ASCE 41-13
Performance Based Seismic Evaluation and Retrofit of Existing Buildings

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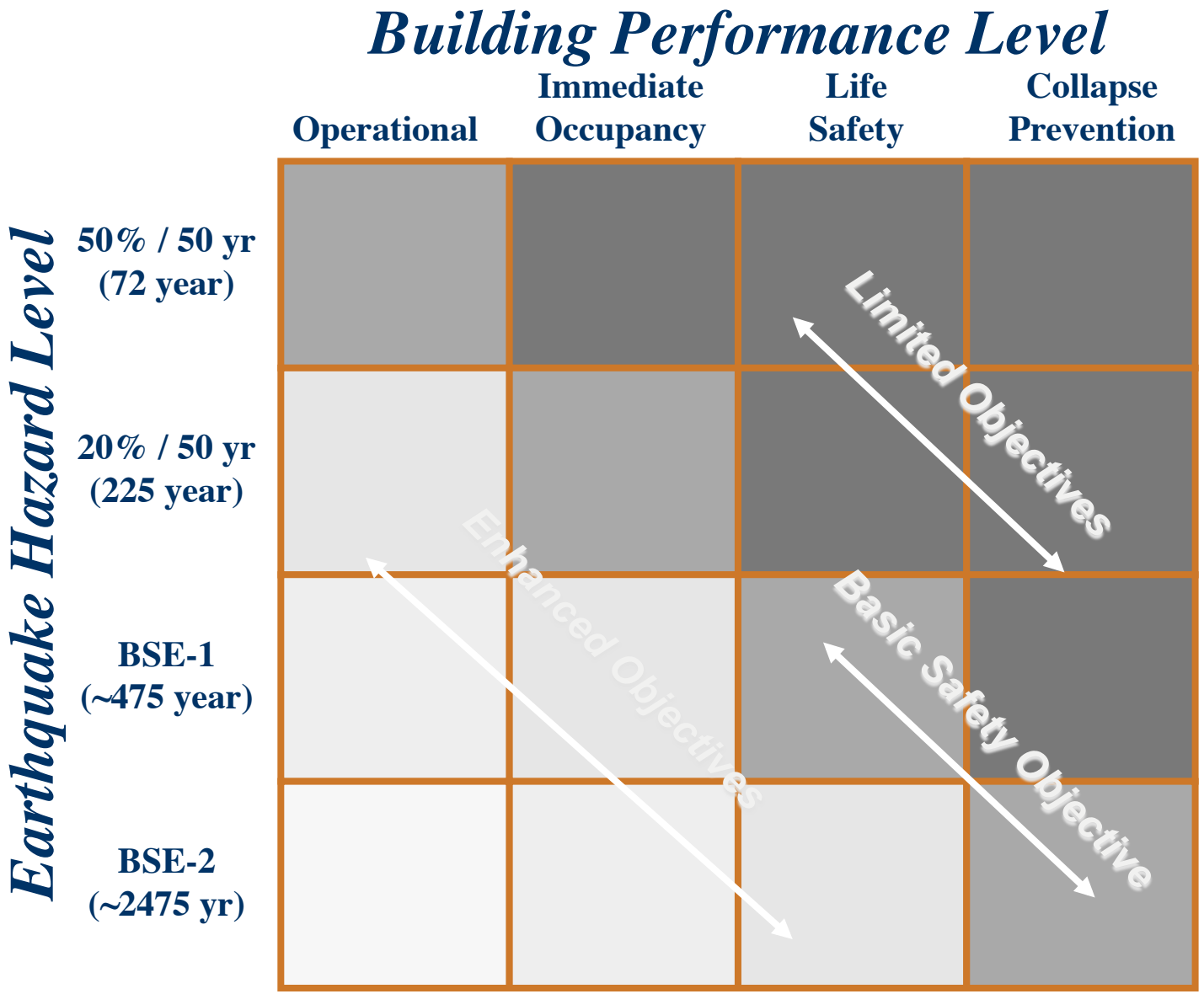
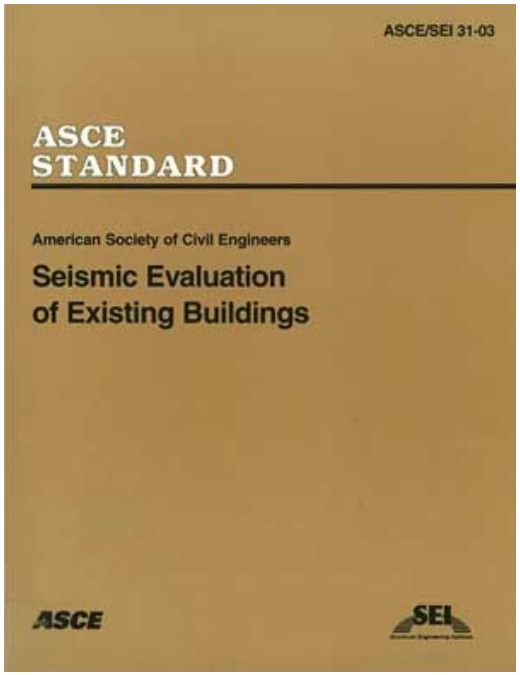
Existing Building Tools

