

Chapter 1

GENERAL PROVISIONS

1.1 GENERAL

1.1.1 Purpose. The *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* (referred to hereinafter as the *Provisions*) present criteria for the design and construction of structures to resist earthquake ground motions. The purposes of these *Provisions* are as follows:

1. To provide minimum design criteria for structures appropriate to their primary function and use considering the need to protect the health, safety, and welfare of the general public by minimizing the earthquake-related risk to life and
2. To improve the capability of essential facilities and structures containing substantial quantities of hazardous materials to function during and after design earthquakes.

The design earthquake ground motion levels specified herein could result in both structural and nonstructural damage. For most structures designed and constructed according to these *Provisions*, structural damage from the design earthquake ground motion would be repairable although perhaps not economically so. For essential facilities, it is expected that the damage from the design earthquake ground motion would not be so severe as to preclude continued occupancy and function of the facility. The actual ability to accomplish these goals depends upon a number of factors including the structural framing type, configuration, materials, and as-built details of construction. For ground motions larger than the design levels, the intent of these *Provisions* is that there be a low likelihood of structural collapse.

1.1.2 Scope and application

1.1.2.1 Scope. These *Provisions* shall apply to the design and construction of structures—including additions, changes of use, and alterations—to resist the effects of earthquake motions. Every structure, and portion thereof, shall be designed and constructed to resist the effects of earthquake motions as prescribed by these *Provisions*.

Exceptions:

1. Detached one- and two-family dwellings in Seismic Design Category A, B, or C (as defined in Sec. 1.4) are exempt from all requirements of these *Provisions*.
2. Detached one- and two-family wood-frame dwellings that are designed and constructed in accordance with the conventional light-frame construction requirements in Sec. 12.5 are exempt from all other requirements of these *Provisions*.
3. Agricultural storage structures intended only for incidental human occupancy are exempt from all requirements of these *Provisions*.
4. Structures located within those regions of Figures 3.3-1 through 3.3-14 of these *Provisions* having S_S less than or equal to 0.15 and S_I less than or equal to 0.04 and structures assigned to Seismic Design Category A shall only be required to comply with Sec. 1.5 of these *Provisions*.

1.1.2.2 Additions. Additions shall be designed and constructed in accordance with the following:

1.1.2.2.1. An addition that is structurally independent from an existing structure shall be designed and constructed as required for a new structure in accordance with Sec. 1.1.2.1.

1.1.2.2.2. An addition that is not structurally independent from an existing structure shall be designed and constructed such that the entire structure complies with the seismic-force-resistance requirements for new structures unless all of the following conditions are satisfied:

1. The addition complies with the requirements for new structures, and
2. The addition does not increase the seismic forces in any structural element of the existing structure by more than 5 percent, unless the capacity of the element subject to the increased forces is still in compliance with these *Provisions*, and
3. The addition does not decrease the seismic resistance of any structural element of the existing structure to less than that required for a new structure.

1.1.2.3 Change of use. Where a change of use results in a structure being reclassified to a higher Seismic Use Group, the structure shall comply with the requirements of Section 1.1.2.1 for a new structure.

Exception: Where a change of use results in a structure being reclassified from Seismic Use Group I to Seismic Use Group II, compliance with these *Provisions* is not required if the structure is located where S_{DS} is less than 0.3.

1.1.2.4 Alterations. Alterations are permitted to be made to any structure without requiring the structure to comply with these *Provisions* provided the alterations comply with the requirements for a new structure. Alterations that increase the seismic force in any existing structural element by more than 5 percent or decrease the design strength of any existing structural element to resist seismic forces by more than 5 percent shall not be permitted unless the entire seismic-force-resisting system is determined to comply with these *Provisions* for a new structure. All alterations shall comply with these *Provisions* for a new structure.

