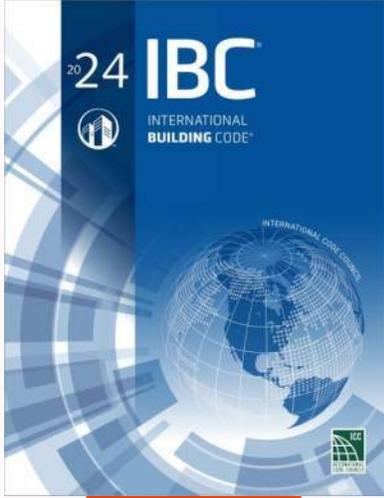




2024 IBC

A Practical Guide to Structural Plan Review

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International Code Council, 2024 IBC®

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Learning Objectives

1. Understand loads and load paths
2. Understand the basic structural requirements of the code and its referenced standards
3. Learn how to perform a structural plan review of simple commercial or residential projects



Seminar Format

1. Introduction
2. Components
3. Loads & Load Paths
4. IBC Chapter 16
5. Materials
6. Plan Review Fundamentals
- 7. The Plan Review**



Part 1. Introduction

A photograph of a man in a dark suit, white shirt, and red tie. He is pointing his right index finger towards the camera. In the background, there is a screen displaying the word 'INTRODUCTION' in large, white, all-caps letters. The screen is slightly out of focus, and the man's hand is in sharp focus in the foreground.

INTRODUCTION

Introduction by Nick Youngson CC BY-SA 3.0 Pix4free



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Introduction

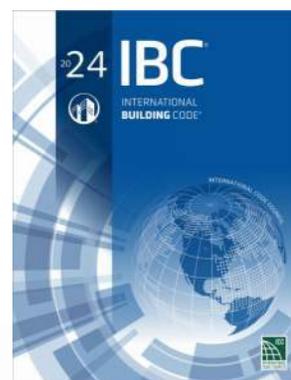
- The mission of all building departments is to...
- What areas of the code are primary to “life safety”?
- Are we focusing our attention on the primary items?
- On the ICC plans examiner exam, how many structural questions are there?
- How many structural chapters are there in the OSSC?



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Introduction

- This class is focused on the 2024 IBC and not the structural requirements of the IRC.
- **IRC R301.1.3:**
 - “When a building of otherwise conventional construction contains structural elements exceeding the limits of... (the IRC), these elements shall be designed in accordance with accepted engineering practice.”



Introduction

- **ICC Performing Structural Plan Reviews:**
- “The purpose of a structural plan review is to determine that building structures...”
 - Comply with applicable standards of construction.
 - Use appropriate materials and methods.
 - Are safe for people and property.
 - Comply with code requirements.



Part 2. Components



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What constitutes a “Structure”?

- Is the answer in the definition?
- **IBC 202:** STRUCTURE. That which is built or constructed.

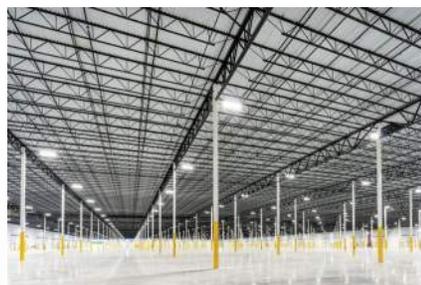


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Stock Images

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Two Categories of Structures

- **IBC 202:** BEARING WALL STRUCTURE. A building or other structure in which **vertical loads** from *floors and roofs* are primarily supported by *walls*.
- **IBC 202:** FRAME STRUCTURE. A building or other structure in which **vertical loads** from *floors and roofs* are primarily supported by *columns*.



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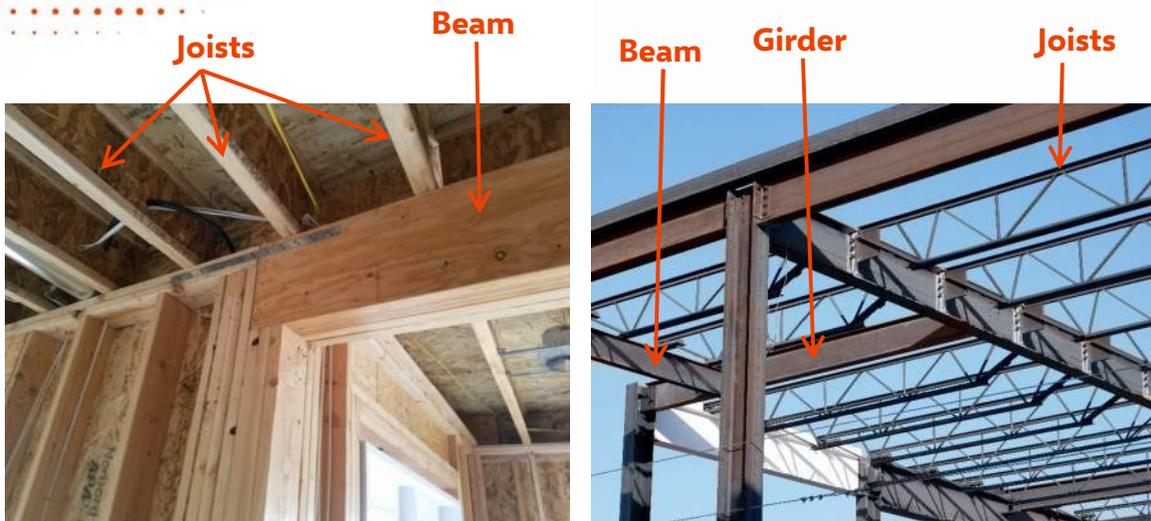
Vertical Components

○ Floor & Ceiling Framing:

- **Joists:** Small horizontal members that support floors or ceilings and span between beams or walls.
- **Beams:** Larger horizontal members that support floors, ceilings or roofs and transfer loads to load-bearing members.
- **Girders:** Larger, primary horizontal members that support beams or smaller girders and transfer loads to columns or bearing walls.



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Vertical Components

○ Roof Framing:

- **Rafters:** A sloped structural member that supports the roof and transfers load to other elements.
- **Purlins:** Small horizontal structural members supporting the roof deck and which span between rafters or load-bearing elements.
- **Truss:** A framework of rafters, posts, and struts, supporting a roof or floor.

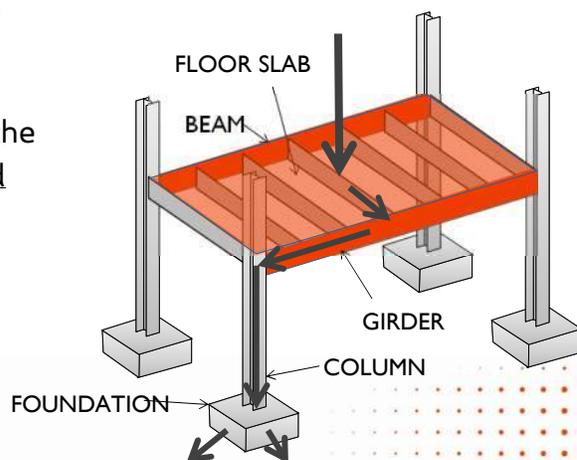


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Vertical Components

○ Wall & Column Framing:

- **Bearing Walls:** Walls that support the weight of the floor, ceiling, roof and walls above.
 - Light-frame > 100plf
 - Concrete or Masonry > 200plf
- **Posts/Columns:** Vertical structural members that support loads.