- **0.75*1976 UBC**
- **ATC 3-06**
- **ATC 14**
- **FEMA 178 → 310 → ASCE 31-03**
  Evaluating Existing Buildings
- **FEMA 273 → 356 → ASCE 41-06**
  "Rehabilitation" of Existing Buildings
- **ASCE 41-13**
  Evaluating and "Retrofit" of Existing Buildings


Building Performance Level
Operational
Immediate Occupancy
Life Safety
Collapse Prevention
Earthquake Hazard Level
50% / 50 yr (72 year)
20% / 50 yr (225 year)
BSE-1 (~475 year)
BSE-2 (~2475 yr)
Limited Objectives
Enhanced Objectives
Basic Safety Objective

Overview of the New Standard



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ASCE 41-13

General Provisions

The Old

ASCE 31-03

- Two Performance Levels – Life Safety & Immediate Occupancy
- One Seismic Hazard – (2/3)*MCE
- Buried within the acceptance criteria is a factor of 0.75, which is intended to give existing buildings a “break”

ASCE 41-06

- Three Performance Levels – Collapse Prevention, Life Safety & Immediate Occupancy
- Performance ranges between levels
- Two Seismic Hazard – 10%/50 or (2/3)*MCE and MCE
- No break for existing buildings
- Basic Safety Objective ≈ Performance of Occupancy Category II

The New

New Design Equivalent Hazards – No "Break"

BSE-2N is the ASCE 7-10 MCE_R

BSE-1N is 2/3*ASCE 7-10 MCE_R

Existing Building Hazards – the "Break"

BSE-2E is the 5% in 50-year (975-year)

BSE-1E is the 20% in 50-year (225-year)

BSE-2E and BSE-1E cannot be greater than the BSE-2N and BSE-1N

- In SF, San Jose, parts of LA, and Oakland this means no force reduction for existing buildings

Seismic Design Maps & Tools
US Seismic Design Maps
Use the Tool
Documentation & Help
Java Ground Motion Parameter Calculator
Download the Tool
Documentation & Help
Worldwide Seismic Design Values
Use the Tool
Documentation & Help

U.S. Seismic Design Maps

Please note that the most recent design code(s) (e.g., 2012 International Building Code) may not yet govern in your municipality. If you are unsure of which document is currently enforced in your area, please consult your local building or transportation official before using this application.

Application | Batch Mode | Help

Design Code Reference Document
Consult your local design official if you need help selecting this.
2013 ASCE 41 (dev only)

