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Course Description

This course investigates the differences between the seismic portions of the 2014 New York City Building Code and the latest released Code.

The objective is to highlight and explain the modifications and additional requirements in seismic design.

Learning Objectives

1. Computing seismic base shear
2. Designing seismic considering electronic values of mapped acceleration parameters
3. New seismic requirements for geotechnical investigation and geotechnical peer review
4. New seismic requirements for steel structures
5. Special inspections and tests for seismic resistance

STRUCTURAL CODE TRAINING
SEISMIC

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SUMMARY

0 INTRODUCTION (15 slides)

1 CHAPTER 16: STRUCTURAL DESIGN (8 slides)

2 CHAPTER 18: SOILS AND FOUNDATIONS (3 slides)

3 CHAPTER 22: STEEL (5 slides)

4 CHAPTER 17: SPECIAL INSPECTIONS AND TESTS (7 slides)

INTRODUCTION

- Several fault lines lie underneath New York City.
- Moderate earthquakes (~ 5.0 magnitude) have occurred every 100 years in the region. The last one was in 1884.
- Most buildings were built before 1995, before seismic provisions in the Building Code were adopted ➔ URM are particularly vulnerable to seismic events.
- Dense population and dense built environment heighten the risk.

RISK = PROBABILITY x IMPACT

Moderate seismic hazard + High density & monetary value + Lack of seismic design (before 1995) = HIGH SEISMIC RISK