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Lateral Force-Resisting System (LFRS)

Lateral Components

- **IBC 202:** MAIN WINDFORCE-RESISTING SYSTEM. An assemblage of structural elements assigned to provide support and stability for the overall structure. The system generally receives wind loading from more than one surface
- **IBC 202:** SEISMIC FORCE-RESISTING SYSTEM. That part of the structural system that has been considered in the design to provide the required resistance to the prescribed seismic forces.



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Lateral Components

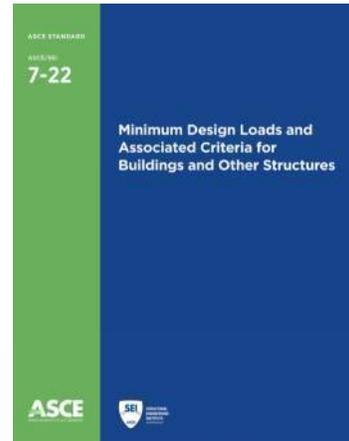
- **Vertical LFRS:** *ASCE 7-22 definitions*
 - **Shear Walls:** A wall, bearing or non-bearing, designed to resist lateral forces acting in the plane of the wall.
 - **Braced Frames:** An essentially vertical truss that is provided in a building frame system to resist (lateral) forces.
 - **Moment Frames:** A frame in which members and joints resist lateral forces by flexure and along the axis of the members.
 - **Cantilevered Columns:** An LFRS in which lateral forces are resisted entirely by columns cantilevered from their base.



Lateral Components

o **ASCE 7-22 → Table 12.2-1:**

- Only structures in SDC 'A' are exempt from seismic design requirements.



American Society of Civil Engineers, ASCE 7-22

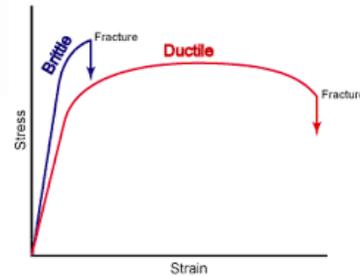
Table 12.2-1. Design Coefficients and Factors for Seismic Force-Resisting Systems.

Seismic Force-Resisting System	ASCE 7 Section Where Detailing Requirements Are Specified	Response Modification Coefficient, R ^a	Overstrength Factor, Ω _e ^b	Deflection Amplification Factor, C _d ^c	Structural System Limitations Including Structural Height, h _x , Limits (ft) ^d				
					Seismic Design Category				
					B	C	D ^e	E ^e	F ^f
A. BEARING WALL SYSTEMS									
1. Special reinforced concrete shear walls ^{g,h}	14.2	5	2½	5	NL	NL	160	160	100
2. Reinforced concrete ductile coupled walls ^g	14.2	8	2½	8	NL	NL	160	160	100
3. Ordinary reinforced concrete shear walls ^g	14.2	4	2½	4	NL	NL	NP	NP	NP
4. Detailed plain concrete shear walls ^g	14.2	2	2½	2	NL	NP	NP	NP	NP
5. Ordinary plain concrete shear walls ^g	14.2	1½	2½	1½	NL	NP	NP	NP	NP
6. Intermediate precast shear walls ^g	14.2	4	2½	4	NL	NL	40 ⁱ	40 ⁱ	40 ⁱ
7. Ordinary precast shear walls ^g	14.2	3	2½	3	NL	NP	NP	NP	NP
8. Special reinforced masonry shear walls	14.4	5	2½	3½	NL	NL	160	160	100
9. Intermediate reinforced masonry shear walls	14.4	3½	2½	2¼	NL	NL	NP	NP	NP
10. Ordinary reinforced masonry shear walls	14.4	2	2½	1¾	NL	160	NP	NP	NP
11. Detailed plain masonry shear walls	14.4	2	2½	1¾	NL	NP	NP	NP	NP
12. Ordinary plain masonry shear walls	14.4	1½	2½	1¾	NL	NP	NP	NP	NP
13. Prestressed masonry shear walls	14.4	1½	2½	1¾	NL	NP	NP	NP	NP
14. Ordinary reinforced AAC masonry shear walls	14.4	2	2½	2	NL	35	NP	NP	NP
15. Ordinary plain AAC masonry shear walls	14.4	1½	2½	1½	NL	NP	NP	NP	NP
16. Light-frame (wood) walls sheathed with wood structural panels rated for shear resistance	14.5	6½	3	4	NL	NL	65	65	65
17. Light-frame (cold-formed steel) walls sheathed with wood structural panels rated for shear resistance or steel sheets	14.1	6½	3	4	NL	NL	65	65	65
18. Light-frame walls with shear panels of all other materials	14.1 and 14.5	2	2½	2	NL	NL	35	NP	NP
19. Light-frame (cold-formed steel) wall systems using flat strap bracing	14.1	4	2	3½	NL	NL	65	65	65
20. Cross-laminated timber shear walls	14.5	3	3	3	65	65	65	65	65
21. Cross-laminated timber shear walls with shear resistance provided by high-aspect-ratio panels only	14.5	4	3	4	65	65	65	65	65
B. BUILDING FRAME SYSTEMS									
1. Steel eccentrically braced frames	14.1	8	2	4	NL	NL	160	160	100
2. Steel special concentrically braced frames	14.1	6	2	5	NL	NL	160	160	100
3. Steel ordinary concentrically braced frames	14.1	3¼	2	3¼	NL	NL	35 ^j	35 ^j	NP ^k
4. Special reinforced concrete shear walls ^{g,h}	14.2	6	2½	5	NL	NL	160	160	100
5. Reinforced concrete ductile coupled walls ^g	14.2	8	2½	8	NL	NL	160	160	100
6. Ordinary reinforced concrete shear walls ^g	14.2	5	2½	4½	NL	NL	NP	NP	NP

American Society of Civil Engineers, ASCE 7-22

Lateral Components

- **Three key design values in Table 12.2-1:**
- **Response Modification Factor (R):**
 - This describes whether system is brittle (i.e. ,stiff) or ductile (i.e. ,flexible).
 - Higher R-value → lower design loads & more detailing expense
 - Lower R-value → higher design loads & less detailing expense



Lateral Components

- Is there a problem with this? **3.4 LFRS – Cantilevered Columns**

Steel Cantilevered Column			
Lateral Loads (per column)			
Wind (ASD)	=	312.817021213318 lb	Refer to lateral analysis
Seismic (ASD)	=	262.14743482906 lb	Refer to lateral analysis
Primary response coeff.	R =	6.5	Refer to lateral analysis
Cantilevered column			
Height	H =	14.5 ft	
Cantilevered column size	=	HSS6x6x1/2	

