

**APPENDIX A
REFERENCES**

A-1. Government Publications

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Seismic Design for Buildings.

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NEHRP Guidelines for the Seismic Rehabilitation of Buildings.

FEMA 274, October 1997
NEHRP Commentary on the Guidelines for the Seismic Rehabilitation of Buildings.

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NEHRP Recommended Provisions for Seismic Regulations for Buildings and Other Structures. Part 2. – Commentary.

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c. General Accounting Office
GAO/GGD-92-62, May 1992
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d. National Advisory Council on Historic Preservation
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e. National Institute of Standards and Technology
ICSSC RP4, February 1994
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f. Office of the President
Executive Order 12941, December 1, 1994
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A-2. Nongovernment Publications

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El Segundo, California, 90245.

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Box 19150
Redford Station, Detroit, MI 48219.

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ACI 530-95/ASCE 5-95/TMS 402-95, Building Code Requirements for Masonry Structures.

c. American Institute of Steel Construction, Inc.
One East Wacker Drive, Suite 3100
Chicago, Ill., 60601-2001.

Seismic Provisions for Structural Steel Buildings, April 1997.

d. *American Society of Mechanical Engineers*
1400 East 47th Street
New York, NY, 10017.

ASME 17.1-96, Safety Code for Elevators and Escalators.

e. *American Society for Testing Materials*
1916 Race Street
Philadelphia, PA 19105.

ASTM A307-94, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

ASTM A325-96, Specification for Structural Bolts and Studs, Steel, Heat-treated, 120/105 ksi Minimum Tensile Strength.

f. *National Fire Protection Association*
Batterymarch Park
Quincy, MA 02269.

NFPA 13, 1996 Edition
Standard for the Installation of Sprinkler Systems.

g. *Sheet Metal and Air Conditioning Contractors National Association*
Chantilly, VA 22046.

SMACNA 1982, Guidelines for Seismic Restraint of Mechanical Systems and Plumbing Piping Systems.

SMACNA 1991, Seismic Restraint Guidelines for Mechanical Equipment.

**APPENDIX B
SYMBOLS AND NOTATIONS**

		m	Component or element demand modifier to account for expected ductility at the selected performance level as defined in Chapter 7 of TI 809-04.
CERL	The Construction Engineering Research Laboratory of the US Army Corps of Engineers in Champaign, Illinois.	m ²	Square meters.
CMU	Concrete masonry units.	NEHRP	The National Earthquake Hazards Reduction Program, enacted by Public Law 101-614.
C _s	Seismic response coefficient	NFPA	National Fire Protection Agency.
EDP	Electronic data processing.	NDP	Nonlinear dynamic procedure as defined in paragraph 5-4 of TI 809-04.
F _a	Acceleration-based site coefficient at short periods in Table 3-2a of TI 809-04.	NSP	Nonlinear static procedure as defined in paragraph 5-4 of TI 809-04.
F _p	Seismic design force for nonstructural components as defined in paragraph 6-3b.	P-Δ	The secondary moment caused by the unfactored vertical load, P, at and above the level under consideration, multiplied by the story drift, Δ, at that level.
F _v	Velocity-based site coefficient at a period of 1 second in Table 3-2b of TI 809-04.	QA/QC	Quality assurance and quality control as defined in Chapter 10.
FRP	Fiber reinforced polymer.	Q _{CE}	The expected strength of deformation-controlled structural components as defined in paragraph 5-2a(4)(a).
h	Average roof height of structure relative to grade.	Q _{CL}	Lower-bound strength of deformation-controlled structural components as defined in paragraph 5-2a(2).
I _p	Importance factor for nonstructural components as defined in paragraph 4-4b(2).	Q _D	Dead load effect (action) as defined in Section 4.2.4.2 of FEMA 310.
LDP	Linear dynamic procedure as defined in paragraph 5-3 of TI 809-04.	Q _E	Effects of seismic forces (actions) as defined in Section 4.2.4.3.1 of FEMA 310.
LSP	Linear static procedure as defined in paragraph 5-3 of TI 809-04.	Q _G	Effects of gravity loads as defined by Equation 7-1 of this document or 4-6 and 4-7 of FEMA 310.
M _p	The plastic moment capacity of a structural component	Q _L	Live load effect (action) as defined in Section 4.2.4.2 of FEMA 310 or ASCE 7.
MCE	The maximum considered earthquake as defined in paragraph 3-1c of TI 809-04.	Q _N	The nominal strength of structural components as defined in Section 5.10 of FEMA 273.

