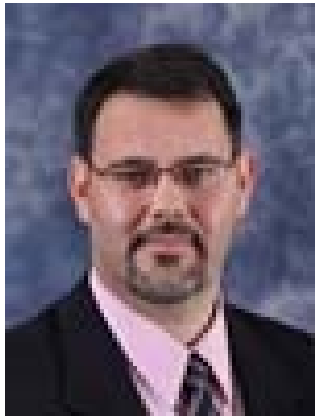
Eliminating the Confusion from Seismic Codes & Standards



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PART 1
Introduction to Earthquakes

by
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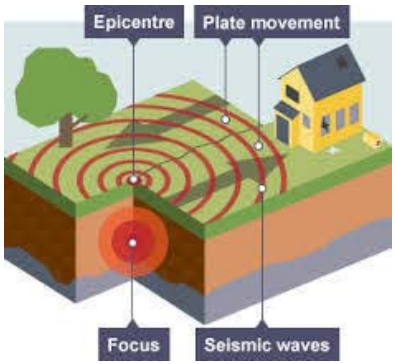
Brief Introduction to Earthquakes



- Earthquake – Rapid vibration of the earth's surface due to the sudden movements in the subsoil, leading to energy release spreading in the shape of waves propagating in all directions
- Focus (Hypocenter) – Exact point in the subsoil where a rupture starts and from which the energy generated radiates
- Epicenter – Hypocenter vertical projection onto the surface

Measuring a Quake's Intensity

Mercalli Scale

Estimates intensity on the surface based on the effect locally induced on structures, people and things.

I. Instrumental	Generally not felt by people unless in favorable conditions.
II. Weak	Felt only by a couple people that are sensitive, especially on the upper floors of buildings. Delicately suspended objects (including chandeliers) may swing slightly.
III. Slight	Felt quite noticeably by people indoors, especially on the upper floors of buildings. Many do not recognize it as an earthquake. Standing automobiles may rock slightly. Vibration similar to the passing of a truck. Duration can be estimated. Indoor objects (including chandeliers) may shake.
IV. Moderate	Felt indoors by many to all people, and outdoors by few people. Some awakened. Dishes, windows, and doors disturbed, and walls make cracking sounds. Chandeliers and indoor objects shake noticeably. The sensation is more like a heavy truck striking building. Standing automobiles rock noticeably. Dishes and windows rattle alarmingly. Damage none.
V. Rather Strong	Felt inside by most or all, and outside. Dishes and windows may break and bells will ring. Vibrations are more like a large train passing close to a house. Possible slight damage to buildings. Liquids may spill out of glasses or open containers. None to a few people are frightened and run outdoors.
VI. Strong	Felt by everyone, outside or inside; many frightened and run outdoors, walk unsteadily. Windows, dishes, glassware broken; books fall off shelves; some heavy furniture moved or overturned; a few instances of fallen plaster. Damage slight to moderate to poorly designed buildings, all others receive none to slight damage.
VII. Very Strong	Difficult to stand. Furniture broken. Damage light in building of good design and construction; slight to moderate in ordinarily built structures; considerable damage in poorly built or badly designed structures; some chimneys broken or heavily damaged. Noticed by people driving automobiles.
VIII. Destructive	Damage slight in structures of good design, considerable in normal buildings with a possible partial collapse. Damage great in poorly built structures. Brick buildings easily receive moderate to extremely heavy damage. Possible fall of chimneys, factory stacks, columns, monuments, walls, etc. Heavy furniture moved.
IX. Violent	General panic. Damage slight to moderate (possibly heavy) in well-designed structures. Well-designed structures thrown out of plumb. Damage moderate to great in substantial buildings, with a possible partial collapse. Some buildings may be shifted off foundations. Walls can fall down or collapse.
X. Intense	Many well-built structures destroyed, collapsed, or moderately to severely damaged. Most other structures destroyed, possibly shifted off foundation. Large landslides.
XI. Extreme	Few, if any structures remain standing. Numerous landslides, cracks and deformation of the ground.
XII. Catastrophic	Total destruction -- everything is destroyed. Lines of sight and level distorted. Objects thrown into the air. The ground moves in waves or ripples. Large amounts of rock move position. Landscape altered, or leveled by several meters. Even the routes of rivers can be changed.