Earthquake Hazard Level
The particular analysis procedure to use.
BSE-2E

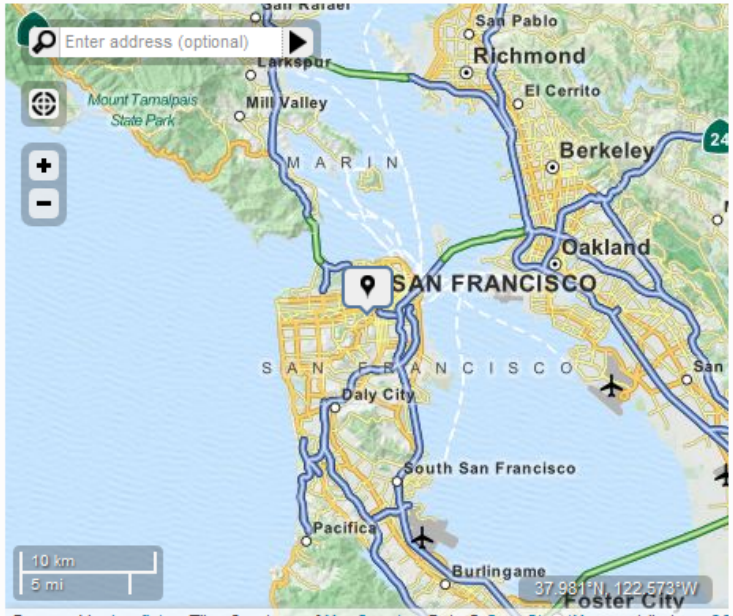
Report Title (Optional)
This will appear at the top of the generated report.

Site Soil Classification
This is **not** automatically selected based on site location.
Site Class D - "Stiff Soil" (Default)

Site Latitude
Decimal degrees for the site location.
37.766

Site Longitude
Decimal degrees for the site location.
-122.435

Compute Values



Sacramento Example

New Design Equivalent Hazards – No “Break”

BSE-2N is 0.87

BSE-1N is 0.58

Existing Building Hazards – the “Break”

BSE-2E is 0.66

BSE-1E is 0.44

San Francisco Example

New Design Equivalent Hazards – No “Break”