G. CANTILEVERED COLUMN SYSTEMS DETAILED TO CONFORM TO THE REQUIREMENTS FOR:

System Type	Reference	Requirement
1. Steel special cantilever column systems	14.1	2½
2. Steel ordinary cantilever column systems	14.1	1¼
3. Special reinforced concrete moment frames ^m	12.2.5.5 and 14.2	2½
4. Intermediate reinforced concrete moment frames	14.2	1½
5. Ordinary reinforced concrete moment frames	14.2	1
6. Timber frames	14.5	1½



<p>21</p>	<p>28</p>	<p>12</p>	<p>23</p>	<p>8 others! 92 total</p>
<p>Bearing wall</p>	<p>Building frame</p>	<p>Moment-resisting frame</p>	<p>Dual system</p>	
<ul style="list-style-type: none"> • Supports all gravity and lateral loads • Lack redundancy • R-value varies from 1.5 to 6.5 	<ul style="list-style-type: none"> • Frame carries gravity (i.e. gravity frame) • Shear walls or braced frames carry lateral load • Need to consider deformation compatibility • R-value varies from 1.5 to 8.0 	<ul style="list-style-type: none"> • Specially detailed frame to support both gravity and lateral loads • High level of ductility and redundancy • R-value varies from 3.0 to 8.0 	<ul style="list-style-type: none"> • Similar to building frame system except the gravity frame also provide secondary lateral force resistance. • R-value varies from 4.0 to 8.0 	



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Lateral Components

○ Horizontal LFRS:

- Floor or Roof *Diaphragms*
- **IBC 202:** DIAPHRAGM – A horizontal or sloped system acting to transmit lateral forces to vertical elements of the lateral force-resisting system.
- When a building experiences lateral forces, the diaphragm acts as a "**bridge**" to distribute those forces across its area.
- Commonly constructed using wood-sheathed panels (plywood or OSB), concrete slabs, or steel decking.

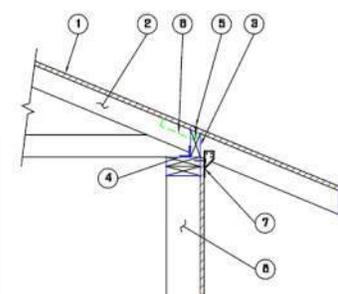
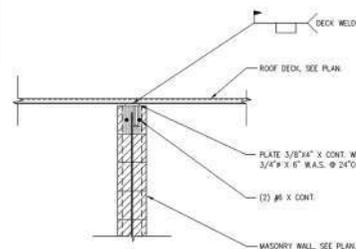


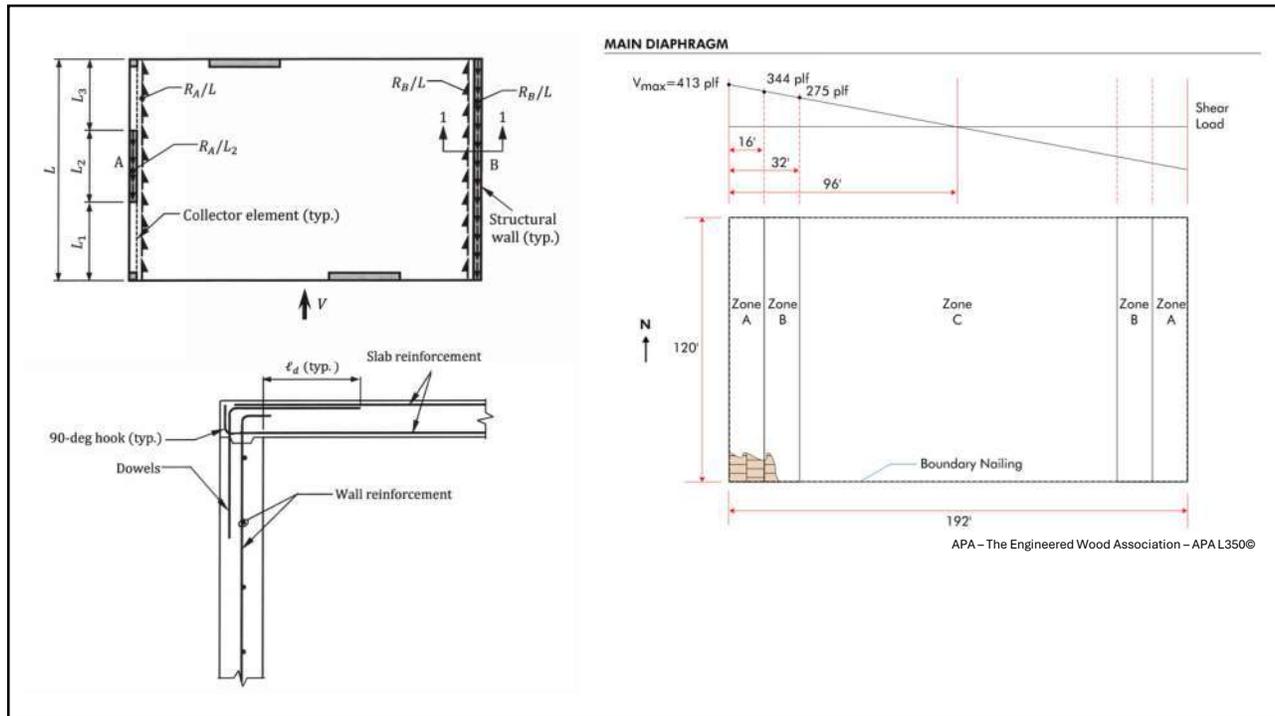
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Lateral Components

○ Diaphragm Components: ASCE 7-22 definitions

- **Boundary** – A location where shear is transferred into or out of the diaphragm element. Transfer is either to a boundary element or to a vertical LFRS.
- **Collector** (drag strut, tie) – A diaphragm boundary element parallel to the applied load that collects and transfers forces to the vertical LFRS.
- **Subdiaphragm** – A portion of a diaphragm used to transfer wall anchorage forces to diaphragm crossies.





Foundation Components

- Foundations support both vertical and lateral components.
- **IBC 202:** SHALLOW FOUNDATION. A shallow foundation is an individual or strip footing, a mat foundation, a slab-on-grade foundation or a similar foundation element.
- **IBC 202:** DEEP FOUNDATION. A deep foundation is a foundation element that does not satisfy the definition of a shallow foundation.