Q_s	Snow load effect (action) as defined in Section 4.2.4.2 of FEMA 310.	Θ	Component or element joint rotation in radians as defined in Figure 7-2a.
Q_{UD}	Design action due to combined gravity and seismic loads for deformation-controlled components as defined by Equation 4-8 of FEMA 310.	Θ/Θ_y	Component or element joint rotation ratio as defined in Figure 7-2b.
Q_{UF}	Design action due to combined gravity and seismic loads for force-controlled components as defined by Equations 4-9 or 4-10 of FEMA 310.	Ω_o	Overstress factor as defined in Para. 4.5 of TI-809-04.
S_1	The mapped maximum considered earthquake, 5% damped, spectral response acceleration at a period of 1 second as defined in paragraph 3-1c of TI 809-04.		
S_{D1}	The design, 5% damped, spectral response acceleration at a period of 1 second as defined in paragraph 3-2b of TI 809-04.		
S_{DS}	The design, 5% damped, spectral response acceleration at short periods as defined in paragraph 3-2b of TI 809-04.		
S_s	The mapped maximum considered earthquake, 5% damped, spectral response acceleration at short periods as defined in paragraph 3-1c of TI 809-04.		
SITR	Special Independent Technical Review.		
SMACNA	Sheet Metal and Air Conditioning Contractors National Association.		
URM	Unreinforced masonry, includes brick, stone, hollow clay tile, and CMU.		
V_{DL+LL}	The shear due to the effects of the dead load plus the design live load.		
Δ/Δ_y	Component or element deformation ratio as defined in Figure 7-2b.		
δ_t	The target displacement of the building reference point in the nonlinear static procedure as defined by Equation 5-5 in TI 809-04.		

APPENDIX C GLOSSARY

Acceptance Criteria: Permissible values of such properties as drift, component strength demand, and inelastic deformation used to determine the acceptability of a component's projected behavior at a given Performance Level.

Action: Sometimes called a generalized force, most commonly a single force or moment. However, an action may also be a combination of forces and moments, a distributed loading, or any combination of forces and moments. Actions always produce or cause displacements or deformations; for example, a bending moment action causes flexural deformation in a beam; an axial force action in a column causes axial deformation in the column; and a torsional moment action on a building causes torsional deformations (displacements) in the building.

Addition: An increase in 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.

Appendage: An architectural component such as a canopy, marquee, ornamental balcony, or statuary.

Approval: The written acceptance by the regulatory agency of documentation that establishes the qualification of a material, system, component, procedure, or person to fulfill the requirements of these provisions for the intended use.

Architectural Component Support: Those structural members or assemblies of members, including braces, frames, struts and attachments, that transmit all loads and forces between architectural systems, components, or elements and the structure.

Attachments: Means by which components and their supports are secured or connected to the seismic-force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

Base: The level at which the horizontal seismic ground motions are considered to be imparted to the structure.

Base Shear: Total design lateral force or shear at the base.

Basement: A basement is any level below the first story.

Boundary Elements: Diaphragm and shear wall boundary members to which sheathing transfers forces. Boundary members include chords and drag struts at diaphragm and shear wall perimeters, interior openings, discontinuities, and reentrant corners.

Boundary Members: Portions along wall and diaphragm edges strengthened by longitudinal and transverse reinforcement and/or structural steel members.

Braced Frames: An essentially vertical truss, or its equivalent, of the concentric or eccentric type that is provided in a building frame system or dual-frame system to resist in-plane lateral loads.

Concentrically Braced Frame (CBF): A braced frame in which the members are subjected primarily to axial forces.

Eccentrically Braced Frame (EBF): A diagonally braced frame in which at least one end of each brace frames into a beam a short distance from a beam-column joint or from another diagonal brace.

V-Braced Frame: A concentric braced frame (CBF) in which a pair of diagonal braces located either above or below a beam is connected to a single point within the clear beam span. Where the diagonal braces are below the beam, the system also is referred to as an "inverted V-brace frame," or "chevron bracing."

X-Braced Frame: A concentric braced frame (CBF) in which a pair of diagonal braces crosses near the mid-length of the braces.

Brittle: Systems, members, materials, and connections that do not exhibit significant energy dissipation capacity in the inelastic range.

Building: Any structure whose use could include shelter of human occupants.

Building Performance Level: A limiting damage state, considering structural and nonstructural building components, used in the definition of Performance Objectives.

Capacity: The permissible strength or deformation for a component action.

Components: The basic structural members that constitute the building, such as beams, columns, slabs, braces, piers, walls, coupling beams, and connections. Components such as columns and beams are combined to form elements (e.g., a frame).

Component, Deformation-controlled: A structural component that can deform inelastically in a ductile manner.