https://nychazardmitigation.com/hazard-specific/earthquakes/

INTRODUCTION

Geological characteristics

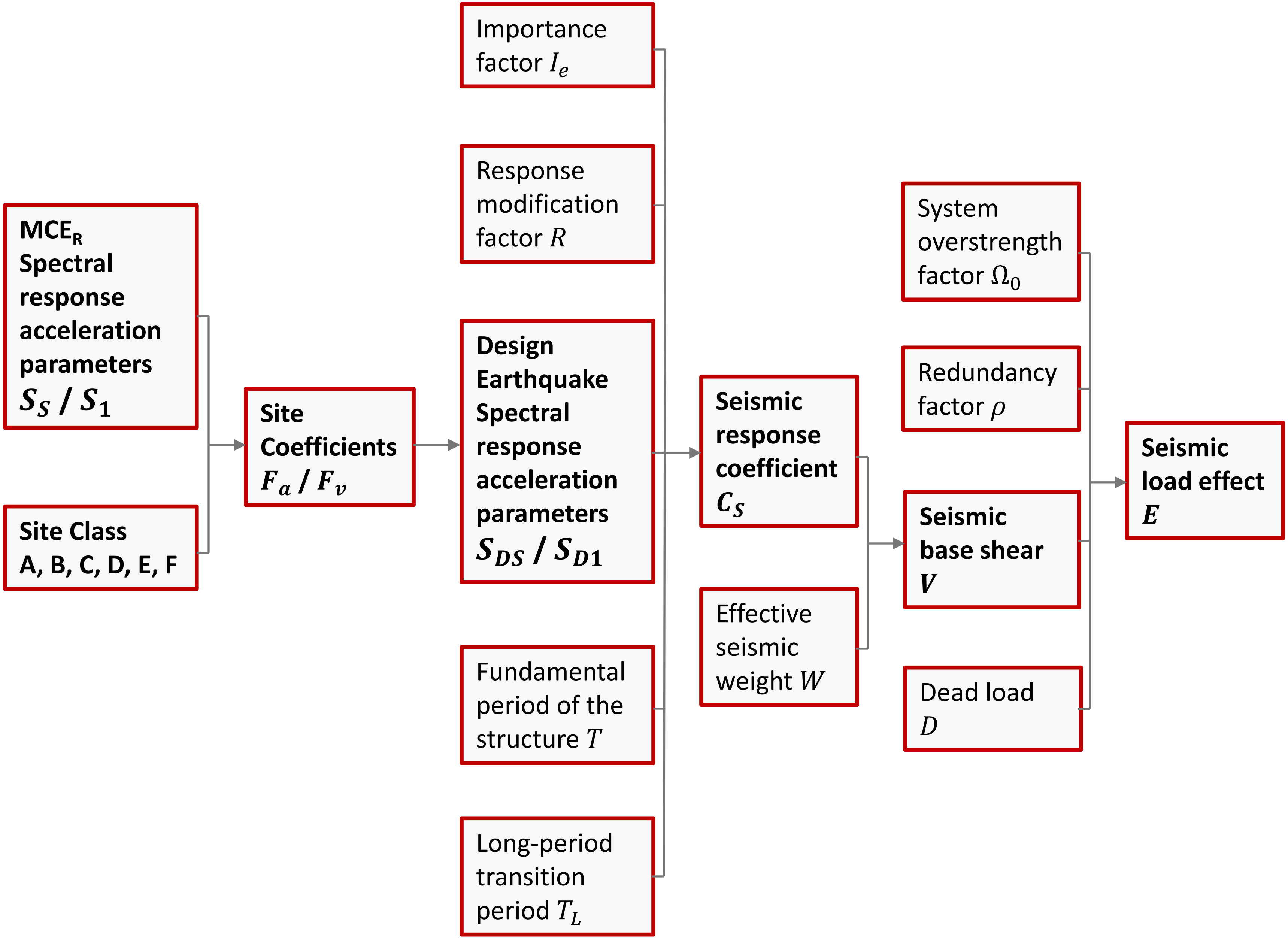
Soil properties

Type of structure

Social importance of the building

↓

SEISMIC DESIGN


Importance factor I_e
Response modification factor R
MCE$_R$ Spectral response acceleration parameters S_S / S_1
Site Class A, B, C, D, E, F
Site Coefficients F_a / F_v
Design Earthquake Spectral response acceleration parameters S_{DS} / S_{D1}
Fundamental period of the structure T
Long-period transition period T_L
Seismic response coefficient C_S
Effective seismic weight W
System overstrength factor Ω_0
Redundancy factor ρ
Seismic base shear V
Dead load D
Seismic load effect E

HOW TO COMPUTE SEISMIC BASE SHEAR?

EQUIVALENT LATERAL FORCE PROCEDURE

- Seismic base shear: $V = C_s W$

where

W is the effective seismic weight
C_s is the seismic response coefficient

- Seismic response coefficient: $C_S = \frac{S_{DS}}{\left(\frac{R}{I_e}\right)}$

where

S_{DS} is the design spectral response acceleration parameter at short period (0.2s)
R is the response modification factor
I_e is the importance factor

HOW TO COMPUTE SEISMIC BASE SHEAR?

- But C_s need not exceed the following:

$$C_S = \frac{S_{D1}}{T\left(\frac{R}{I_e}\right)} \qquad for\ T \le T_L$$

$$C_S = \frac{S_{D1}T_L}{T^2\left(\frac{R}{I_e}\right)} \qquad for\ T > T_L$$

where

S_{D1} is the design spectral response acceleration parameter at 1-s period
R is the response modification factor
I_e is the importance factor
T is the fundamental period of the structure
T_L is the long-period transition period

SEISMIC IMPORTANCE FACTOR

Every buildings and other structures shall be assigned an Importance Factor that accounts for the **degree of risk to human life, health**, **and welfare** associated with damage to property or loss of use or functionality.

Risk Category from Table 1.5-1	Seismic Importance Factor, I_e
I	1.00
II	1.00
III	1.25
IV	1.50

ASCE Table 1.5-2 Importance factors by risk category of buildings and other structures for earthquake loads

DESIGN COEFFICIENTS

Response modification coefficient R: Factor that reduces seismic load effects to strength level as specified by the applicable building code. It is the capacity to dissipate energy of the structural system.

Deflection amplification factor C_d: Factor introduced to predict expected maximum deformations from that produced by the design seismic forces. It converts elastic lateral displacements to total nonlinear lateral displacements.

System overstrength factor Ω_0: Factor specified by the applicable building code in order to determine the amplified seismic load, where required by the provisions.

Seismic load effect: $E = E_h + E_v = \boldsymbol{\rho Q_E} + 0.2\ S_{DS}\ D$

Amplified seismic load effect: $\mathrm{E_m} = E_{mh} + E_v = \boldsymbol{\Omega_0 Q_E} + 0.2\ S_{DS}\ D$

where: Q_E = effects of horizontal seismic forces
D = dead load effects
ρ = redundancy factor (Factor assigned to the seismic force-resisting system in each of two orthogonal directions for all structures. Its value equals either 1.0 or 1.3 depending on the Seismic Design Category and the type of structure.)

DESIGN COEFFICIENTS AND FACTORS FOR SEISMIC-FORCE RESISTING SYSTEMS

NYC Building Code 2022 Table 1613.5

Seismic Force-Resisting System	ASCE 7 Section Where Detailing Requirements Are Specified	Response Modification Coefficient	Overstrength Factor	Deflection Amplification Factor	Structural System Limitations Including Structural Height, h_n (ft), Limits[c]		
					Seismic Design Category		
A. BEARING WALL SYSTEMS		R^a	$\Omega_0{}^g$	$C_d{}^b$	B	C	D[d]
1. Special reinforced concrete shear walls[l,m]	14.2	5	2.5	5	NL	NL	160
2. Ordinary reinforced concrete shear walls[l]	14.2	4	2.5	4	NL	NL	NP
3. Detailed plain concrete shear walls[l]	14.2	2	2.5	2	NL	NP	NP
4. Ordinary plain concrete shear walls[l]	14.2	1.5	2.5	1.5	NL	NP	NP
5. Intermediate precast shear walls[l]	14.2	4	2.5	4	NL	NL	40[k]
6. Ordinary precast shear walls[l]	14.2	3	2.5	3	NL	NP	NP
7. Special reinforced masonry shear walls	14.4	5	2.5	3.5	NL	NL	160
8. Intermediate reinforced masonry shear walls	14.4	3.5	2.5	2.25	NL	NL	NP
9. Ordinary reinforced masonry shear walls	14.4	2	2.5	1.75	NL	160	NP
10. Detailed plain masonry shear walls	14.4	2	2.5	1.75	NL	NP	NP

NL = Not Limited ; NP = Not Permitted.