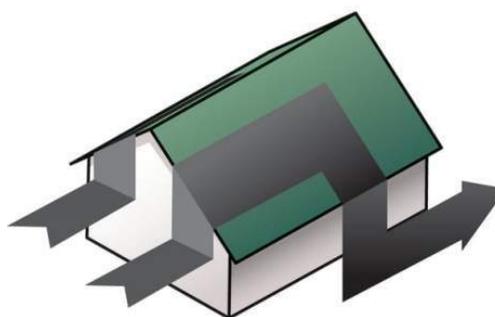
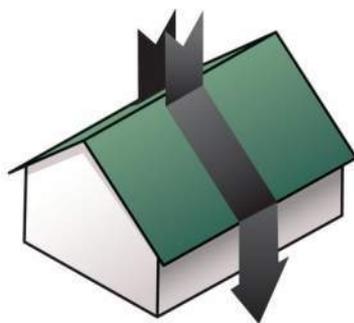
Part 3. Loads & Load Paths



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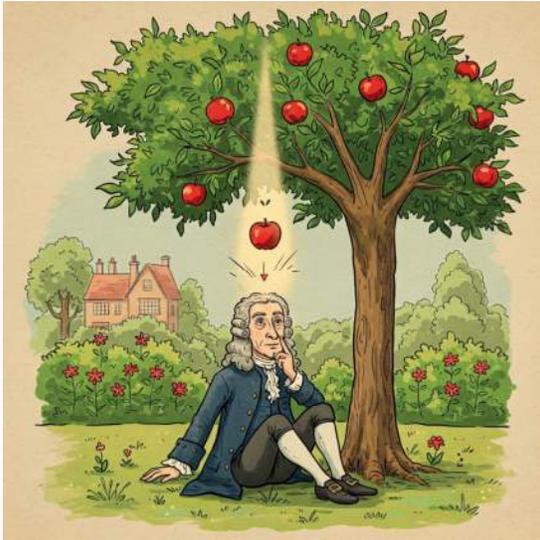
Loads & Load Paths

- Structures must resist both **vertical** and **lateral** loads.



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Gravity Loads



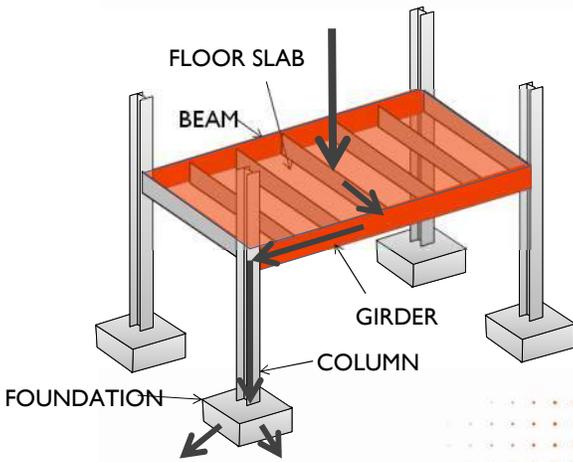
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Gravity Loads

- Dead loads
- Live loads
- Soil loads
- Snow loads
- Rain loads
- Flood loads




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Gravity Loads

- Uniform loads
- Concentrated loads



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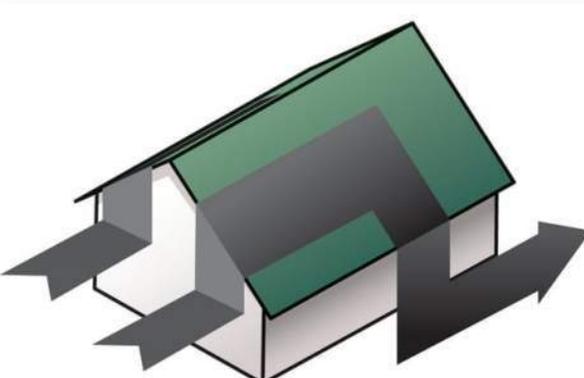
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Gravity Loads

- Is there an adequate gravity load path?



Lateral Loads

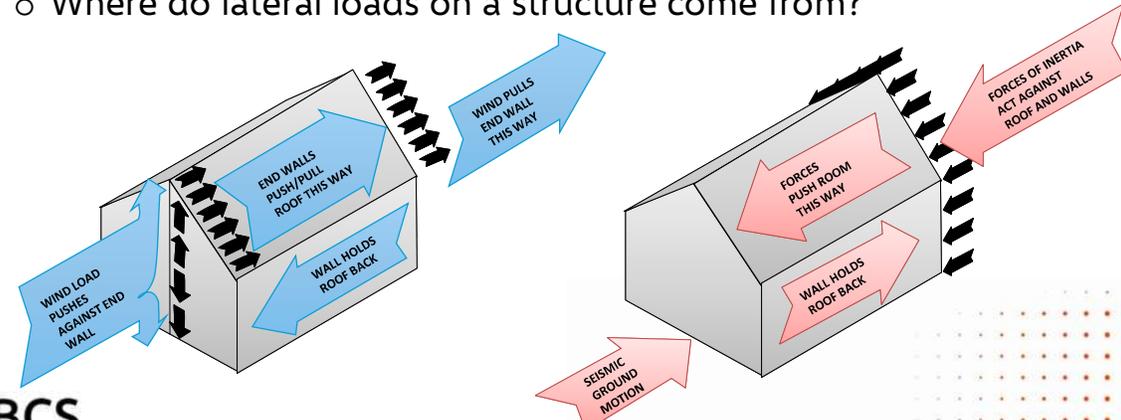


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Lateral Loads

- Where do lateral loads on a structure come from?

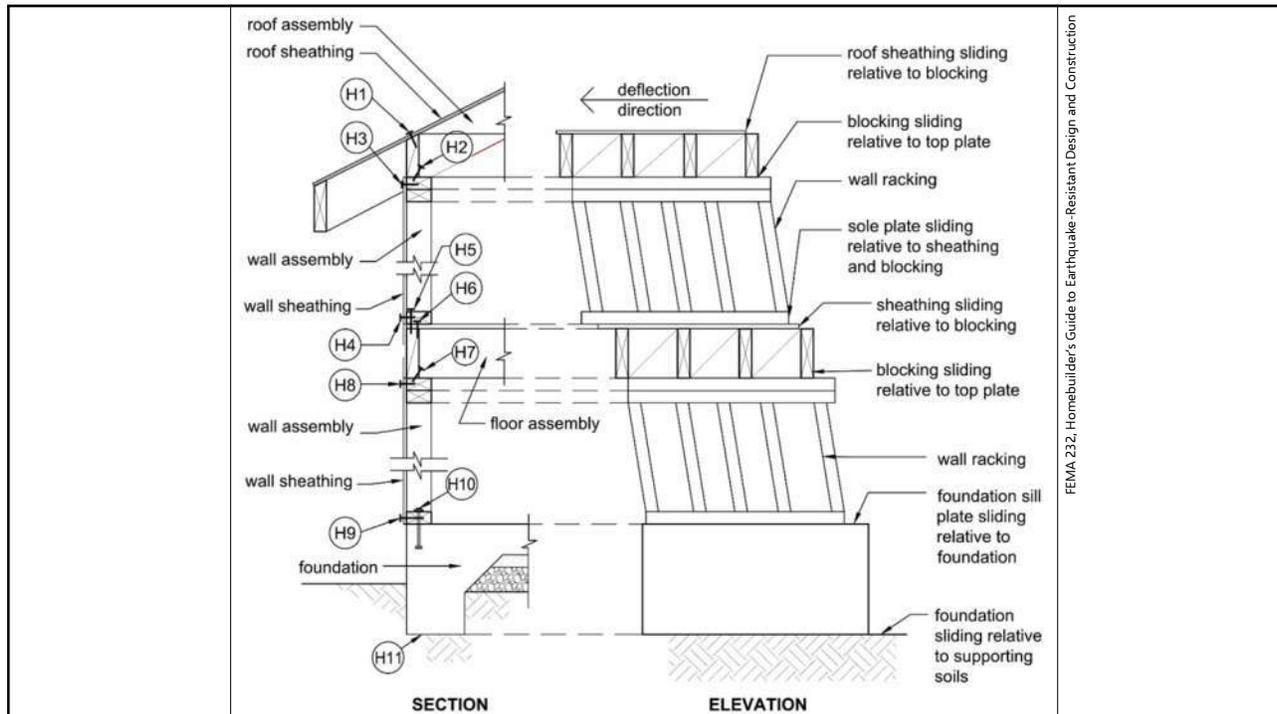


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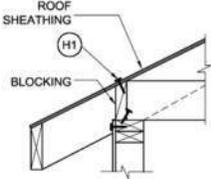
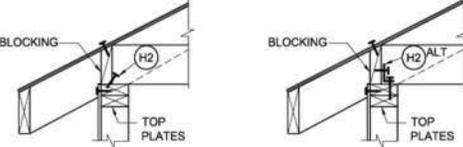