Component, Equipment: A mechanical or electrical component or element that is part of a mechanical and/or electrical system within or without a building system.

Component, Flexible: Component, including its attachments, having a fundamental period greater than 0.06 sec.

Component, Force-controlled: A structural component that is essentially brittle and lacks the ability to deform inelastically in a ductile manner.

Component, Rigid: Component, including its attachments, having a fundamental period less than or equal to 0.06 sec.

Concrete:

Plain Concrete: Concrete that is either unreinforced or contains less reinforcement than the minimum amount specified in ACI-318 for reinforced concrete.

Reinforced Concrete: Concrete reinforced with no less than the minimum amount required by ACI-318, prestressed or nonprestressed, and designed on the assumption that the two materials act together in resisting forces.

Confined Region: That portion of a reinforced concrete component in which the concrete is confined by closely spaced special transverse reinforcement restraining the concrete in directions perpendicular to the applied stress.

Construction Documents: The written, graphic, electronic, and pictorial documents describing the design, locations, and physical characteristics of the project.

Coupling Beam: A beam that is used to connect adjacent concrete wall piers to make them act together as a unit to resist lateral loads.

Critical Action: That component action that reaches its elastic limit at the lowest level of lateral deflection, or loading, for the structure.

Damping: The exponential decay of the free vibration of an elastic single-degree-of-freedom system due to internal energy dissipation. Usually expressed as a percentage of critical damping.

Critical Damping: The amount of energy dissipation required to restrain a displaced elastic single-degree-of-freedom system from vibration beyond the initial "at rest" position.

Demand: The amount of force or deformation imposed on an element or component.

Design Earthquake Ground Motion: The earthquake effects that buildings and structures are specifically proportioned to resist as defined in Sec. 4.1 of NEHRP '97.

Design Earthquake: The earthquake for use with this document is two-thirds the maximum considered earthquake.

Diaphragm: A horizontal or nearly horizontal system acting to transfer lateral forces to the vertical-resisting elements. Diaphragms are classified as either flexible or rigid according to the requirement of Sec. 12.3.4.2 of NEHRP '97.

Diaphragm Boundary: A location where shear is transferred into or out of the diaphragm sheathing. Transfer is either to a boundary element or to another force-resisting element.

Diaphragm Chord: A diaphragm boundary element perpendicular to the applied load that is assumed to take axial stresses due to the diaphragm moment in a manner analogous to the flanges of a beam. Also applies to shear walls.

Diaphragm Collector: A diaphragm component provided to transfer lateral force from the diaphragm to vertical elements of the later-force-resisting system or to other portions of the diaphragm.

Displacement:

Design Displacement: The design earthquake lateral displacement, excluding additional displacement due to actual and accidental torsion, required for design of the isolation system.

Total Design Displacement: The design earthquake lateral displacement, including additional displacement due to actual and accidental torsion, required for design of the isolation system, or an element thereof.

Total Maximum Displacement: The maximum capable earthquake lateral displacement, including additional displacement due to actual and accidental torsion, required for verification of the stability of the isolation system or elements thereof, design of building separations, and vertical-load testing of isolator unit prototypes.

Displacement Restraint System: A collection of structural elements that limits lateral displacement of seismically isolated structures due to the maximum considered earthquake.

Drag Strut (Collector, Tie, Diaphragm Strut): A diaphragm or shear wall boundary element parallel to the applied load that collects and transfers diaphragm shear forces to the vertical-force-resisting elements, or distributes forces within the diaphragm or shear wall. A drag strut often is an extension of a boundary element that transfers forces into the diaphragm or shear wall.

Drift Ratio: Ratio of the displacement of the top of a structural component, relative to its base, to the height of the component.

Interstory Drift Ratio: The interstory displacement divided by the story height.

Effective Damping: The value of equivalent viscous damping corresponding to energy dissipated during cyclic response of the isolation system.

Effective Stiffness: The value of the lateral forces in the isolation system, or an element thereof, divided by the corresponding lateral displacement.

Element: An assembly of structural components that act together in resisting lateral forces, such as moment-resisting frames, braced frames, shear walls and diaphragms.

Ductile Element: An element capable of sustaining large cyclic deformations beyond the attainment of its nominal strength without any significant loss of strength.

Limited Ductile Element: An element that is capable of sustaining moderate cyclic deformations beyond the attainment of nominal strength without significant loss of strength.

Nonductile Element: An element having a mode of failure that results in an abrupt loss of resistance when the element is deformed beyond the deformation corresponding to the development of its nominal strength. Nonductile elements cannot reliably sustain significant deformation beyond that attained at their nominal strength.