Richter Scale

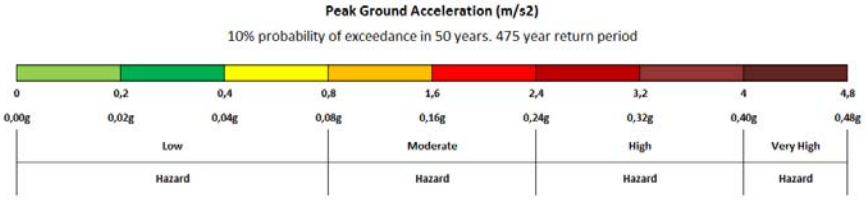
Measures energy released at focus (logarithmic scale)

RICHTER SCALE			
Magnitude		TNT Equivalent	Example
0	1.0	kg / 35 ounces	Breaking a rock on a lab table
0.5	5.6	kg / 12 lbs	
1	31.6	kg / 70 lbs	Large blast at a construction site
1.5	178.0	kg / 395 lbs	
2	1.0	ton	Large quarry or mine blast
2.5	5.6	tons	
3	31.6	tons	
3.5	178.0	tons	
4	1000.0	tons	Small nuclear weapon
4.5	56000.0	tons	Average tornado
5	316000.0	tons	
5.5	178000.0	tons	
6	1.0	million tons	
6.5	5.6	million tons	Northridge, CA quake, 1994
7	31.6	million tons	Largest thermonuclear weapon
7.5	178.0	million tons	
8	1.0	billion tons	
8.5	5.6	billion tons	
9	31.6	billion tons	
9.5	178.0	billion tons	Chilean quake, 1960
10	1.0	trillion tons	Never registered

Magnitude Change	Ground Motion Change (Displacement)	Approx. Energy Change
0.1	1.3 times	1.4 times
0.3	2.0 times	3 times
0.5	3.2 times	5.5 times
1.0	10 times	32 times
2.0	100 times	1,000 times
3.0	1,000 times	32,000 times
4.0	10,000 times	1,000,000 times

Peak Ground Acceleration

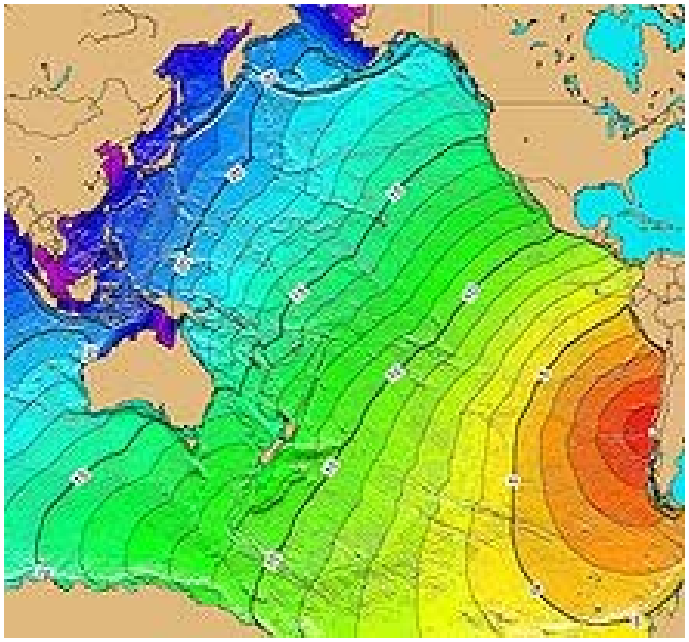
Measures horizontal waves' maximum acceleration on the surface in "g" (m/s^2)



MMI Scale	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
PGA(g)					0.01		0.10	0.2	0.3			
OBE&SSE							OBE		SSE			
Richter Magnitude	1	2	3	4	5	6	7	8	9			

* Richter Magnitude formula according to MMI scale: M=1+MMI×(2/3)(Gutenberg & Richter, 1956)
* MMI scale formula according to PGA(g): MMI=3logA+1.5(Gutenberg & Richter, 1956)

Most Powerful Earthquake Recorded



Chile - Valdivia (May 22nd, 1960)

- 3000 casualties
- 2.000.0000 evacuated
- 6.000.000.000$ damages (actualized 2011)

Details

- Depth: 39km / 25mi
- Duration: 6 minutes
- Mercalli: XI/XII
- Richter: 9.5
- PGA: 0.33g