Lateral Loads

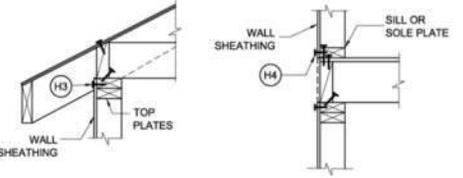
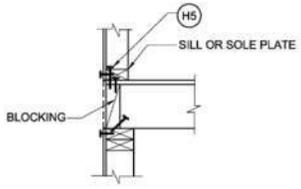
o Must be designed to resist...



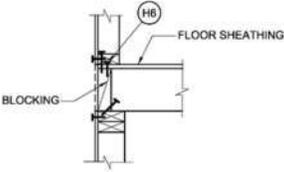
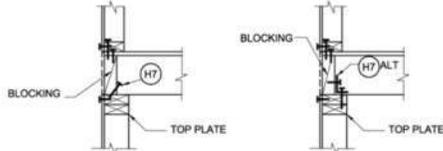
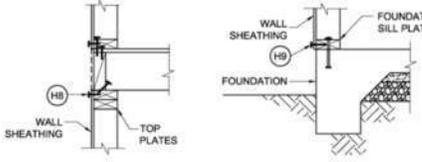
FEEMA 232, Homebuilder's Guide to Earthquake-Resistant Design and Construction

Item ^a	Minimum Fastening per IRC Table R602.3(1) and Discussion ^b	Illustration
H1 (31)	<p>Sheathing^c 3/8" to 1/2" 19/32" to 3/4" 7/8" to 1 1/4"</p> <p>Nailing^d 8d common @ 6" 8d common @ 6" 10d common @ 6"</p> <ul style="list-style-type: none"> Resists roof sheathing sliding with respect to blocking below. Develops bracing strength of roof sheathing. Six-inch nail spacing applies to supported sheathing edges and blocking (including above walls). Twelve-inch spacing applies at other panel supports. Rafter blocking is not always required by IRC; however, sheathing should be nailed to blocking where blocking is provided. 	
H2 (1)	<ul style="list-style-type: none"> Four 8d box (0.113" x 2 1/2") or three 8d common (0.131" x 2 1/2") toenails each block. Resists rafter blocking sliding with respect to wall top plate. <i>Use of angle clips in lieu of toenails is a recommended above-code measure.</i> Rafter blocking is not always required by IRC; however, it should be fastened where provided. 	

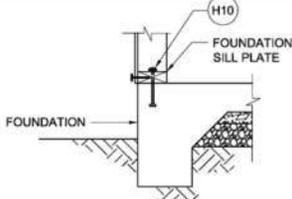
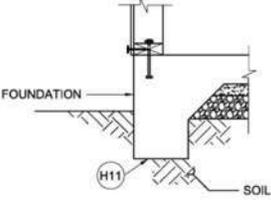
FEMA 232, Homebuilder's Guide to Earthquake-Resistant Design and Construction

Item ^a	Minimum Fastening per IRC Table R602.3(1) and Discussion ^b	Illustration
H3 & H4 (31, 32, 33)	<p>Sheathing^c 3/8" to 1/2" 19/32" to 3/4" 7/8" to 1 1/4"</p> <p>Nailing^d 8d common @ 6" 8d common @ 6" 10d common @ 6"</p> <ul style="list-style-type: none"> Provides wall racking resistance, develops the bracing strength of the wall. Six-inch nail spacing applies to sheathing edges. Twelve-inch spacing applies at other studs. 	
H5 (16, 15)	<p>At Braced Wall Panels</p> <ul style="list-style-type: none"> Three 16d box (0.135" x 3 1/2") or two 16d common (0.162" x 3 1/2") face nails each 16 inches on center (space evenly). <p>Between Braced Wall Panels</p> <ul style="list-style-type: none"> One 16d box (0.135" x 3 1/2") face nail at 12 inches on center or one 16d sinker (0.148" x 3 1/4") face nail at 16 inches on center. Resists wall sole plate sliding with respect to sheathing and blocking or rim joist below. 	

FEMA 232, Homebuilder's Guide to Earthquake-Resistant Design and Construction

Item ^a	Minimum Fastening per IRC Table R602.3(1) and Discussion ^b	Illustration
H6 (31, 32, 33)	<p>Sheathing^c 3/8" to 1/2" 19/32" to 3/4" 7/8" to 1 1/4"</p> <p>Nailing^d 8d common @ 6" 8d common @ 6" 10d common @ 6"</p> <ul style="list-style-type: none"> Resists floor sheathing sliding with respect to blocking below, develops bracing strength of floor sheathing. Six-inch nail spacing applies to supported sheathing edges and blocking. Twelve-inch spacing applies at other panel supports. 	
H7 (23)	<ul style="list-style-type: none"> 8d box (0.113" x 2 1/2") at 4 inches on center (4 at 16") or 8d common (0.131" x 2 1/2") (3 at 16") toenails each block. Resists joist blocking sliding with respect to wall top plate. <i>Use of angle clips in lieu of toenails is a recommended above-code measure.</i> 	
H8 & H9 (31, 32, 33)	<p>Sheathing^c 3/8" to 1/2" 19/32" to 3/4" 7/8" to 1 1/4"</p> <p>Nailing^d 8d common @ 6" 8d common @ 6" 10d common @ 6"</p> <ul style="list-style-type: none"> Provides wall racking resistance, develops bracing strength of wall sheathing. Six-inch nail spacing applies to all sheathing edges. Twelve-inch spacing applies at other studs. 	

FEMA 232, Homebuilder's Guide to Earthquake-Resistant Design and Construction

Item ^a	Minimum Fastening per IRC Table R602.3(1) and Discussion ^b	Illustration
H10	<ul style="list-style-type: none"> Anchor bolts in accordance with Sections R403.1.6 and R403.1.6.1. Steel plate washers in accordance with R602.11.1. Requirements vary by SDC. See Chapter 4 of this guide for further discussion. Resists foundation sill plate sliding with respect to slab-on-grade or other foundation. 	
H11	<ul style="list-style-type: none"> Foundation embedment in accordance with §403.1.4 provides for development of lateral bearing and friction, which permits transfer of loads between the foundation and supporting soil. Resists foundation sliding relative to soil (grade). 	