Equipment Support: Those structural members or assemblies of members or manufactured elements, including braces, frames, legs, lugs, snuggers, hangers or saddles, that transmit gravity load and operating load between the equipment and the structure.

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

Flexible Diaphragm: A diaphragm with stiffness characteristics indicated in paragraph 5-9b(1) of TI-809-04.

Flexible Equipment Connections: Those connections between equipment components that permit rotational and/or translational movement without degradation of performance. Examples include universal joints, bellows expansion joints, and flexible metal hose.

Foundations:

Allowable Bearing Capacity: Foundation load or stress commonly used in working-stress design (often controlled by long-term settlement rather than soil strength).

Deep Foundation: Piles or piers.

Differential Compaction: An earthquake-induced process in which loose or soft soils become more compact and settle in a nonuniform manner across a site.

Footings: A structural component transferring the weight of a building to the foundation soils and resisting lateral loads.

Foundation Soils: Soils supporting the foundation system and resisting vertical and lateral loads.

Foundation Springs: Method of modeling to incorporate load-deformation characteristics of foundation soils.

Foundation System: Structural components (footings, piles).

Foundation Ties: Horizontal beams between footings or pile and pier caps to prevent differential lateral displacements in poor soils. Ties are usually designed as struts for a small percentage of the vertical footing load.

Landslide: A down-slope mass movement of earth resulting from any cause.

Liquefaction: An earthquake-induced process in which saturated, loose, granular soils lose a substantial amount of shear strength as a result of increase in porewater pressure during earthquake shaking.

Pier: Similar to pile; usually constructed of concrete and cast in place.

Pile: A deep structural component transferring the weight of a building to the foundation soils and resisting vertical and lateral loads; constructed of concrete, steel, or wood; usually driven into soft or loose soils.

Retaining Wall: A free-standing wall that has soil on one side.

Shallow Foundation: Isolated or continuous spread footings or mats.

Spread Footing: An individual footing under a column or a pier. Usually square or rectangular in shape.

SPT N-Values: Using a standard penetration test (ASTM Test D1586), the number of blows of a 140-pound hammer falling 30 inches required to drive a standard 2-inch-diameter sampler a distance of 12 inches.

Strip Footing: A continuous footing, usually a uniform width, under a bearing or shear wall.

Ultimate Bearing Capacity: Maximum possible foundation load or stress (strength); increase in deformation or strain results in no increase in load or stress.

Frame Systems:

Building Frame System: A structural system with an essentially complete space frame system providing support for vertical loads. Seismic-force resistance is provided by shear walls or braced frames.

Dual-Frame System: A structural system with an essentially complete space frame system providing support for vertical loads. Seismic force resistance is provided by moment-resisting frames and shear walls or braced frames as prescribed in Sec. 5.2.2.1 of NEHRP '97.

Moment Frame System: A structural system with an essentially complete space frame system providing support for vertical loads, with restrained connections between the beams and columns to permit the frames to resist lateral forces through the flexural rigidity and strength of its members.

Fundamental Period: The first mode period of the building in the direction under consideration.

Grade Plane: A reference plane representing the average of finished ground level adjoining the building at all exterior walls. Where the finished ground level slopes away from the exterior walls, the reference plane shall be established by the lowest point within the area between the buildings and the lot line, or where the lot line is more than 6 ft. (1,829mm) from the building, between the building and a point 6 ft. (1829mm) from the building.

Hazardous Contents: 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.

Inspection, Special: The observation of the work by the special inspector to determine compliance with the approved construction documents.

Continuous Special Inspection: The full-time observation of the work by an approved special inspector who is present in the area where work is being performed.

Periodic Special Inspection: The part-time or intermittent observation of the work by an approved special inspector who is present in the area where work has been or is being performed.

Inspector, Special (who shall be identified as the Owner's Inspector): A person approved by the regulatory agency as being qualified to perform special inspection required by the approved quality assurance plan. The quality assurance personnel of a fabricator may be approved by the regulatory agency as a special inspector.

Inter-Story Drift: The relative horizontal displacement of two adjacent floors in a building. Inter-story drift can also be expressed as a percentage of the story height separating the two adjacent floors.

Joint: That portion of a column bounded by the highest and lowest surfaces of the other members framing into it.

Lateral-Force-Resisting System: Those elements of the structure that provide its basic lateral strength and stiffness, and without which the structure would be laterally unstable.

Ledger: A continuous steel or timber element, bolted to a wall. Used to transfer vertical and horizontal diaphragm forces to concrete or masonry walls.

Load:

Dead Load: The gravity load due to the weight of all permanent structural and nonstructural components of a building such as walls, floors, roofs, and the operating weight of fixed service equipment.