SITE CLASSIFICATION

ASCE 7 Table 20.3-1

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard rock	>5,000 ft/s	NA	NA
B. Rock	2,500 to 5,000 ft/s	NA	NA
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the following characteristics: —Plasticity index $PI > 20$, —Moisture content $w \geq 40\%$, —Undrained shear strength $\bar{s}_u < 500$ psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

<u>Site Class F</u>: Soils vulnerable to potential failure or collapse under seismic loading ; Peats and/or highly organic clays ; Very high plasticity clays ; Very thick soft/medium stiff clays

where

$\bar{v}_s$ is the average shear wave velocity

$\bar{N}$ is the average field standard penetration resistance

$\overline{N_{ch}}$ is the average field standard penetration resistance for cohesionless soil layers

(free-running soils, whose strength depends on friction between particles: sands, gravels…)

$\overline{s_u}$ is the average undrained shear strength

SITE CLASSIFICATION

ASCE 7 Table 20.3-1

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard rock	>5,000 ft/s	NA	NA
B. Rock	2,500 to 5,000 ft/s	NA	NA
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the following characteristics: —Plasticity index $PI > 20$, —Moisture content $w \geq 40\%$, —Undrained shear strength $\bar{s}_u < 500$ psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

Seismic waves travel faster through hard rocks than through softer soils. As the waves pass from deeper harder to shallow softer rocks they slow down and get bigger in amplitude as the energy piles up.

Softer soils amplify ground motion.

SEISMIC DESIGN CATEGORY

NYC Building Code Table 1613.3.5

RISK CATEGORY	SITE CLASS		
	A	B/C/D	E
I/II/III	**A**	**B**	**C**
IV	**A**	**C**	**D**

- Seismic Design Category E: Risk category I, II, or III structures located where the mapped spectral response acceleration parameter at 1-s period $S_1 \geq 0.75g$.
- Seismic Design Category F: Risk category IV structures located where the mapped spectral response acceleration parameter at 1-s period $S_1 \geq 0.75g$.

Seismic Design Category determines the level of detailing for seismic design requirement, as specified in the Building Code.

Exception: Buildings and other structures assigned to SDC A are exempt from seismic design requirements.

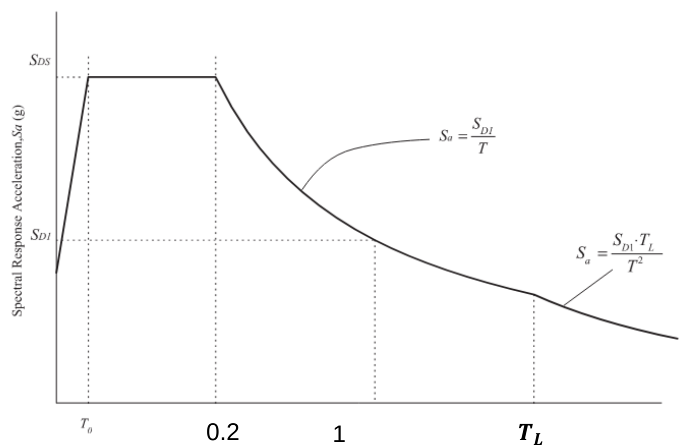
MAPPED ACCELERATION PARAMETERS

<u>MAPPED RISK-TARGETED MAXIMUM CONSIDERED EARTHQUAKE spectral response acceleration</u>:

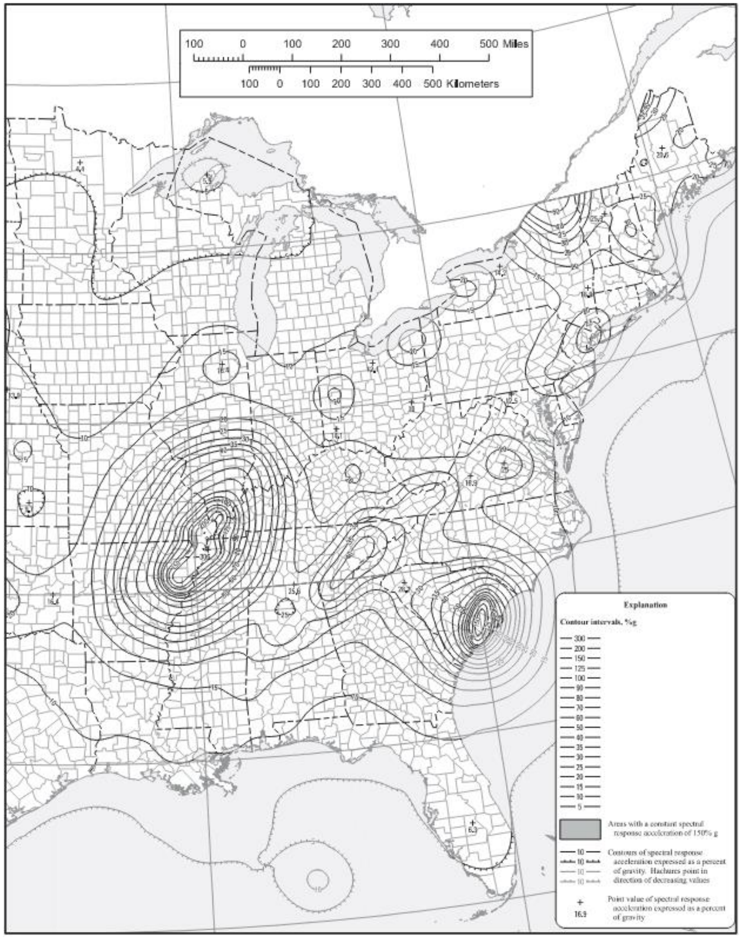
Most severe earthquake effects considered by this standard with 2% probability of exceedance in 50 years (2,500 years mean recurrence interval).