Exception: Alterations to existing structural elements or additions of new structural elements that are not required by these *Provisions* and are initiated for the purpose of increasing the strength or stiffness of the seismic-force-resisting system of an existing structure need not be designed for forces in accordance with these *Provisions* provided that an engineering analysis is submitted indicating the following:

1. The design strengths of existing structural elements required to resist seismic forces is not reduced,
2. The seismic force to required existing structural elements is not increased beyond their design strength,
3. New structural elements are detailed and connected to the existing structural elements as required by these *Provisions*, and
4. New or relocated nonstructural elements are detailed and connected to existing or new structural elements as required by these *Provisions*.

1.1.2.5 Alternate materials and alternate means and methods of construction. Alternate materials and alternate means and methods of construction to those prescribed in these *Provisions* are permitted if approved by the authority having jurisdiction. Substantiating evidence shall be submitted demonstrating that the proposed alternate, for the purpose intended, will be at least equal in strength, durability, and seismic resistance.

1.1.3 References. The following reference document shall be used for loads other than earthquakes and for combinations of loads as indicated in this chapter:

ASCE 7 *Minimum Design Loads for Buildings and Other Structures*, American Society of Civil Engineers, 1998.

1.1.4 Definitions

Addition: An increase in the building area, aggregate floor area, height, or number of stories of a structure.

Alteration: Any construction or renovation to an existing structure other than an addition.

Component: A part or element of an architectural, electrical, mechanical, or structural system.

Dead load: See Sec. 4.1.3.

Design earthquake ground motion: The earthquake effects that structures are specifically proportioned to resist as defined in Chapter 3.

Essential facility: A facility or structure required for post-earthquake recovery.

Hazardous material: A material that is highly toxic or potentially explosive and in sufficient quantity to pose a significant life-safety threat to the general public if an uncontrolled release were to occur.

Live load: See Sec. 4.1.3.

Occupancy importance factor: A factor assigned to each structure according to its Seismic Use Group as prescribed in Sec. 1.3.

Owner: Any person, agent, firm, or corporation having a legal or equitable interest in the property.

Seismic Design Category: A classification assigned to a structure based on its Seismic Use Group and the severity of the design earthquake ground motion at the site.

Seismic-force-resisting system: That part of the structural system that has been considered in the design to provide the required resistance to the shear prescribed herein.

Seismic forces: The assumed forces prescribed herein, related to the response of the structure to earthquake motions, to be used in the design of the structure and its components.

Seismic Use Group: A classification assigned to the structure based on its use as defined in Sec. 1.2.

Structure: That which is built or constructed.

1.1.5 Notation

F_x The design lateral force applied at level x .

I The occupancy importance factor as defined in Sec. 1.3.

S_I See Sec. 3.1.4.

S_{DI} See Sec. 3.1.4.

S_{DS} See Sec. 3.1.4.

S_S See Sec. 3.1.4.

T See Sec. 4.1.4.

W The seismic weight, including the total dead load and applicable portions of other loads as required by these *Provisions*.

w_x The portion of the seismic weight, W , located or assigned to Level x .

Level x The level under consideration; $x = 1$ designates the first level above the base.

1.2 SEISMIC USE GROUPS

All structures shall be assigned to one of the following Seismic Use Groups:

1.2.1 Seismic Use Group III. Seismic Use Group III structures are those having essential facilities that are required for post-earthquake recovery and those containing substantial quantities of hazardous substances including:

1. Fire, rescue, and police stations
2. Hospitals
3. Designated medical facilities having emergency treatment facilities
4. Designated emergency preparedness centers
5. Designated emergency operation centers
6. Designated emergency shelters
7. Power generating stations or other utilities required as emergency back-up facilities for Seismic Use Group III facilities
8. Emergency vehicle garages and emergency aircraft hangars
9. Designated communication centers
10. Aviation control towers and air traffic control centers
11. Structures containing sufficient quantities of toxic or explosive substances deemed to be hazardous to the public
12. Water treatment facilities required to maintain water pressure for fire suppression.