Gravity Load (W): The total dead load and applicable portions of other loads as defined in Sec. 5.3.2 of NEHRP '97.

Live Load: The load superimposed by the use and occupancy of the building, not including the wind load, earthquake load, or dead load; see Sec. 5.3.2 of NEHRP '97.

LRFD (Load and Resistance Factor Design): A method of proportioning structural components (members, connectors, connecting elements, and assemblages using load and resistance factors such that no applicable limit state is exceeded when the structure is subjected to all design load combinations.

Masonry: The assemblage of masonry units, mortar, and possibly grout and/or reinforcement. Types of masonry are classified herein with respect to the type of the masonry units, such as clay-unit masonry, concrete masonry, or hollow-clay tile masonry.

Bed Joint: The horizontal layer of mortar on which a masonry unit is laid.

Cavity Wall: A masonry wall with an air space between wythes. Wythes are usually joined by wire reinforcement, or steel ties. Also known as a noncomposite wall.

Clay-Unit Masonry: Masonry constructed with solid, cored, or hollow units made of clay. Hollow clay units may be ungrouted, or grouted.

Clay Tile Masonry: Masonry constructed with hollow units made of clay tile. Typically, units are laid with cells running horizontally, and are thus ungrouted. In some cases, units are placed with cells running vertically, and may or may not be grouted.

Collar Joint: Vertical longitudinal joint between wythes of masonry or between masonry wythe and back-up construction that may be filled with mortar or grout.

Composite Masonry Wall: Multiwythe masonry wall acting with composite action.

Concrete Masonry: Masonry constructed with solid or hollow units made of concrete. Hollow concrete units may be ungrouted, or grouted.

Head Joint: Vertical mortar joint placed between masonry units in the same wythe.

Hollow Masonry Unit: A masonry unit whose net cross-sectional area in every plane parallel to the bearing surface is less than 75% of the gross cross-sectional area in the same plane.

Infill: A panel of masonry placed within a steel or concrete frame. Panels separated from the surrounding frame by a gap are termed "isolated infills." Panels that are in tight contact with a frame around its full perimeter are termed "shear infills."

In-plane Wall: See shear wall.

Nonbearing Wall: A wall that is designed and detailed so as not to participate in providing support for gravity loads.

Out-of-plane Wall: A wall that resists lateral forces applied normal to its plane.

Parapet: Portions of a wall extending above the roof diaphragm. Parapets can be considered as flanges to roof diaphragms if adequate connections exist or are provided.

Partially Grouted Masonry Wall: A masonry wall containing grout in some of the cells.

Perforated Wall or Infill Panel: A wall or panel not meeting the requirements for a solid wall or infill panel.

Pier: A vertical portion of masonry wall between two horizontally adjacent openings. Piers resist axial stresses from gravity forces, and bending moments from combined gravity and lateral forces.

Reinforced Masonry (RM) Walls: A masonry wall that is reinforced in both the vertical and horizontal directions. Reinforced walls are assumed to resist loads through resistance of the masonry in compression and the reinforcing steel in tension or compression. Reinforced masonry is partially grouted or fully grouted.

Running Bond: A pattern of masonry where the head joints are staggered between adjacent courses by more than a third of the length of a masonry unit. Also refers to the placement of masonry units such that head joints in successive courses are horizontally offset at least one-quarter the unit length.

Solid Masonry Unit: A masonry unit whose net cross-sectional area in every plane parallel to the bearing surface is 75% or more of the gross cross-sectional area in the same plane.

Solid Wall or Solid Infill Panel: A wall or infill panel with openings not exceeding 5% of the wall surface area. The maximum length or height of an opening in a solid wall must not exceed 10% of the wall width or story height. Openings in a solid wall or infill panel must be located within the middle 50% of a wall length and story height, and must not be contiguous with adjacent openings.

Stack Bond: In contrast to running bond, usually a placement of units such that the head joints in successive courses are aligned vertically.

Transverse Wall: A wall that is oriented transverse to the in-plane shear walls, and resists lateral forces applied normal to its plane. Also known as an out-of-plane wall.

Unreinforced Masonry (URM) Wall: A masonry wall containing less than the minimum amounts of reinforcement as defined for reinforced masonry (RM) walls. An unreinforced wall is assumed to resist gravity and lateral loads solely through resistance of the masonry materials.

Wythe: A continuous vertical section of a wall, one masonry unit in thickness.

Maximum Considered Earthquake Ground

Motion: The most severe earthquake effects considered by this document as defined in Chapter 3 of TI-809-04.