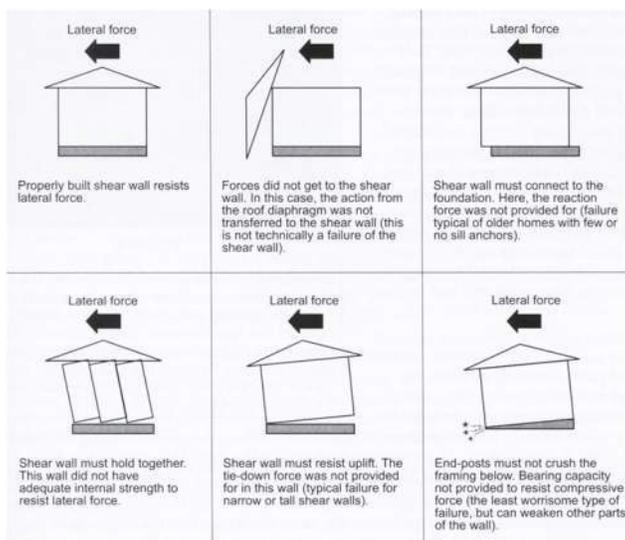
FEMA 232, Homebuilder's Guide to Earthquake-Resistant Design and Construction

Lateral Loads

- o Interior shear walls are a common concern.



Connections – Connections – Connections



Connections – Connections – Connections



Lateral Load Path

- **Connections** – Applies to all construction types



1994 Northridge Earthquake, Tilt-up wall anchorage failure, <https://www.seaoc.org/news/416622/Revisiting-Earthquake-Lessons--Wall-Anchorage-to-Flexible-Diaphragms.htm>

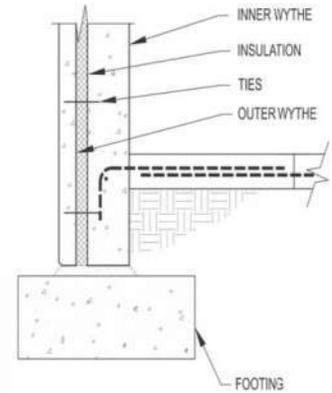


Lateral Load Path

- Connections – Applies to all construction types

Example Review Comment:

The project calls for tilt-up panels to be directly connected to the floor slab, with no physical connection to the footing. Please provide calculations showing that the portion of the floor slab that is used is capable of transferring the required forces to the supporting soils. In addition, please provide a check of the panel-to-slab connection for side-edge concrete breakout.

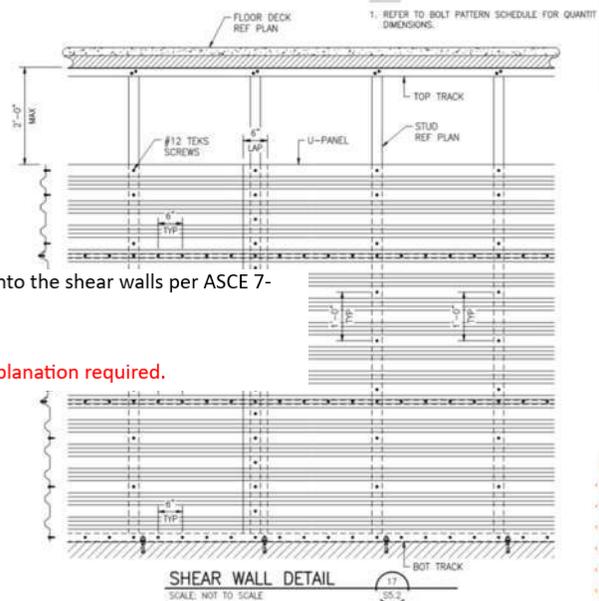


Lateral Load Path

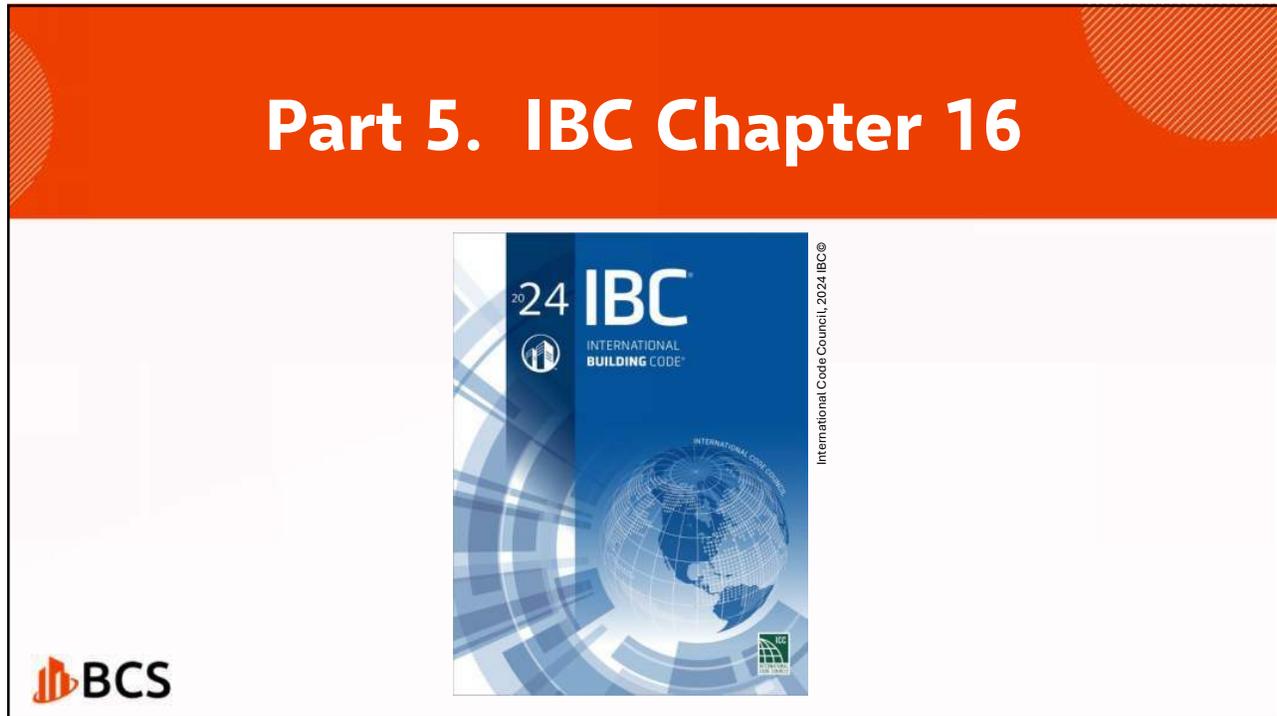
- What do you think of this?

II. Please provide a complete lateral load path from the floor into the shear walls per ASCE 7-16 §12.1.3.

Lateral load path defined in design calculations. No further explanation required.



