designed and constructed to support safely the nominal loads in load combinations defined in this document without exceeding the appropriate specified allowable stresses for the materials of construction.

**1.3.2 Serviceability.** Structural systems and members thereof shall be designed to have adequate stiffness to limit deflections, lateral drift, vibration, or any other deformations that adversely affect the intended use and performance of buildings and other structures.

**1.3.3 Self-Straining Forces.** Provision shall be made for anticipated self-straining forces arising from differential settlements of foundations and from restrained dimensional changes due to temperature, moisture, shrinkage, creep, and similar effects.

**1.3.4 Analysis.** Load effects on individual structural members shall be determined by methods of structural analysis that take into account equilibrium, general stability, geometric compatibility, and both short- and long-term material properties. Members that tend to accumulate residual deformations under repeated service loads shall have included in their analysis the added eccentricities expected to occur during their service life.

**1.3.5 Counteracting Structural Actions.** All structural members and systems, and all components and cladding in a building or other structure, shall be designed to resist forces due to earthquake and wind, with consideration of overturning, sliding, and uplift, and continuous load paths shall be provided for transmitting these forces to the foundation. Where sliding is used to isolate the elements, the effects of friction between sliding elements shall be included as a force. Where all or a portion of the resistance to these forces is provided by dead load, the dead load shall be taken as the minimum dead load likely to be in place during the event causing the considered forces. Consideration shall be given to the effects of vertical and horizontal deflections resulting from such forces.

**1.4 General Structural Integrity.** Buildings and other structures shall be designed to sustain local damage with the structural system as a whole remaining stable and not being damaged to an extent disproportionate to the original local damage. This shall be achieved through an arrangement of the structural elements that provides stability to the entire structural system by transferring loads from any locally damaged region to adjacent regions capable of resisting those loads without collapse. This shall be accomplished by providing sufficient continuity, redundancy, or energy-dissipating capacity (ductility), or a combination thereof, in the members of the structure.

**1.5 Classification of Buildings and Other Structures.** Buildings and other structures shall be classified, based on

the nature of occupancy according to Table 1-1 for the purposes of applying flood, wind, snow, and earthquake provisions. The categories range from I to IV, where Category I represents buildings and other structures with a low hazard to human life in the event of failure and Category IV represents essential facilities. Each building or other structure shall be assigned to the highest applicable category or categories. Assignment of the same structure to multiple categories, based on use and the type of load condition being evaluated (e.g., wind, seismic, etc.), shall be permissible.

When buildings or other structures have multiple uses (occupancies), the relationship between the uses of various parts of the building or other structure and the independence of the structural systems for those various parts shall be examined. The classification for each independent structural system of a multiple use building or other structure shall be that of the highest usage group in any part of the building or other structure which is dependent on that basic structural system.

**1.6 Additions and Alterations to Existing Structures.** When an existing building or other structure is enlarged or otherwise altered, structural members affected shall be strengthened if necessary so that the factored loads defined in this document will be supported without exceeding the specified design strength for the materials of construction. When using allowable stress design, strengthening is required when the stresses due to nominal loads exceed the specified allowable stresses for the materials of construction.

**1.7 Load Tests.** A load test of any construction shall be conducted when required by the authority having jurisdiction whenever there is reason to question its safety for the intended occupancy or use.

**Table 1-1**  
**Classification of Buildings and Other Structures for Flood, Wind, Snow, and Earthquake Loads**

Nature of Occupancy	Category
Buildings and other structures that represent a low hazard to human life in the event of failure including, but not limited to <ul style="list-style-type: none"> <li>• Agricultural facilities</li> <li>• Certain temporary facilities</li> <li>• Minor storage facilities</li> </ul>	I
All buildings and other structures except those listed in Categories I, III and IV	II
Buildings and other structures that represent a substantial hazard to human life in the event of failure including, but not limited to. <ul style="list-style-type: none"> <li>• Buildings and other structures where more than 300 people congregate in one area</li> <li>• Buildings and other structures with elementary school, secondary school or day-care facilities with capacity greater than 150</li> <li>• Buildings and other structures with a capacity greater than 500 for colleges or adult education facilities</li> <li>• Health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities</li> <li>• Jails and detention facilities</li> <li>• Power generating stations and other public utility facilities not included in Category IV</li> </ul>	III
Buildings and other structures containing sufficient quantities of toxic, explosive or other hazardous substances to be dangerous to the public if released including but not limited to <ul style="list-style-type: none"> <li>• Petrochemical facilities</li> <li>• Fuel storage facilities</li> <li>• Manufacturing or storage facilities for hazardous chemicals</li> <li>• Manufacturing or storage facilities for explosives</li> </ul>	
Buildings and other structures that are equipped with secondary containment of toxic, explosive or other hazardous substances (including, but not limited to double wall tank, dike of sufficient size to contain a spill, or other means to contain a spill or a blast within the property boundary of the facility and prevent release of harmful quantities of contaminants to the air, soil, ground water, or surface water) or atmosphere (where appropriate) shall be eligible for classification as a Category II structure	
In hurricane prone regions, buildings and other structures that contain toxic, explosive, or other hazardous substances and do not qualify as Category IV structures shall be eligible for classification as Category II structures for wind loads if these structures are operated in accordance with mandatory procedures that are acceptable to the authority having jurisdiction and which effectively diminish the effects of wind on critical structural elements or which alternatively protect against harmful releases during and after hurricanes.	
Buildings and other structures designated as essential facilities including, but not limited to <ul style="list-style-type: none"> <li>• Hospitals and other health care facilities having surgery or emergency treatment facilities</li> <li>• Fire, rescue and police stations and emergency vehicle garages</li> <li>• Designated earthquake, hurricane, or other emergency shelters</li> <li>• Communications centers and other facilities required for emergency response</li> <li>• Power generating stations and other public utility facilities required in an emergency</li> <li>• Ancillary structures (including, but not limited to communication towers, fuel storage tanks, cooling towers, electrical substation structures, fire water storage tanks or other structures housing or supporting water or other fire-suppression material or equipment) required for operation of Category IV structures during an emergency</li> <li>• Aviation control towers, air traffic control centers and emergency aircraft hangers</li> <li>• Water storage facilities and pump structures required to maintain water pressure for fire suppression</li> <li>• Buildings and other structures having critical national defense functions</li> </ul>	IV