Moment Frames: A building frame system in which seismic forces are resisted by shear and flexure in the members and joints of the frame.

Panel Zone: The portion of the column in a beam/column joint of a structural steel moment frame that is bounded by the beam flange connection.

Partition: A nonstructural interior wall that spans from floor to ceiling, to the floor or roof structure immediately above, or to subsidiary structural members attached to the structure above. A partition may receive lateral support from the floor above, but shall be designed and detailed so as not to provide lateral or vertical support for that floor.

P-Delta Effect: The secondary effect on shears and moments of frame members due to the action of the

vertical loads induced by displacement of the building frame resulting from the design loads.

Pilaster: A vertical element, reinforced to function as a column, that is constructed integrally as part of a concrete or masonry wall.

Primary Component: Those components that are required as part of the building's lateral-force-resisting system (as contrasted to secondary components).

Primary Element: An element that is essential to the ability of the structure to resist earthquake-induced deformations.

Quality Assurance Plan: A detailed written procedure that establishes the systems and components subject to special inspection and testing.

Rehabilitation Concept: Preliminary design and drawings based on selected rehabilitation strategy. Design and drawings should establish preliminary sizes and configurations of principal structural components in sufficient detail to develop the program construction cost estimate.

Rehabilitation Strategy: After assessment of the results of the structural evaluation, all feasible options should be explored for the mitigation of the observed deficiencies. If structural mitigation is authorized, one or more rehabilitative strategies (e.g., strengthen or stiffen existing structural members or add new shear walls) should be developed.

Required Strength: The load effect (force, moment, stress, as appropriate) acting on a component or connection, determined by structural analysis from the factored loads (using the most appropriate critical load combinations).

Rigid Diaphragm: A diaphragm that meets requirements of paragraph 5-9b (1) in TI-809-04.

Secondary Component: Those components that are not required for lateral-force resistance (contrasted to primary components). They may or may not actually resist some lateral forces.

Secondary Element: An element that does not affect the ability of the structure to resist earthquake-induced deformations.

Seismic Demand: Seismic hazard level commonly expressed in the form of a ground shaking response

spectrum. It may also include an estimate of permanent ground deformation.

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 Evaluation: Assessment of the vulnerability of the building's structural and nonstructural components and systems to seismic-geologic hazards.

Tier 1 Evaluation: Preliminary assessment of structural, nonstructural, and geologic site hazards by means of checklists in FEMA 310.

Tier 2 Evaluation: "Deficiencies only" or "full building" assessment of the seismic vulnerability of structural and nonstructural components and systems based on guidelines in Chapter 4 of FEMA 310, and the linear analytical procedures in FEMA 273.

Tier 3 Evaluation: Detailed assessment of the vulnerability of structural components and systems with the nonlinear analytical procedures in FEMA 273.

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 wall 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-Geologic Hazard: The potential for the occurrence of natural phenomena, associated with earthquakes, that could cause damage to the built environment and/or injury or death to the public. The hazard may be defined in deterministic or probabilistic terms.

Seismic Isolation and Energy Dissipation:

Design Displacement: The design earthquake displacement of an isolation or energy dissipation system, or elements thereof, excluding additional displacement due to actual and accidental torsion.

Design Earthquake: A user-specified earthquake for the design of an isolated building, having ground-shaking criteria described in Chapter 3 of TI-809-04.

Displacement-Dependent Energy Dissipation Devices: Devices having mechanical properties such that the force in the device is related to the relative displacement in the device.

Displacement Restraint System: Collection of structural components and elements that limit lateral displacement of seismically isolated buildings during the maximum considered earthquake.

Effective Damping: The value of equivalent viscous damping corresponding to the energy dissipated by the building, or element thereof, during a cycle of response.

Energy Dissipation Device (EDD): Non-gravity-load-supporting element designed to dissipate energy in a stable manner during repeated cycles of earthquake demand.

Energy Dissipation System (EDS): Complete collection of all energy dissipation devices, their supporting framing, and connections.

Isolation Interface: The boundary between the upper portion of the structure (superstructure), which is isolated, and the lower portion of the structure, which moves rigidly with the ground.

Isolation System: The collection of structural elements that includes all individual isolator units, all structural elements that transfer force between elements of the isolation system, and all connections to other structural elements. The isolation system also includes the wind-restraint system, if such a system is used to meet the design requirements of this section.

Isolator Unit: A horizontally flexible and vertically stiff structural element of the isolation system that permits large lateral deformations under seismic load. An isolator unit may be used either as part of or in addition to the weight-supporting system of the building.

Maximum Displacement: The maximum earthquake displacement of an isolation or energy dissipation system, or elements thereof,

excluding additional displacement due to actual or accidental torsion.