Determined from the maps in ASCE 7, chapter 22.

- $\boldsymbol{S_S}$: spectral response acceleration parameter at 0.2s short-period
- $\boldsymbol{S_1}$: spectral response acceleration parameter at 1s period
- $\boldsymbol{T_L}$: long-period transition period



Design Response Spectrum



S_S Risk-Adjusted Maximum Considered Earthquake (MCER) Ground Motion Parameter for the United States for 0.2 s Spectral Response Acceleration (5% of Critical Damping), Site Class B.

MAPPED ACCELERATION PARAMETERS

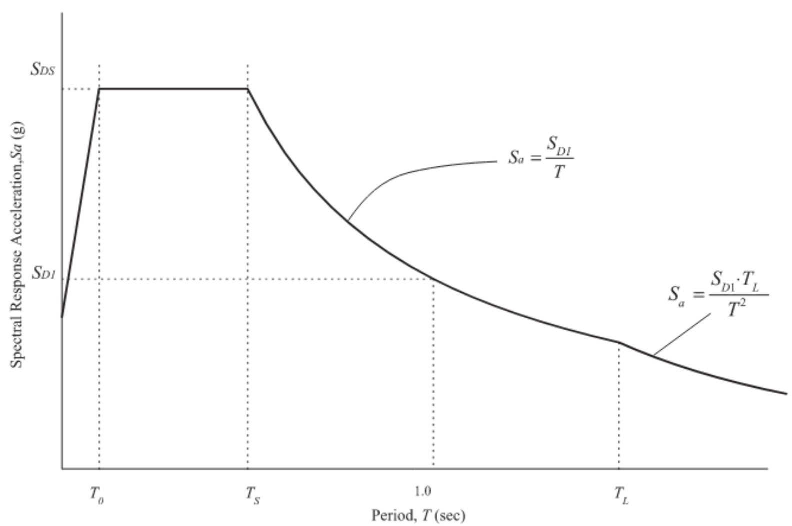
RISK-TARGETED MAXIMUM CONSIDERED EARTHQUAKE spectral response acceleration parameters: ADJUSTED FOR SITE CLASS EFFECTS with site coefficients F_a and F_v

$$S_{MS} = F_a S_S \qquad S_{M1} = F_v S_1$$

DESIGN EARTHQUAKE spectral response acceleration parameters:

Design Earthquake with 10% probability of exceedance in 50 years (expected to occur once in 500 years).

$$S_{DS} = {}^2/_3\, S_{MS} \qquad S_{D1} = {}^2/_3\, S_{M1}$$



Design Response Spectrum

SITE COEFFICIENTS F_a & F_v

ASCE 7 Tables 11.4-1 & 11.4-2

Table 11.4-1 Site Coefficient, F_a

	Mapped Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameter at Short Period				
Site Class	$S_S \le 0.25$	$S_S = 0.5$	$S_S = 0.75$	$S_S = 1.0$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7				

Note: Use straight-line interpolation for intermediate values of S_S.

Table 11.4-2 Site Coefficient, F_v

	Mapped Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameter at 1-s Period				
Site Class	$S_1 \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \ge 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7				

Note: Use straight-line interpolation for intermediate values of S_1.

WHAT ARE THE DIFFERENCES IN THE SEISMIC PORTIONS OF THE NEW YORK CITY BUILDING CODES BETWEEN 2014 AND 2022?

2014 PROVISIONS

2022 PROVISIONS

CHAPTER 16:

STRUCTURAL DESIGN

- Mapped maximum considered earthquake acceleration parameters
- Site coefficients
- Electronic values for mapped acceleration parameters
- Determination of Seismic Design Category
- Design coefficients
- Ballasted photovoltaic panel systems

MAPPED ACCELERATION PARAMETERS

1613.3.1. The mapped maximum considered earthquake spectral response acceleration at short period and at 1-s period shall be, respectively:

S_s = 0.296g S_1 = 0.061g

2014 provision: S_s = 0.281g S_1 = 0.073g

- VALUES PROVIDED BY THE CODE FOR ALL LOCATIONS IN NEW YORK CITY

SITE COEFFICIENTS F_a & F_v

TABLE 1613.3.3(1)
Values of site coefficient F_a as a function of site class and mapped spectral response acceleration at short periods (S_s)

SITE CLASS	F_a (2014)	F_a (2022)
A	0.80	0.80
B (V_s measured)	1.00	0.90
B (V_s unmeasured)		1.00
C	1.20	1.30
D	1.57	1.57
E	2.37	2.28
F	Note a	Note a

a. Site-specific geotechnical investigation and dynamic site response analyses shall be performed to determine appropriate values