Part 5. IBC Chapter 16



General Design

- IBC 1604.3: Serviceability

TABLE 1604.3—DEFLECTION LIMITS^{a, b, c, h, i}

CONSTRUCTION	L or L _v	S' or W'	D + L ^{1, 2}
Roof members: ^d			
Supporting plaster or stucco ceiling	l/360	l/360	l/240
Supporting nonplaster ceiling	l/240	l/240	l/180
Not supporting ceiling	l/180	l/180	l/120
Floor members	l/360	—	l/240
Exterior walls:			
With plaster or stucco finishes	—	l/360	—
With other brittle finishes	—	l/240	—
With flexible finishes	—	l/120	—
Interior partitions: ^e			
With plaster or stucco finishes	l/360	—	—
With other brittle finishes	l/240	—	—
With flexible finishes	l/120	—	—
Farm buildings	—	—	l/180
Greenhouses	—	—	l/120

International Code Council, 2024 IBC©



General Design

○ IBC 1604.3: *Serviceability*

- Shall comply with the more restrictive deflection limits of Table 1604.3 or those required by a referenced standard.
- Framing supporting glass shall not exceed either of the following:
 - Framing member span \leq 13.5 feet \rightarrow 1/175
 - Framing member span $>$ 13.5 feet \rightarrow 1/240 + 1/4-inch



General Design

○ IBC 1604.4: *Analysis*

- "Any system or method of construction to be used shall be based on a rational analysis..."
- "Such analysis shall result in a system that provides a **complete load path** capable of transferring loads from their point of origin to the load-resisting elements."



General Design

o IBC 1604.5: Risk Category

- Every structure shall be assigned a risk category.

TABLE 1604.5—RISK CATEGORY OF BUILDINGS AND OTHER STRUCTURES

RISK CATEGORY	NATURE OF OCCUPANCY
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: <ul style="list-style-type: none"> • Agricultural facilities. • Certain temporary facilities. • Minor storage facilities.
II	Buildings and other structures except those listed in Risk Categories I, III and IV.

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III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: <ul style="list-style-type: none"> • Buildings and other structures whose primary occupancy is public assembly with an occupant load greater than 300. • Buildings and other structures containing one or more public assembly spaces, each having an occupant load greater than 300 and a cumulative occupant load of these public assembly spaces of greater than 2,500. • Buildings and other structures containing Group E or Group I-4 occupancies or combination thereof, with an occupant load greater than 250. • Buildings and other structures containing educational occupancies for students above the 12th grade with an occupant load greater than 500. • Group I-3, Condition 1 occupancies. • Any other occupancy with an occupant load greater than 5,000.^a • Power-generating stations with individual power units rated 75 MW_{ac} (megawatts, alternating current) or greater, water treatment facilities for potable water, wastewater treatment facilities and other public utility facilities not included in Risk Category IV. • Buildings and other structures not included in Risk Category IV containing quantities of toxic or explosive materials that: <ul style="list-style-type: none"> • Exceed maximum allowable quantities per control area as given in Table 307.1(1) or 307.1(2) or per outdoor control area in accordance with the <i>International Fire Code</i>; and • Are sufficient to pose a threat to the public if released.^b
-----	---

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IV

Buildings and other structures designated as essential facilities and buildings where loss of function represents a substantial hazard to occupants or users, including but not limited to:

- Group I-2, Condition 2 occupancies.
- Ambulatory care facilities having emergency surgery or emergency treatment facilities.
- Group I-3 occupancies other than Condition 1.
- Fire, rescue, ambulance and police stations and emergency vehicle garages
- Designated earthquake, hurricane or other emergency shelters.
- Designated emergency preparedness, communications and operations centers and other facilities required for emergency response.
- Public utility facilities providing power generation, potable water treatment, or wastewater treatment.
- Power-generating stations and other public utility facilities required as emergency backup facilities for *Risk Category IV* structures.
- Buildings and other structures containing quantities of highly toxic materials that:
 - Exceed maximum allowable quantities per control area as given in Table 307.1(2) or per outdoor control area in accordance with the *International Fire Code*; and
 - Are sufficient to pose a threat to the public if released.^b
- Aviation control towers, air traffic control centers and emergency aircraft hangars.
- Buildings and other structures having critical national defense functions.
- Water storage facilities and pump structures required to maintain water pressure for fire suppression.

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General Design

o IBC 1604.5: *Risk Category*

- Multiple occupancies → assigned to highest risk category
- Where "...a building or structure provides required access to, required egress from or shares life safety systems, designated seismic systems, emergency power systems, or emergency and egress lighting systems with another portion having a higher risk category, or provides required electrical, communications, mechanical, plumbing or conveying support to another portion assigned to Risk Category IV, both portions shall be assigned to the higher risk category."



General Design

o **IBC 1604.8: Anchorage**

- Buildings and other structures shall be provided with anchorage.
- *IBC 1604.8.1:* Roof-to-walls and columns, and of walls and columns to foundations → Shall resist uplift and sliding forces

TABLE 2304.10.2—FASTENING SCHEDULE		
DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER ^a	SPACING AND LOCATION
Roof		
1. Blocking between ceiling joists, rafters or trusses to top plate or other framing below	4-8d box (2½" x 0.113"); or 3-8d common (2½" x 0.131"); or 3-10d box (3" x 0.128"); or 3-3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	Each end, toenail

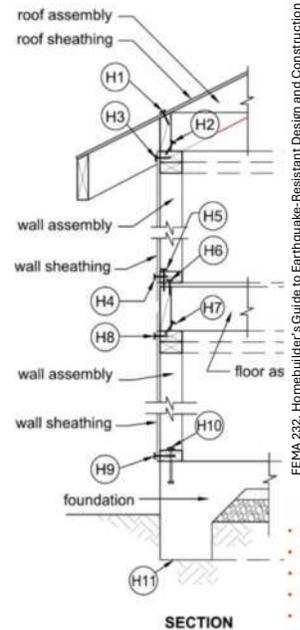


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General Design

o **IBC 1604.8: Anchorage**

- *IBC 1604.8.2:* Bearing and shear walls shall be anchored to the roof, to all floors, and to all members that provide lateral support. Connections shall be capable of resisting design loads.



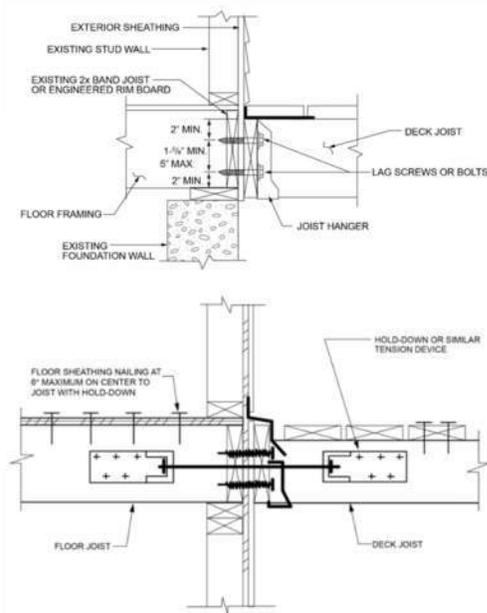
FEMA 232, Homebuilder's Guide to Earthquake-Resistant Design and Construction



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General Design

- **IBC 1604.8: Anchorage**
 - *IBC 1604.8.3:* Decks shall be positively anchored for both vertical and lateral loads.