Magnitude Change	Ground Motion Change (Displacement)	Approx. Energy Change
0.1	1.3 times	1.4 times
0.3	2.0 times	3 times
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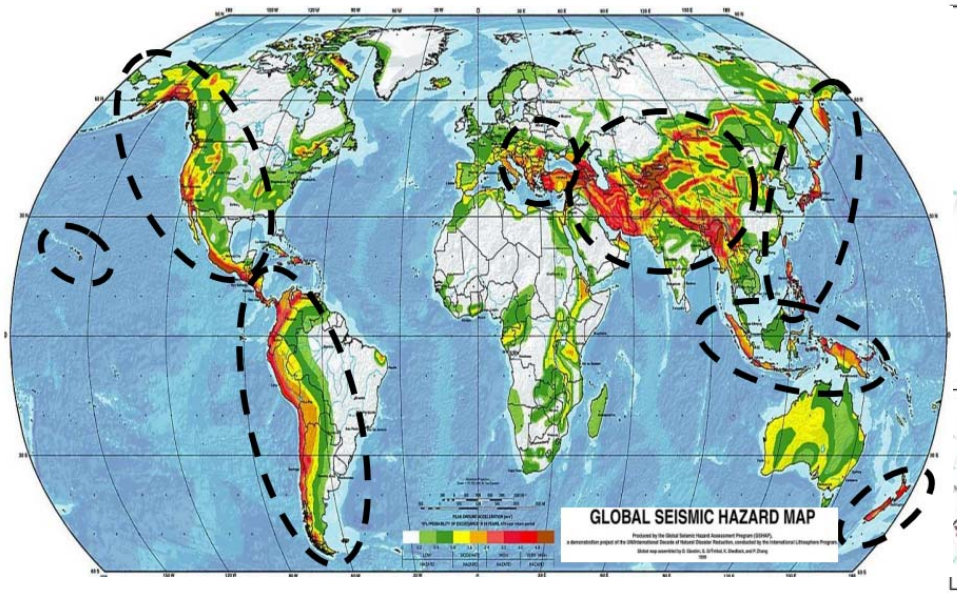
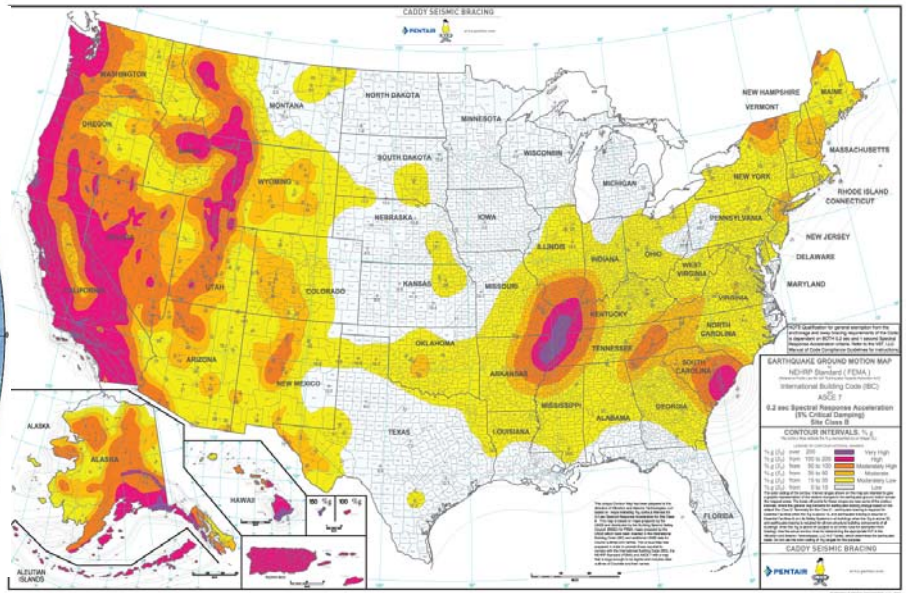
Seismic Maps





Eliminating the Confusion from Seismic Codes & Standards

PART 2

by
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nVent CADDY Sr. Business Development Manager, Seismic
Member ASCE 19 Committee on Structural Applications
Member NFPA 13 Committee on Hanging and Bracing
Member UL 203 STP for Listing of Hangers and Seismic Braces