TABLE 1613.3.3(2)
Values of site coefficient F_v as a function of site class and mapped spectral response acceleration at 1-s period (S_1)

SITE CLASS	F_v (2014)	F_v (2022)
A	0.80	0.80
B (V_s measured)	1.00	0.90
B (V_s unmeasured)		1.00
C	1.70	1.50
D	1.57	2.40
E	3.50	4.20
F	Note a	Note a

a. Site-specific geotechnical investigation and dynamic site response analyses shall be performed to determine appropriate values

- INCREASING THE SITE COEFFICIENTS INCREASES THE EARTHQUAKE LOAD

DETERMINATION OF SEISMIC DESIGN CATEGORY

2022 Table 1613.3.5

RISK CATEGORY	SITE CLASS		
	A	B/C/D	E
I/II/III	**A**	**B**	**C**
IV	**A**	**C**	**D**

- SHORTCUT METHOD TO DETERMINE THE SEISMIC DESIGN CATEGORY

Alternative seismic design category determination: The seismic design category is permitted to be determined from Table 11.6-1 of ASCE 7 alone, except for Risk Category IV structures for which Table 1613.3.5 of this code shall be used.

2014 Table 1613.5.6 / ASCE 7 Table 11.6-1

TABLE 1613.5.6(1) SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD (0.2 SECOND) RESPONSE ACCELERATIONS

VALUE OF S_{DS}	RISK CATEGORY[a]		
	I & II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g < S_{DS} < 0.33g$	B	B	C
$0.33g < S_{DS} < 0.50g$	C	C	D
$0.50g < S_{DS}$	D[a]	D[a]	D[a]

TABLE 1613.5.6(2) SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

VALUE OF S_{D1}	RISK CATEGORY[a]		
	I & II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g < S_{D1} < 0.133g$	B	B	C
$0.133g < S_{D1} < 0.20g$	C	C	D
$0.20g \leq S_{D1}$	D[a]	D[a]	D[a]

MAPPED ACCELERATION PARAMETERS: ELECTRONIC VALUES

- ➢ A NEW METHOD TO DETERMINE **SITE-SPECIFIC** MAPPED ACCELERATION PARAMETERS

1613.3.1. Electronic values of mapped acceleration parameters S_s and S_1 and other seismic design parameters provided at the U.S. Geological Survey (USGS) website may be used as per the guidelines of ASCE 7, Section 11.4.

Seismic design parameters are available from the USGS web services through third-party GUIs:

- ASCE 7 Hazard tool: https://asce7hazardtool.online/
- SEAOC Seismic design tool: https://seismicmaps.org/
- ATC Hazard tool: https://hazards.atcouncil.org/

https://www.usgs.gov/programs/earthquake-hazards

ASCE 7 Hazards Report

Address:
129 W 27th St
New York, New York
10001

Standard: ASCE/SEI 7-22
Risk Category: II
Soil Class: C - Very Dense Soil and Soft Rock

Elevation: 36.12 ft (NAVD 88)
Latitude: 40.746121
Longitude: -73.992355

Site Soil Class:
Results:

PGA_M :	0.18	T_L :	6
S_{MS} :	0.28	S_s :	0.28
S_{M1} :	0.065	S_1 :	0.05
S_{DS} :	0.19	S_{DC} :	
S_{D1} :	0.043	V_{S30} :	530

SITE COEFFICIENTS F_a & F_v DETERMINATION FOR ELECTRONIC VALUES

Table 11.4-1 Site Coefficient, F_a

Site Class	Mapped Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.5$	$S_S = 0.75$	$S_S = 1.0$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7				

Note: Use straight-line interpolation for intermediate values of S_S.

Table 11.4-2 Site Coefficient, F_v

Site Class	Mapped Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameter at 1-s Period				
	$S_1 \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \ge 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7				

Note: Use straight-line interpolation for intermediate values of S_1.

- When electronic values of mapped acceleration parameters are used, the site coefficients cannot be taken from Tables 1613.3.3 of the code.
- GENERAL PROCEDURES IN CHAPTER 11 OF ASCE 7 SHALL BE FOLLOWED TO DETERMINE F_A AND F_V

DESIGN COEFFICIENTS AND FACTORS FOR SEISMIC-FORCE RESISTING SYSTEMS

- MORE RESTRICTIVE PROVISION: HEIGHT LIMITS FROM NOT LIMITED TO 160 FT

Seismic Force-Resisting System	ASCE 7 Section Where Detailing Requirements Are Specified	Response Modification Coefficient	Overstrength Factor	Deflection Amplification Factor	Structural System Limitations Including Structural Height, h_n (ft), Limits[c] Seismic Design Category		
A. BEARING WALL SYSTEMS		R^a	$\Omega_0{}^g$	$C_d{}^b$	B	C	D[d]
1. Special reinforced concrete shear walls[l,m]	14.2	5	2.5	5	NL	NL	160
2. Ordinary reinforced concrete shear walls[l]	14.2	4	2.5	4	NL	NL	NP
3. Detailed plain concrete shear walls[l]	14.2	2	2.5	2	NL	NP	NP
4. Ordinary plain concrete shear walls[l]	14.2	1.5	2.5	1.5	NL	NP	NP
5. Intermediate precast shear walls[l]	14.2	4	2.5	4	NL	NL	40[k]
6. Ordinary precast shear walls[l]	14.2	3	2.5	3	NL	NP	NP
7. Special reinforced masonry shear walls	14.4	5	2.5	3.5	NL	NL	160
8. Intermediate reinforced masonry shear walls	14.4	3.5	2.5	2.25	NL	NL	NP
9. Ordinary reinforced masonry shear walls	14.4	2	2.5	1.75	NL	160	NP
10. Detailed plain masonry shear walls	14.4	2	2.5	1.75	NL	NP	NP

NL = Not Limited ; NP = Not Permitted.