Tie-Down System: The collection of structural connections, components, and elements that provide restraint against uplift of the structure above the isolation system.

Total Design Displacement: The design displacement of an isolation or energy dissipation system, or elements thereof, including additional displacement due to actual and accidental torsion.

Velocity-Dependent Energy Dissipation Devices: Devices having mechanical characteristics such that the force in the device is dependent on the relative velocity in the device.

Wind-Restraint System: The collection of structural elements that provides restraint of the seismic-isolated structure for wind loads. The wind-restraint system may be either an integral part of isolator units or a separate device.

Seismic Response Coefficient: Coefficient C_s , as determined from Sec. 5.3.2.1 of NEHRP '97.

Seismic Use Group: A classification assigned to a building based on its use as defined in Sec. 1.3 of NEHRP '97.

Shear Panel: A floor, roof, or wall component sheathed to act as a shear wall or diaphragm.

Site Class: A classification assigned to a site based on the types of soils present and their engineering properties as defined in Sec. 4.1.2 of NEHRP '97.

Site Coefficients: The values of F_a and F_v , indicated in Tables 1.4.2.3a and 1.4.2.3b, respectively, of TI-809-04.

Special Transverse Reinforcement: Reinforcement composed of spirals, closed stirrups, or hoops and supplementary cross-ties provided to restrain the concrete and qualify the portion of the component, where used, as a confined region.

Steel Frame Elements:

Connection: A link between components or elements that transmits actions from one component or element to another component or element. Categorized by type of action (moment, shear, or axial), connection links are frequently nonductile.

Continuity Plates: Column stiffeners at the top and bottom of the panel zone.

Diagonal Bracing: Inclined structural members carrying primarily axial load, employed to enable a structural frame to act as a truss to resist lateral loads.

Dual System: A structural system included in building with the following features:

- An essentially complete space frame provides support for gravity loads.
- Resistance to lateral load is provided by concrete or steel shear walls, steel eccentrically braced frames (EBF), or concentrically braced frames (CBF) along with moment-resisting frames (Special Moment Frames, or Ordinary Moment Frames) that are capable of resisting at least 25% of the lateral loads.

Joint: An area where two or more ends, surfaces, or edges are attached. Categorized by the type of fastener or weld used and the method of force transfer.

Lateral Support Member: A member designed to inhibit lateral buckling or lateral-torsional buckling of a component.

Link: In an EBF, the segment of a beam that extends from column to brace, located between the end of a diagonal brace and a column, or between the ends of two diagonal braces of the EBF. The length of the link is defined as the clear distance between the diagonal brace and the column face, or between the ends of two diagonal braces.

Link Intermediate Web Stiffeners: Vertical web stiffeners placed within the link.

Panel Zone: The area of a column at the beam-to-column connection delineated by beam and column flanges.

Storage Racks: Include industrial pallet racks, movable shelf racks, and stacker racks made of cold-

formed or hot-rolled structural members. Does not include other types of racks such as drive-in and drive-through racks, cantilever racks, portable racks, or racks made of materials other than steel.

Story: The vertical distance from the top to top of two successive tiers of beams or finished floor surfaces; and, for the topmost story, from the top of the floor finish to the top of the ceiling joists, or where there is not a ceiling, to the top of the roof rafters.

Story Above Grade: Any story having its finished floor surface entirely above grade, except that a basement shall be considered as a story above grade where the finished floor surface of the floor above the basement is:

1. More than 6 feet (1,829mm) above the grade plane;
2. More than 6 feet (1,829mm) above the finished ground level for more than 40 percent of the total building perimeter; or
3. More than 12 feet (3,658mm) above the finished ground level at any point.

Story Drift Ratio: The story drift, as determined in Sec. 5.3.7 of NEHRP '97, divided by the story height.

Story Shear: The summation of design lateral forces at levels above the story under consideration.

Strength:

Design Strength: Nominal strength multiplied by a strength reduction factor, ϕ .

Effective Strength: Nominal strength multiplied by a strength increase factor to represent the expected mean strength at the expected deformation value. Includes variability in material strength, and such phenomena as strain hardening and plastic section development.

Nominal Strength: Strength of a member or cross section calculated in accordance with the requirements and assumptions of the strength design methods of NEHRP '97 (or the referenced standards) before application of any strength reduction factors.

Required Strength: Strength of a member, cross section, or connection required to resist factored loads or related internal moments and forces in such combinations as stipulated by NEHRP '97.

Structure: That which is built or constructed, and limited to buildings or non-building structures as defined herein.