BSE-2N is 1.50

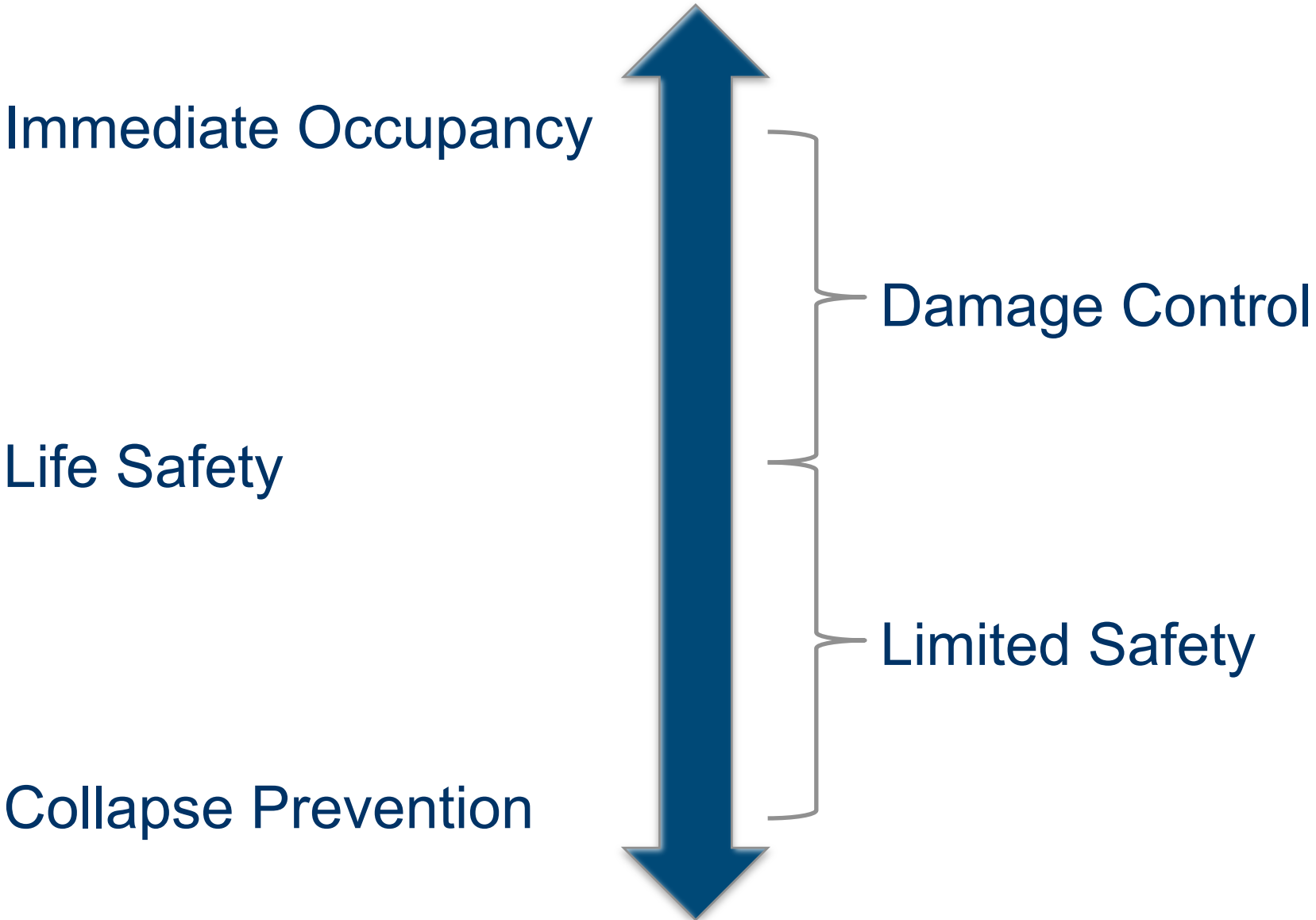
BSE-1N is 1.00

Existing Building Hazards – the “Break”