2022 Table 1613.5

DESIGN COEFFICIENTS AND FACTORS FOR SEISMIC-FORCE RESISTING SYSTEMS

- HEIGHT LIMITS FROM NOT LIMITED TO 160 FT
- OVERSTENGTH FACTOR FROM 2 TO 2.5

Seismic Force-Resisting System	ASCE 7 Section Where Detailing Requirements Are Specified	Response Modification Coefficient	Overstrength Factor	Deflection Amplification Factor	Structural System Limitations Including Structural Height, h_n (ft), Limits[c] — Seismic Design Category		
B. BUILDING FRAME SYSTEMS		R^a	$\Omega_0{}^g$	$C_d{}^b$	B	C	D[d]
1. Steel eccentrically braced frames	14.1	8	2	4	NL	NL	160
2. Steel special concentrically braced frames	14.1	6	2	5	NL	NL	160
4. Special reinforced concrete shear walls[l,m]	14.2	6	2.5	5	NL	NL	160
10. Steel and concrete composite eccentrically braced frames	14.3	8	2.5	4	NL	NL	160
11. Steel and concrete composite special concentrically braced frames	14.3	5	2	4.5	NL	NL	160
13. Steel and concrete composite plate shear walls	14.3	6.5	2.5	5.5	NL	NL	160
14. Steel and concrete composite special shear walls	14.3	6	2.5	5	NL	NL	160
16. Special reinforced masonry shear walls	14.4	5.5	2.5	4	NL	NL	160
18. Ordinary reinforced masonry shear walls	14.4	2	2.5	2	NL	160	NP
25. Steel buckling-restrained braced frames	14.1	8	2.5	5	NL	NL	160
26. Steel special plate shear walls	14.1	7	2	6	NL	NL	160

NL = Not Limited ; NP = Not Permitted.

2022 Table 1613.5

DESIGN COEFFICIENTS AND FACTORS FOR SEISMIC-FORCE RESISTING SYSTEMS

- HEIGHT LIMITS FROM NOT LIMITED TO 160 FT

Seismic Force-Resisting System	ASCE 7 Section Where Detailing Requirements Are Specified	Response Modification Coefficient	Overstrength Factor	Deflection Amplification Factor	Structural System Limitations Including Structural Height, h_n (ft), Limits[c]		
					Seismic Design Category		
C. MOMENT-RESISTING FRAME SYSTEMS		R^a	$\Omega_0{}^g$	$C_d{}^b$	B	C	D[d]
2. Steel special truss moment frames	14.1	7	3	5.5	NL	NL	160
10. Steel and concrete composite partially restrained moment frames	14.3	6	3	5.5	160	160	100
E. DUAL SYSTEMS WITH INTERMEDIATE MOMENT FRAMES CAPABLE OF RESISTING AT LEAST 25% OF PRESCRIBED SEISMIC FORCES		R^a	$\Omega_0{}^g$	$C_d{}^b$	B	C	D[d]
2. Special reinforced concrete shear walls[l]	14.2	6.5	2.5	5	NL	NL	160
3. Ordinary reinforced masonry shear walls	14.4	3	3	2.5	NL	160	NP

NL = Not Limited ; NP = Not Permitted.

2022 Table 1613.5

BALLASTED PHOTOVOLTAIC PANEL SYSTEMS

NEW PROVISION

1613.6. Ballasted, roof-mounted photovoltaic panel systems need not be rigidly attached to the roof or supporting structure.

In structures assigned to Seismic Design Category C or D, ballasted nonpenetrating systems shall be designed to accommodate seismic displacement determined by nonlinear response-history analysis or shake-table testing, using input motions consistent with ASCE 7 lateral and vertical seismic forces for nonstructural components on roofs.

CHAPTER 18:

SOILS AND FOUNDATIONS

- Geotechnical peer review
- Geotechnical peer review report

GEOTECHNICAL PEER REVIEW

NEW PROVISION

1818.4.1. A geotechnical peer review shall be performed, and a report shall be required:

- where structural peer review is required
- for structures of **Risk Category III or IV where the seismic site class is F**
- where performance-based foundation design is utilized
- as required by the commissioner

The reviewing engineer shall review seismic analysis including any site-specific analysis, associated mitigation methods, and analyses pertaining to liquefaction for conformance with codes.

GEOTECHNICAL PEER REVIEW REPORT

NEW PROVISION

1818.5.2. The reviewing engineer shall submit a report to the department stating whether or not the geotechnical design shown on the plans, reports and specifications generally conforms to the requirements of this code.