Structural Observations: The visual observations performed by the registered design professional in responsible charge (or another registered design professional) to determine that the seismic-force-resisting system is constructed in general conformance with the construction documents.

Structural Performance Level: A limiting structural damage state, used in the definition of Performance Objectives.

Structural Use Panel: A wood-based panel product that meets the requirements of NEHRP '97, and is bonded with a waterproof adhesive. Included under this designation are plywood, oriented strand board, and composite panels.

Subdiaphragm: A portion of a diaphragm used to transfer wall anchorage forces to diaphragm cross ties.

Target Displacement: An estimate of the likely building roof displacement in the design earthquake.

Tie-Down (Hold-down): A device used to resist uplift of the chords of shear walls. These devices are intended to resist load without significant slip between the device and the shear wall chord, or be shown with cyclic testing to not reduce the wall capacity or ductility.

Time Effect Factor (λ): A factor applied to the adjusted resistance to account for effects of duration of load.

Torsional Force Distribution: The distribution of horizontal shear wall through a rigid diaphragm when the center of mass of the structure at the level under consideration does not coincide with the center of rigidity (sometimes referred to as diaphragm rotation).

Toughness: The ability of a material to absorb energy without losing significant strength.

Veneers: Facings or ornamentation of brick, concrete, stone, tile, or similar materials attached to a backing.

Wall: A component that has a slope of 60 degrees or greater with the horizontal plane used to enclose or divide space.

Bearing Wall: An exterior or interior wall providing support for vertical loads.

Cripple Wall: A framed stud wall, less than 8 feet (2400mm) in height, extending from the top of the foundation to the underside of the lowest floor framing. Cripple walls occur in both engineered structures and conventional construction.

Light-Framed Wall: A wall with wood or steel studs.

Light-Framed Wood Shear Wall: A wall constructed with wood studs and sheathed with material rated for shear resistance.

Nonbearing Wall: An exterior or interior wall that does not provide support for vertical loads, other than its own weight, or as permitted by the building code administered by the regulatory agency.

Nonstructural Wall: All walls other than bearing walls or shear walls.

Shear Wall (Vertical Diaphragm): A wall designed to resist lateral forces parallel to the plane of the wall (sometimes referred to as a vertical diaphragm).

Wall System, Bearing: A structural system with bearing walls providing support for all or major portions of the vertical loads. Shear walls or braced frames provide seismic-force resistance.

Wind-Restraint System: The collection of structural elements that provides restraint of the seismic-isolated structure for wind loads. The wind-restraint system may be either an integral part of isolator units or a separate device.

Wood and Light Metal Framing:

Aspect Ratio: Ratio of height to width for vertical diaphragms, and width to depth for horizontal diaphragms.

Balloon Framing: Continuous stud framing from sill to roof, with intervening floor joists nailed to studs and supported by a let-in ribbon (see platform framing).

Cripple Wall: Short wall between foundation and first floor framing.

Cripple Studs: Short studs between header and top plate at opening in wall framing, or studs between base sill and sill of opening.

Decking: Solid sawn lumber or glued laminated decking, nominally 2 to 4 inches thick, and 4 inches and wider. Decking may be tongue-and-groove, or connected at longitudinal joints with nails or metal clips.

Edge Distance: The distance from the edge of the member to the center of the nearest fastener. When a member is loaded perpendicular to the grain, the loaded edge shall be defined as the edge in the direction toward which the fastener is acting.

Gypsum Wallboard or Drywall: An interior wall surface sheathing material sometimes considered for resisting lateral forces.

Hold-Down: Hardware used to anchor the vertical chord forces to the foundation or framing of the structure in order to resist overturning of the wall.

Panel: A sheet-type wood product.

Panel Rigidity or Stiffness: The in-plane shear rigidity of a panel, the product of panel thickness and modulus of rigidity.

Panel Shear: Shear stress acting through the panel thickness.

Platform Framing: Construction method in which stud walls are constructed one floor at a time, with a floor or roof joist bearing on top of the wall framing at each level.

Plywood: A structural panel comprising plies of wood veneer arranged in cross-aligned layers. The plies are bonded with an adhesive that cures upon application of heat and pressure.

Row of Fasteners: Two or more fasteners aligned with the direction of load.

Sheathing: Lumber or panel products that are attached to parallel framing members, typically forming wall, floor, ceiling, or roof surfaces.

Stud: Wood member used as vertical framing member in interior or exterior walls of a building, usually 2" x 4" or 2" x 6" sizes, and precision end-trimmed.

Tie: See drag strut.

Tie-Down: Hardware used to anchor the vertical chord forces to the foundation or framing of the structure in order to resist overturning of the wall.