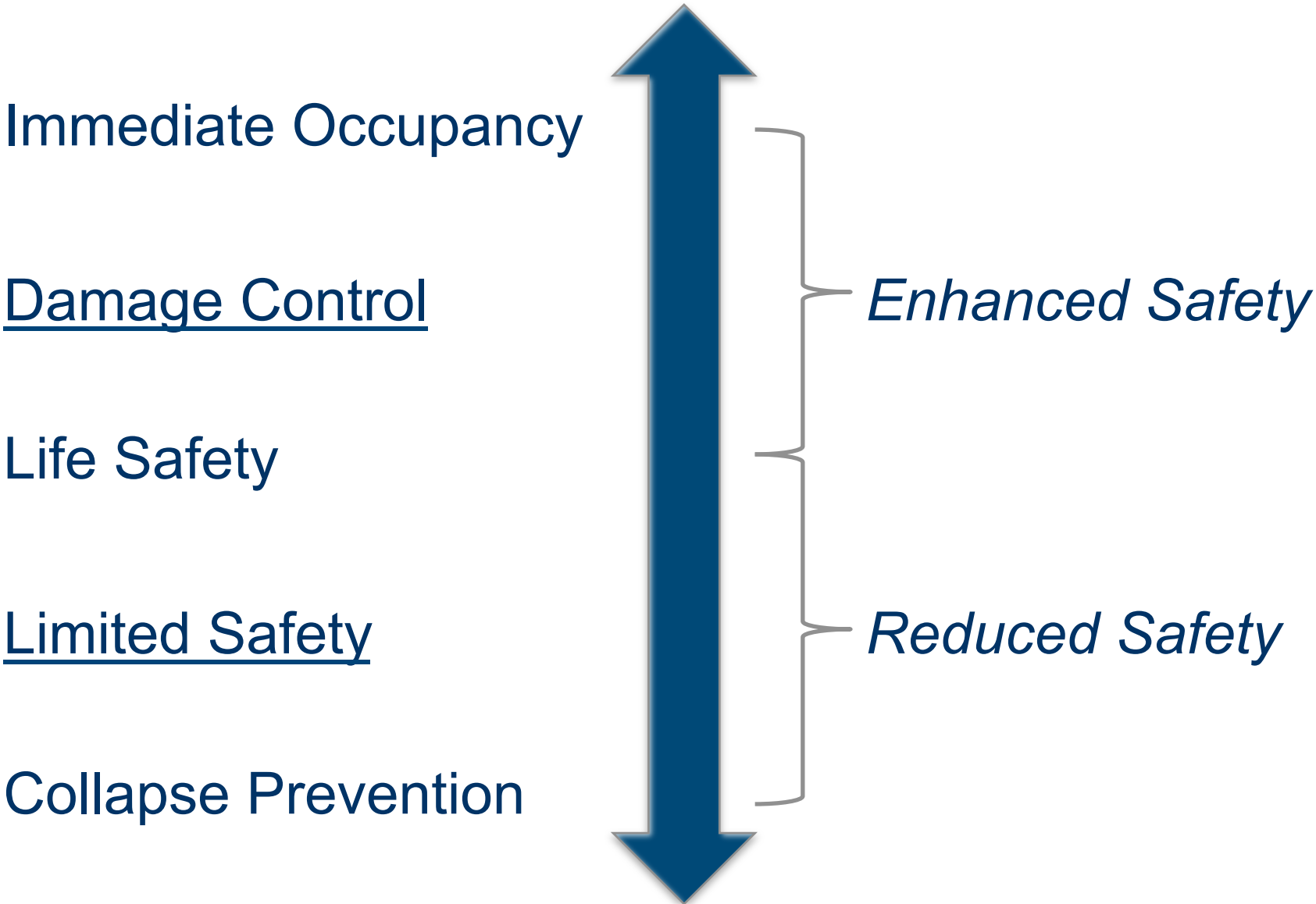
BSE-2E is 1.48

BSE-1E is 0.99

Old Structural Performance Levels & Ranges



New Structural Performance Levels & Ranges



‘06 Nonstructural Performance Levels

Operational

Immediate Occupancy

Life Safety

Hazards Reduced

Not Considered

Nonstructural Performance Levels

Operational

Position Retention

Life Safety

Not Considered

ASCE 7 I_p = 1.5

ASCE 7 I_p = 1.0

Actually can seriously injure or kill

Basic Performance Objective for Existing Buildings - BPOE

	Tier 1	Tier 2	Tier 3	
Risk Category	BSE-1E	BSE-1E	BSE-1E	BSE-2E
I & II	**Life Safety** Structural Performance **Life Safety** Nonstructural Performance (3-C)	**Life Safety** Structural Performance **Life Safety** Nonstructural Performance (3-C)	**Life Safety** Structural Performance **Life Safety** Nonstructural Performance (3-C)	**Collapse Prevention** Structural Performance Nonstructural Performance Not Considered (5-D)
III	**Damage Control** Structural Performance **Position Retention** Nonstructural Performance (2-B)	**Damage Control** Structural Performance **Position Retention** Nonstructural Performance (2-B)	**Damage Control** Structural Performance **Position Retention** Nonstructural Performance (2-B)	**Limited Safety** Structural Performance Nonstructural Performance Not Considered (4-D)
IV	**Immediate Occupancy** Structural Performance **Position Retention** Nonstructural Performance	**Immediate Occupancy** Structural Performance **Position Retention** Nonstructural	**Immediate Occupancy** Structural Performance **Position Retention** Nonstructural	**Life Safety** Structural Performance Nonstructural Performance Not

Basic Performance Objective Equivalent to New Building Standards - BPON

	Tier 3	
Risk Category	BSE-1N	BSE-2N
I & II	**Life Safety** Structural Performance **Position Retention** Nonstructural Performance (3-C)	**Collapse Prevention** Structural Performance Nonstructural Performance Not Considered (5-D)
III	**Damage Control** Structural Performance **Position Retention** Nonstructural Performance (2-B)	**Limited Safety** Structural Performance Nonstructural Performance Not Considered (4-D)
IV	**Immediate Occupancy** Structural Performance **Operational** Nonstructural Performance (1-A)	**Life Safety** Structural Performance Nonstructural Performance Not Considered (3-D)

Limits on Deficiency-Based Procedures

Only allowed for Model Bldg type in each direction

Limited use for mixed systems

Tier 2 now allowed for IO retrofit

Table 3-2 Limitations on the Use of the Tier 1 and Tier 2 Procedures[1]