History

- 1977
  - Earthquake Hazards Reduction Act (Public law 95-124)
  - NEHRP Standards (National Earthquake Hazards Reduction Program)
  - No requirement for implementing NEHRP Standards
- 1990
  - Public Law 101-614 amendments to 95-124
  - E.O. (Executive Order) 12699 is signed to implement the law
  - FEMA in charge of implementing NEHRP Standards
    - Recommended Seismic Provisions for New Buildings and Other Structures.
    - New construction started after January 4,1993
    - Federally owned, regulated or funded by Federal loans, grants or loan guarantees
  - Building Seismic Safety Council
    - Certifies Model Building Codes for NEHRP compliance
      - ICBO UBC Uniform Building Code
      - BOCA National Building Code
      - SBCCI Standard Building Code

History Cont'd

- 1996
  - UBC, BOCA & SBCCI
    - Agree not to publish further updates to their Codes
    - Agree to promulgate the use of the IBC (International Building Code) when published
- 1997
  - UBC publishes a 1997 Edition of its Building Code
- 2000
  - ICC (International Code Conference) published its 1st Edition of the IBC
  - BSSC certified the 2000 IBC to satisfy NEHRP and the Federal Law

History Cont'd

- 2003
  - ICC (International Code Conference) published the 2003 IBC
  - BSSC certified the 2003 IBC to satisfy NEHRP and the Federal Law
  - 2003 IBC also generally references **ASCE 7-02 Minimum Design Loads for Buildings for seismic protection**
- 2006
  - ICC (International Code Conference) published the 2006 IBC
  - BSSC certified the 2006 IBC to satisfy NEHRP and the Federal Law
  - 2006 IBC specifically references ASCE 7-05 for seismic protection
    - **ASCE 7-05 Chapter 13 Seismic Design Requirements for Nonstructural Components**

History Cont'd

- 2009
  - ICC published the 2009 IBC
  - BSSC certified the 2009 IBC to satisfy NEHRP and the Federal Law
  - 2009 IBC specifically references ASCE 7-05 for seismic protection
    - **ASCE 7-05 Chapter 13 Seismic Design Requirements for Nonstructural Components**
- 2012
  - ICC (International Code Conference) published the 2012 IBC
  - BSSC certified the 2012 IBC to satisfy NEHRP and the Federal Law
  - 2012 IBC specifically references ASCE 7-10 for seismic protection
    - **ASCE 7-10 Chapter 13 Seismic Design Requirements for Nonstructural Components**

History Cont'd

- 2015
  - ICC published the 2015 IBC
  - BSSC certified the 2015 IBC to satisfy NEHRP and the Federal Law
  - 2015 IBC specifically references ASCE 7-10 for seismic protection
    - **ASCE 7-10 Chapter 13 Seismic Design Requirements for Nonstructural Components**
- 2016
  - E.O. (Executive Order) 13717
    - Cancels and replaces E.O. 12699
    - NIST (National Institute of Science and Technology) replaced FEMA as lead agency
    - ICSSC (Interagency Committee on Seismic Safety in Construction) replaced BSSC for implementation of NEHRP
    - Requires compliance with 2015 IBC or later seismic provisions

History Cont'd

- 2018
  - ICC published the 2018 IBC
  - ICSSC certified the 2018 IBC to satisfy NEHRP and the Federal Law
  - 2018 IBC specifically references ASCE 7-16 for seismic protection
    - **ASCE 7-16 Chapter 13 Seismic Design Requirements for Nonstructural Components**