The report shall include reports by consultants such as geotechnical reports and site-specific seismic studies. Generally, the report should confirm that existing conditions at the site have been investigated appropriately and that the design of the proposed foundations is in general conformance with these conditions.

CHAPTER 22:
STEEL

- Seismic design and detailing
- Seismic requirements for cold-formed steel structures

SEISMIC DESIGN AND DETAILING

EXISTING PROVISIONS

2205.2.1.1. Seismic Design Category B or C

Where a response modification coefficient, R, in accordance with Table 1613.5, is used for the design of structures assigned to **Seismic Design Category B or C**, the structures shall be designed and detailed in accordance with the requirements of AISC 341-16 (Seismic provisions for structural steel buildings).

Exception: The response modification coefficient, R, designated for "Steel systems not specifically detailed for seismic resistance, excluding cantilever column systems" in Table 1613.5, shall be permitted for systems designed and detailed in accordance with AISC 360-16 (Specification for structural steel buildings), and need not be designed and detailed in accordance with AISC 341-16.

2205.2.1.2. Seismic Design Category D

Structures assigned to **Seismic Design Category D** shall be designed and detailed in accordance with AISC 341-16, except as specified in Table 1613.5.

Seismic Force-Resisting System	ASCE 7 Section Where Detailing Requirements Are Specified	Response Modification Coefficient	Overstrength Factor	Deflection Amplification Factor	Structural System Limitations Including Structural Height, h_n (ft), Limits[c]		
					Seismic Design Category		
H. STEEL SYSTEMS NOT SPECIFICALLY DETAILED FOR SEISMIC RESISTANCE, EXCLUDING CANTILEVER COLUMN SYSTEMS	14.1	3	3	3	NL	NL	NP

SEISMIC DESIGN AND DETAILING

NEW PROVISION

***2205.2.2*. Structural steel elements**

The design, detailing, fabrication and erection of structural steel elements in seismic force-resisting systems other than those covered in Section 2205.2.1, including struts, collectors, chords and foundation elements, shall be in accordance with AISC 341-16 where either of the following applies:

1. The structure is assigned to **Seismic Design Category D** except as specified in Table 1613.5.

2. A response modification coefficient, R, greater than 3 in accordance with Table 1613.5, is used for the design of the structure assigned to **Seismic Design Category B or C.**

SEISMIC REQUIREMENTS FOR COLD-FORMED STEEL STRUCTURES

NEW PROVISION

***2210.2.* Seismic Requirements for cold-forms steel structures**

Where a response modification coefficient, R, in accordance with Table 1613.5, is used for the design of cold-formed steel structures, the structures shall be designed and detailed in accordance with the requirements of AISI S100-16 (North American Specification for the Design of Cold-Formed Steel Structural Members), ASCE 8-02 (Specification for the Design of Cold-Formed Stainless Steel Structural Members), or, for cold-formed steel special-bolted moment frames, AISI S400-15 (North American Standard for Seismic Design of Cold Formed Steel Structural Systems).

SEISMIC REQUIREMENTS FOR COLD-FORMED STEEL STRUCTURAL SYSTEMS

NEW PROVISIONS

_2211.1.1.1_ Seismic Design Category B and C

Where a response modification coefficient, R, in accordance with Table 1613.5 is used for the design of cold-formed steel light-frame construction assigned to Seismic Design Category B or C, the seismic force-resisting system shall be designed and detailed in accordance with the requirements of AISI S400-15.

Exception**:** The response modification coefficient, R, designated for "Steel systems not specifically detailed for seismic resistance, excluding cantilever column systems" in Table 1613.5 shall be permitted for systems designed and detailed in accordance with AISI S240-15 (North American Standard for Cold-Formed Steel Structural Framing) and need not be designed and detailed in accordance with AISI S400-15.

_2211.1.1.2_ Seismic Design Category D

In cold-formed steel light-frame construction assigned to Seismic Design Category D, the seismic force-resisting system shall be designed and detailed in accordance with AISI S400-15.

CHAPTER 17:

SPECIAL INSPECTIONS AND TESTS

- Special inspection for seismic resistance of steel construction
- Testing for seismic resistance of structural steel
- Special inspection for seismic resistance of wood construction
- Special inspection for seismic resistance
- Testing for seismic resistance

INTRODUCTION

SPECIAL INSPECTION: Inspection of selected materials, equipment, installation, fabrication, erection or placement of components and connections, to ensure compliance with approved construction documents and referenced standards as required by this chapter or elsewhere in this code or its referenced standards.

SPECIAL INSPECTION, CONTINUOUS: The full-time observation of work requiring special inspection by a special inspector who is continuously present in the area where the work is being performed.

SPECIAL INSPECTION, PERIODIC: The intermittent observation of work requiring special inspection by a special inspector who is present in the area where the work has been or is being performed and at the completion of the work. All work requiring special inspection shall remain accessible and exposed until approved by the special inspector.

NONDESTRUCTIVE TESTING: Group of analysis techniques to evaluate the properties of a material, component or system without causing damage. The six most frequently used Nondestructive Testing methods are eddy-current, magnetic-particle, liquid penetrant, radiographic, ultrasonic, and visual testing.