1.2.2 Seismic Use Group II. Seismic Use Group II structures are those that have a substantial public hazard due to occupancy or use including:

1. Covered structures whose primary occupancy is public assembly with a capacity greater than 300 persons
2. Educational structures through the 12th grade with a capacity greater than 250 persons
3. Day care centers with a capacity greater than 150 persons
4. Medical facilities with greater than 50 resident incapacitated patients not otherwise designated a Seismic Use Group III structure
5. Jails and detention facilities
6. All structures with a capacity greater than 5,000 persons
7. Power generating stations and other public utility facilities not included in Seismic Use Group III and required for continued operation
8. Water treatment facilities required for primary treatment and disinfection for potable water
9. Waste water treatment facilities required for primary treatment.

1.2.3 Seismic Use Group I. Seismic Use Group I structures are those not assigned to Seismic Use Groups III or II.

1.2.4 Multiple use. Structures having multiple uses shall be assigned the classification of the use having the highest Seismic Use Group except that in structures having two or more portions which are structurally separated in accordance with Sec. 4.5.1, each portion shall be separately classified. Where a structurally separated portion of a structure provides access to, egress from, or shares life safety

components with another portion having a higher Seismic Use Group, the lower portion shall be assigned the same rating as the higher.

1.2.5 Seismic Use Group III structure access protection. Where operational access to a Seismic Use Group III structure is required through an adjacent structure, the adjacent structure shall comply with the requirements for Seismic Use Group III structures. Where operational access is less than 10 ft (3 m) from an interior lot line or less than 10 ft (3 m) from another structure, access protection from potential falling debris shall be provided by the owner of the Seismic Use Group III structure.

1.3 OCCUPANCY IMPORTANCE FACTOR

An occupancy importance factor, *I*, shall be assigned to each structure in accordance with Table 1.3-1.

Table 1.3-1 Occupancy Importance Factors

Seismic Use Group	<i>I</i>
I	1.0
II	1.25
III	1.5

1.4 SEISMIC DESIGN CATEGORY

Each structure shall be assigned to a Seismic Design Category in accordance with Sec. 1.4.1. Seismic Design Categories are used in these *Provisions* to determine permissible structural systems, limitations on height and irregularity, those components of the structure that must be designed for seismic resistance, and the types of lateral force analysis that must be performed.

1.4.1 Determination of Seismic Design Category. All structures shall be assigned to a Seismic Design Category based on their Seismic Use Group and the design spectral response acceleration parameters, S_{DS} and S_{DI} , determined in accordance with Chapter 3 of these *Provisions*. Each structure shall be assigned to the more severe Seismic Design Category determined in accordance with Tables 1.4-1 and 1.4-2, irrespective of the fundamental period of vibration of the structure, *T*. If the alternate design procedure of Alternative Simplified Chapter 4 is used, the Seismic Design Category shall be determined from Table 1.4-1 alone, and the value of S_{DS} shall be that determined in Sec Alt. 4.6.1.

Exception: The Seismic Design Category is permitted to be determined from Table 1.4-1 alone when all of the following apply:

1. In each of the two orthogonal directions, the approximate fundamental period of the structure, T_a , determined in accordance with Section 5.2.2.1, is less than $0.8T_s$, where T_s is determined in accordance with Section 3.3.4 and
2. In each of the two orthogonal directions, the fundamental period of the structure used to calculate the story drift is less than T_s and
3. Equation 5.2-2 is used to determine the seismic response coefficient, C_s and
4. The diaphragms are rigid or for diaphragms that are flexible, the distance between vertical elements of the seismic force-resisting system does not exceed 40 feet.

Table 1.4-1 Seismic Design Category Based on S_{DS}

Value of S_{DS}	Seismic Use Group		
	I	II	III
$S_{DS} < 0.167$	A	A	A
$0.167 \leq S_{DS} < 0.33$	B	B	C
$0.33 \leq S_{DS} < 0.50$	C	C	D
$0.50 \leq S_{DS}$	D ^a	D ^a	D ^a

^a See footnote to Table 1.4-2.