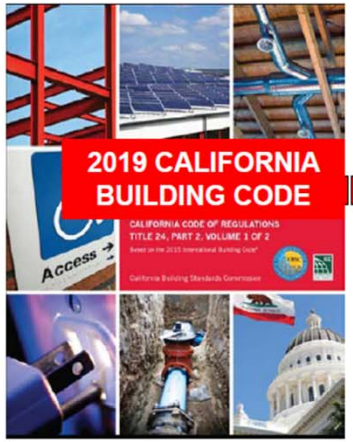
Federal Documents

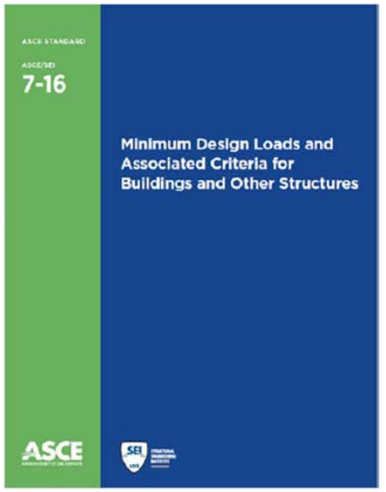
- NEHRP specifically references Seismic Provisions of ASCE 7
- ALL Federal Agencies are required to comply with NEHRP
  - CEGS (Corps of Engineers Guide Spec)
  - NAV-FAC (Naval Facilities Engineering Command)
  - UFGS (Unified Facilities Guide Specifications
- ALL reference **ASCE 7 Chapter 13 Seismic Design Requirements for Nonstructural Components**

CBC / OSHPD

- CBC (California Building Code) is the IBC
- OSHPD Code is the CBC with further restrictions / exceptions
  - OSHPD Code is for California owned and regulated hospital facilities
  - Exceptions to the CBC are published “Express Terms”
  - Code Application Notices (CANs) to interpret specific sections of the CBC
  - Policy Intent Notice (PIN) is the OSHPD policy on a specific subject
  - **ASCE 7-16 Chapter 13 Seismic Design Requirements for Nonstructural Components**

2019 California Building Code (CBC 2019)





ASCE 7 Chapter 13

- Chapter 13 of ASCE 7-10 appears in pages 111-125
- Section 13.2 General Design Requirements
- Section 13.2.2 Special Certification Requirements for Designated Seismic Systems
  - Certain Active Mechanical & Electrical equipment
- Section 13.2.5 Testing Alternative for Seismic Capacity Determination
  - References ICC-ES (International Code Conference Evaluation Service) AC 156 shake table testing
  - While possibly desirable for marketing, NEBS Level 3 Zone 4 Compliance Testing per Telcordia Technologies GR-63 CORE is not recognized by the ICC or ASCE 7

ASCE 7 Chapter 13 Cont'd.

- Section 13.5.7 Access Floors
- Section 13.6.4 Electrical Components
- Section 13.6.5.6 Conduit, Cable Tray, and Other Electrical Distribution Systems (Raceways)
- Section 13.6.11 Other Mechanical and Electrical Components
- Section 13.1.4 EXEMPTIONS

Moral of the Story

- Get the ASCE 7 edition that is referenced by the applicable Code
- Read Chapter 13.
- Mystery Solved!

Eliminating the Confusion from Seismic Codes & Standards

PART 3
Overview of the International Legal and Code Landscape

by

Olivier S. Braquet
nVent CADDY Director, Global Seismic Business

Examples of Standards Internationally Used

- ISO/IEC 11801, Generic Cabling for Customer Premises
- ISO/IEC 18010:2002, Pathways and Spaces
- ISO/IEC 24764, Generic Cabling Systems for Data Centres
- **ISO/IEC 14763-2: 2012,** Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation
- ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
- ANSI/TIA-606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centres
- IEEE 802.3af, Power over Ethernet (PoE) Standard
- ...

Example of Standard Language

- **ISO/IEC 14763-2 (2012),** Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation
- **Section 5.3.5. Environmental conditions**
- **Section 5.3.5.1 Requirements**
- **… the following environmental considerations shall be taken into consideration:**
- Impact of natural events e.g. lightning strike, earthquake

Examples of Regionally Used Standards Cont'd.

- **EU**
  - **EN 50173,** Information Technology – General Cabling Systems
  - **EN 50173 Part 2,** Installation Planning and Practices Inside Buildings
- **Australia**
  - **AS/NZS 3080:2013,** Information technology – Generic cabling for customer premises
  - **AS/NZS 3084:2003(R2013),** Telecommunications installations - Telecommunications pathways and spaces for commercial buildings
  - **EIA/TIA 568 & 569,** Generic Telecommunications Cabling for Customer Premises & Pathways and Spaces
- **China**
  - **GB 50174:2017** Code for design of electronic information system rooms and data centers

No guidance

Moral of the International Landscape

- No international legal or code document provide enough guidance,
- Most national laws guide designer towards using regionally recognized codes and standards when the national level is not enough, and using international codes and standards when the regional level is in turn not enough,

So, since outside of the U.S. laws and codes do not specify what to do and how to do it:

- Get the latest edition of ASCE 7
- Read Chapter 13.
- Mystery Solved!