	Number of Stories[3] beyond which the Tier 3 Systematic Procedures are Required							
	Level of Seismicity							
	Very Low		Low		Moderate		High	
Common Building Type[2]	S-3	S-1	S-3	S-1	S-3	S-1	S-3	S-1
Wood Frames								
Light (W1)	NL	NL	NL	4	4	4	4	4
Multi-Story, Multi-Unit Residential (W1A)	NL	NL	NL	6	6	6	6	4
Commercial and Industrial (W2)	NL	NL	NL	6	6	6	6	4
Steel Moment Frames								
Rigid Diaphragm (S1)	NL	NL	NL	12	12	8	8	6
Flexible Diaphragm (S1A)	NL	NL	NL	12	12	8	8	6
Steel Braced Frames								
Rigid Diaphragm (S2)	NL	NL	NL	8	8	8	8	6
Flexible Diaphragm (S2A)	NL	NL	NL	8	8	8	8	6
Steel Light Frames (S3)	NL	1	1	1	1	1	1	1
Dual Systems with Backup Steel Moment Frames (S4)	NL	NL	NL	12	12	8	8	6
Steel Frames with Infill Masonry Shear Walls								
Rigid Diaphragm (S5)	NL	NL	NL	12	12	8	8	4
Flexible Diaphragm (S5A)	NL	NL	NL	12	12	8	8	4
Concrete Moment Frames (C1)	NL	NL	NL	12	12	8	8	6
Concrete Shear Walls								
Rigid Diaphragm (C2)	NL	NL	NL	12	12	8	8	6
Flexible Diaphragm (C2A)	NL	NL	NL	12	12	8	8	6
Concrete Frame with Infill Masonry Shear Walls								
Rigid Diaphragm (C3)	NL	NL	NL	12	12	8	8	4
Flexible Diaphragm (C3A)	NL	NL	NL	12	12	8	8	4
Precast/Tilt-up Concrete Shear Walls								
Flexible Diaphragm (PC1)	NL	NL	3	2	2	2	2	2
Rigid Diaphragm (PC1A)	NL	NL	3	2	2	2	2	2
Precast Concrete Frames								
With Shear Walls (PC2)	NL	NL	NL	6	6	NP	4	NP
Without Shear Walls (PC2A)	NL	NL	NL	6	6	NP	4	NP
Reinforced Masonry Bearing Walls								
Flexible Diaphragm (RM1)	NL	NL	NL	8	8	8	8	6
Rigid Diaphragm (RM2)	NL	NL	NL	8	8	8	8	6
Unreinforced Masonry Bearing Walls								
Flexible Diaphragm (URM)	NL	NL	6	4	6	NP	4	NP
Rigid Diaphragm (URMA)	NL	NL	6	4	6	NP	4	NP

[1] The Tier 3 Systematic procedures are required for buildings with more than the number of stories listed herein.

[2] Common Building Types are defined in Section 3.2.1.

[3] Number of stories shall be considered as the number of stories above lowest adjacent grade.

NL = No Limit (No limit on the number of stories).

NP = Not Permitted (Tier 3 Systematic procedures are required).

Current Issues


ASCE STANDARD
ASCE/SEI 41-06
Seismic Rehabilitation of Existing Buildings
ASCE
SEI

≠


ASCE STANDARD
ASCE/SEI 7-10
Minimum Design Loads for Buildings and Other Structures
This document uses both the International System of Units (SI) and customary units
ASCE
SEI

≠

Reality

Greatest Impediments

It’s too @*$% Conservative!

Greatest Impediments

DCR = 0.99 => Life Safe

DCR = 1.06 => Not Life Safe

Deterministic Standard for a Probabilistic Phenomena

Possible Future Directions

≈

“Consistency”

Probability Of Achieving a Performance Level

Immediate Occupancy	Collapse Prevention
90% in BSE-1N	97% in BSE-2N
75% in BSE-1N	94% in BSE-2N
50% in BSE-1N	90% in BSE-2N

Probability Of Achieving a Performance Level

Immediate Occupancy	Collapse Prevention
90% in BSE-1N	97% in BSE-2N
75% in BSE-1N	94% in BSE-2N
50% in BSE-1N	90% in BSE-2N

Reduce the “false positives”

ASCE 41-13
Seismic Evaluation and Retrofit of Existing Buildings

Your Thoughts & Questions?