Table 1.4-2 Seismic Design Category Based on S_{DI}

Value of S_{DI}	Seismic Use Group		
	I	II	III
$S_{DI} < 0.067$	A	A	A
$0.067 \leq S_{DI} < 0.133$	B	B	C
$0.133 \leq S_{DI} < 0.20$	C	C	D
$0.20 \leq S_{DI}$	D ^a	D ^a	D ^a

^a Seismic Use Group I and II structures located on sites with S_I greater than or equal to 0.75 shall be assigned to Seismic Design Category E and Seismic Use Group III structures located on such sites shall be assigned to Seismic Design Category F.

1.4.2 Site limitation for Seismic Design Categories E and F. A structure assigned to Seismic Design Category E or F shall not be sited where there is the potential for an active fault to cause rupture of the ground surface at the structure.

Exception: Detached one- and two-family dwellings of light-frame construction.

1.5 REQUIREMENTS FOR SEISMIC DESIGN CATEGORY A

Structures assigned to Seismic Design Category A shall satisfy the requirements of this section.

The effects on the structure and its components due to the forces prescribed in this section shall be taken as E and combined with the effects of other loads in accordance with the load combinations of ASCE 7.

1.5.1 Lateral forces. Each structure shall be analyzed for the effects of static lateral forces applied independently in each of two orthogonal directions. In each direction, the static lateral forces at all levels shall be applied simultaneously. The force at each level shall be determined using Eq. 1.5-1 as follows:

$$F_x = 0.01w_x \quad (1.5-1)$$

where:

F_x = the design lateral force applied at Level x ,

w_x = the portion of the seismic weight, W , located or assigned to Level x , and

W = the seismic weight, including the total dead load and applicable portions of other loads listed below:

1. In areas used for storage, a minimum of 25 percent of the floor live load shall be applicable. Floor live load in public garages and open parking structures is not applicable.
2. Where an allowance for partition load is included in the floor load design, the actual partition weight or a minimum weight of 10 psf (500 Pa/m²) of floor area, whichever is greater, shall be applicable.
3. Total operating weight of permanent equipment.
4. In areas where the design flat roof snow load does not exceed 30 pounds per square foot, the effective snow load is permitted to be taken as zero. In areas where the design snow load is greater than 30 pounds per square foot and where siting and load duration conditions warrant and where approved by the authority having jurisdiction, the effective snow load is permitted to be reduced to not less than 20 percent of the design snow load.

1.5.2 Connections. All parts of the structure between separation joints shall be interconnected, and the connections shall be capable of transmitting the seismic forces induced by the parts being connected. Any smaller portion of the structure shall be tied to the remainder of the structure with elements having a strength of not less than 5 percent of the portion's weight.

A positive connection for resisting a horizontal force acting parallel to the member shall be provided for each beam, girder, or truss to its support. The connection shall have a minimum strength of 5 percent of the reaction due to dead load and live load.

1.5.3 Anchorage of concrete or masonry walls. Concrete or masonry walls shall be connected, using reinforcement or anchors, to the roof and all floors and members that provide lateral support for the wall or that are supported by the wall. The connection shall be capable of resisting a seismic lateral force induced by the wall of 100 pounds per lineal foot (1500 N/m). Walls shall be designed to resist bending between connections where the spacing exceeds 4 ft (1.2 m).

1.5.4 Tanks assigned to Seismic Use Group III. Tanks assigned to Seismic Use Group III, according to Table 14.2-2, shall comply with the freeboard requirements of Sec. 14.4.7.5.3. For tanks in Seismic Design Category A it shall be permitted to take S_{DS} equal to 0.166 and S_{DI} equal to 0.066 without determining the site class.

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