SPECIAL INSPECTION FOR SEISMIC RESISTANCE OF STEEL CONSTRUCTION

NEW PROVISION

1705.2.4. Special inspections of structural steel in the seismic force-resisting systems of buildings and structures assigned to **Seismic Design Category B, C or D**, including struts, collectors, chords and foundation elements, shall be performed in accordance with the quality assurance requirements of AISC 341-16 (Seismic Provisions for Structural Steel Buildings).

Exception: Special inspections are not required in the seismic force-resisting systems of buildings and structures assigned to Seismic Design Category B or C that are **not specifically detailed for seismic resistance, with a response modification coefficient, R, of 3 or less**, excluding cantilever column systems.

TESTING FOR SEISMIC RESISTANCE OF STRUCTURAL STEEL

NEW PROVISION

1705.2.5. Nondestructive testing of structural steel elements in the seismic force-resisting systems of buildings and structures assigned to **Seismic Design Category B, C or D**, including struts, collectors, chords and foundation elements, shall be performed in accordance with the quality assurance requirements of AISC 341-16 (Seismic Provisions for Structural Steel Buildings).

Exception: Nondestructive testing is not required in the seismic force-resisting systems of buildings and structures assigned to Seismic Design Category B or C that are **not specifically detailed for seismic resistance, with a response modification coefficient, R, of 3** or less, excluding cantilever column systems.

SPECIAL INSPECTION FOR SEISMIC RESISTANCE OF WOOD CONSTRUCTION

NEW PROVISION

1705.5.5. For the seismic force-resisting systems of wood structures assigned to **Seismic Design Category C or D**:

1. Continuous special inspection shall be required during field gluing operations of elements of the seismic force resisting system.
2. Periodic special inspection shall be required for nailing, bolting, anchoring and of other elements of the seismic force-resisting system, including wood shear walls, wood diaphragms, drag struts, braces, shear panels and hold-downs.

<u>Exceptions:</u>

1. Special inspections are not required for wood shear walls, shear panels and diaphragms, including nailing, bolting, anchoring and other fastening to other elements of the seismic force-resisting system, where the **fastener spacing of the sheathing is more than 4 inches** (101.6 mm) on center.
2. Where adhesive anchors require continuous special inspection elsewhere in this code, continuous special inspection shall be provided.

SPECIAL INSPECTION FOR SEISMIC RESISTANCE

EXISTING PROVISIONS

1705.12.3 **Plumbing, mechanical, fuel gas, and electrical components.** Periodic special inspection of plumbing, mechanical and electrical components shall be required.

1705.12.5 **Seismic isolation systems.** Periodic special inspection shall be provided for seismic isolation systems in seismically isolated structures assigned to **Seismic Design Category B, C or D** during the fabrication and installation of isolator units and energy dissipation devices.

NEW PROVISIONS

1705.12.1 **Designated seismic systems.** For structures assigned to **Seismic Design Category C or D,** the special inspector shall examine designated seismic systems requiring seismic qualification in accordance with Section 13.2.2 of ASCE 7 and verify that the label, anchorage and mounting conform to the certificate of compliance.

1705.12.2 **Access floors.** Periodic special inspection is required for the anchorage of access floors in structures assigned to **Seismic Design Category D**. *(Access floors are an elevated structural floor that is stabilized over a solid substrate, typically a concrete slab. Access floors system creates a gap ideal for running electrical wiring and HVAC ducts)*

1705.12.4 **Storage racks.** Periodic special inspection is required for the anchorage of storage racks that are 8 feet (2438.4 mm) or greater in height in structures assigned to **Seismic Design Category D.**

TESTING FOR SEISMIC RESISTANCE

NEW PROVISIONS

1705.13.1 **Nonstructural components.** For structures assigned to **Seismic Design Category B, C, or D** where the requirements of Section 13.2.1 of ASCE 7 for nonstructural components, supports or attachments are met by seismic qualification, the registered design professional shall specify on the approved construction documents the requirements for seismic qualification by analysis, testing or experience data. Certificates of compliance for the seismic qualification shall be submitted to the commissioner.

Note: Nonstructural components (architectural, mechanical, electrical components or supports…) shall be assigned to the same Seismic Design Category as the structure that they occupy or to which they are attached.

1705.13.2 **Designated seismic systems.** For structures assigned to **Seismic Design Category C or D** and with designated seismic systems that are subject to the requirements of Section 13.2.2 of ASCE 7 for certification, the registered design professional shall specify on the approved construction documents the requirements to be met by analysis, testing or experience data as specified therein. Certificates of compliance documenting that the requirements are met shall be submitted to the commissioner.

Note: Designated Seismic Systems = Nonstructural components with an importance factor $I_p > 1.0$ (active mechanical and electrical equipment, or component with hazardous substances that must remain operable following earthquake)

1705.13.3 **Seismic isolation systems.** Seismic isolation systems in seismically isolated structures assigned to **Seismic Design Category B, C, or D** shall be tested in accordance with Section 17.8 of ASCE 7.

Audience question

What differences does using electronic values for mapped acceleration parameters make for seismic design?

This concludes the SEAoNY Continuing Education program.

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For upcoming SEAoNY events, please visit www.seaony.org/events.

Thank you for attending!