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Load Combinations

- **IBC 1605.1:**
 - Strength (LRFD) → Section 2.3 of ASCE 7-22
 - Allowable (ASD) → Section 2.4 of ASCE 7-22
 - Alternate ASD → IBC 1605.2
- The idea is that the worst-case events/loading does not all happen at the same time.



Load Combinations

o **ASCE 7-22, Section 2.3 – Strength Example:**

- “Structures, components, and foundations shall be designed so that their strength equals or exceeds the factored loads...”
 1. 1.4D
 2. 1.2D + 1.6L + (0.5L_r or 0.3S or 0.5R)
 3. 1.2D + (1.6L_r or 1.0S or 1.6R) + (L or 0.5W)
 4. 1.2D + 1.0(W or W_T) + L + (0.5L_r or 0.3S or 0.5R)
 5. 0.9D + 1.0 (W or W_T)

There are some exceptions and there are other load combinations if there are flood loads, atmospheric ice loads, etc.



Live Loads

- o **Table 1607.1:** A very important part of the structural plan review!

OCCUPANCY OR USE		UNIFORM (psf)	CONCENTRATED (pounds)	ALSO SEE SECTION
1.	Apartments (see residential)	—	—	—
2.	Access floor systems	Office use	50	2,000
	Computer use	100	2,000	—
3.	Armories and drill rooms	150*	—	—
4.	Assembly areas	Fixed seats (fastened to floor)	60*	—
		Lobbies	100*	—
		Movable seats	100*	—
		Stage floors	150*	—
		Platforms (assembly)	100*	—
		Bleachers, folding and telescopic seating and grandstands	100* (See Section 1607.18)	—
		Stadiums and arenas with fixed seats (fastened to the floor)	60* (See Section 1607.18)	—
Other assembly areas	100*	—		
5.	Balconies and decks	1.5 times the live load for the area served, not required to exceed 100		—
6.	Catwalks for maintenance and service access	40	300	—
7.	Cornices	60	—	—
8.	Corridors	First floor	100	—
		Other floors	Same as occupancy served except as indicated	
9.	Dining rooms and restaurants	100*	—	—
10.	Dwellings (see residential)	—	—	—
11.	Elevator machine room and control room grating (on area of 2 inches by 2 inches)	—	300	—
12.	Finish light floor plate construction (on area of 1 inch by 1 inch)	—	200	—
13.	Fire escapes	—	100	—
		On single-family dwellings only	40	—
14.	Fixed ladders	See Section 1607.10		—

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TABLE 1607.1—MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_{20} , AND MINIMUM CONCENTRATED LIVE LOADS—continued							
OCCUPANCY OR USE			UNIFORM (psf)	CONCENTRATED (pounds)	ALSO SEE SECTION		
28.	Roofs	Ordinary flat, pitched, and curved roofs (that are not occupiable)	20	—	Section 1607.14		
		Roof areas used for assembly purposes	100 ^a	—			
		Roof areas used for occupancies other than assembly	Same as occupancy served	—			
		Vegetative and landscaped roofs:					
		Roof areas not intended for occupancy	20	—			
		Roof areas used for assembly purposes	100 ^a	—			
		Roof areas used for occupancies other than assembly	Same as occupancy served	—			
		Awnings and canopies:					
		Fabric construction supported by a skeleton structure	5 ^a	—			
All other construction, except one- and two-family dwellings	20	—					
28.		Primary roof members exposed to a work floor:			Section 1607.15		
		Single panel point of lower chord of roof trusses or any point along primary structural members supporting roofs over manufacturing, storage warehouses, and repair garages	—	2,000			
		All other primary roof members	—	300			
		All roof surfaces subject to maintenance workers	—	300			

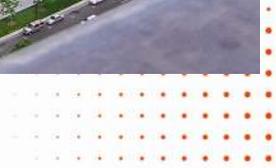
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1606.5 Vegetative and landscaped roofs. The weight of all landscaping and hardscaping materials for vegetative and landscaped roofs shall be considered as *dead load*. The weight shall be computed considering both fully saturated soil and drainage layer materials and fully dry soil and drainage layer materials to determine the most severe *load* effects on the structure.



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Live Loads

- **IBC 1607.2:** Loads not specified → approved by B.O.
- **IBC 1607.5:** Partition loads – where partitions are subject to change → 15psf (*except where 80psf floor LL*)
- Special provisions for helipads, vehicles, handrails and guards, elevators & machinery, and more.



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Live Loads

- Compare to architectural plans...



Live Loads

- **In some cases, live loads can be reduced:**
 - IBC 1607.13.1* → Basic floor live load reduction
 - IBC 1607.13.2 → Alternative floor live load reduction
 - IBC 1607.14.1 → Roof live load reduction
 - Pay attention to Table 1607.1 footnotes, there are cases where live load reductions are not allowed.
 - If live load reductions are used, IBC 1603.1.1 requires the plans to clearly state such.

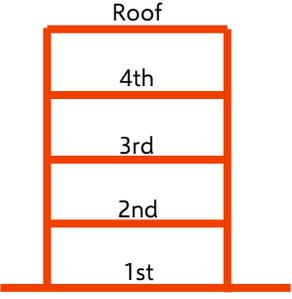


Live Loads

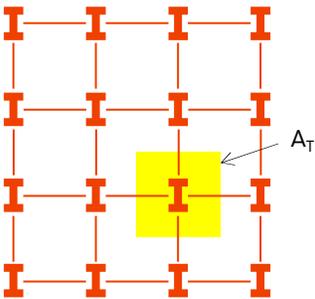
- **IBC 1607.12.1: Basic Uniform Live Load Reduction**
 - Each supported area is looked at
 - $K_{LL}A_T$ must be $\geq 400ft^2$
 - K_{LL} → Table 1607.13.1
 - A_T → Tributary area
 - Minimum LL:
 - One floor = $0.5*L_o$
 - > One floor = $0.4*L_o$

ELEMENT	K_{LL}
Interior columns	4
Exterior columns without cantilever slabs	4
Edge columns with cantilever slabs	3
Corner columns with cantilever slabs	2
Edge beams without cantilever slabs	2
Interior beams	2
Members not previously identified including:	1
Edge beams with cantilever slabs	
Cantilever beams	
One-way slabs	
Two-way slabs	
Members without provisions for continuous shear transfer normal to their span	





Elevation View



Plan View

Interior column at the 1st floor supports the roof, 2nd, 3rd and 4th floors.

Columns are spaced at 30-feet center-to-center.

$$A_T = 30' \times 30' = 900 \text{ ft}^2$$

$$K_{LL}A_T = (4)(900 \text{ ft}^2) = 3,600 \text{ ft}^2 \geq 400\text{ft}^2$$

Office Live Load $\rightarrow L_o = 50\text{psf}$ (Table 1607.1)

$$L = L_o \left(0.25 + \frac{15}{\sqrt{K_{LL}A_T}} \right) = 25\text{psf} > 0.4 L_o$$

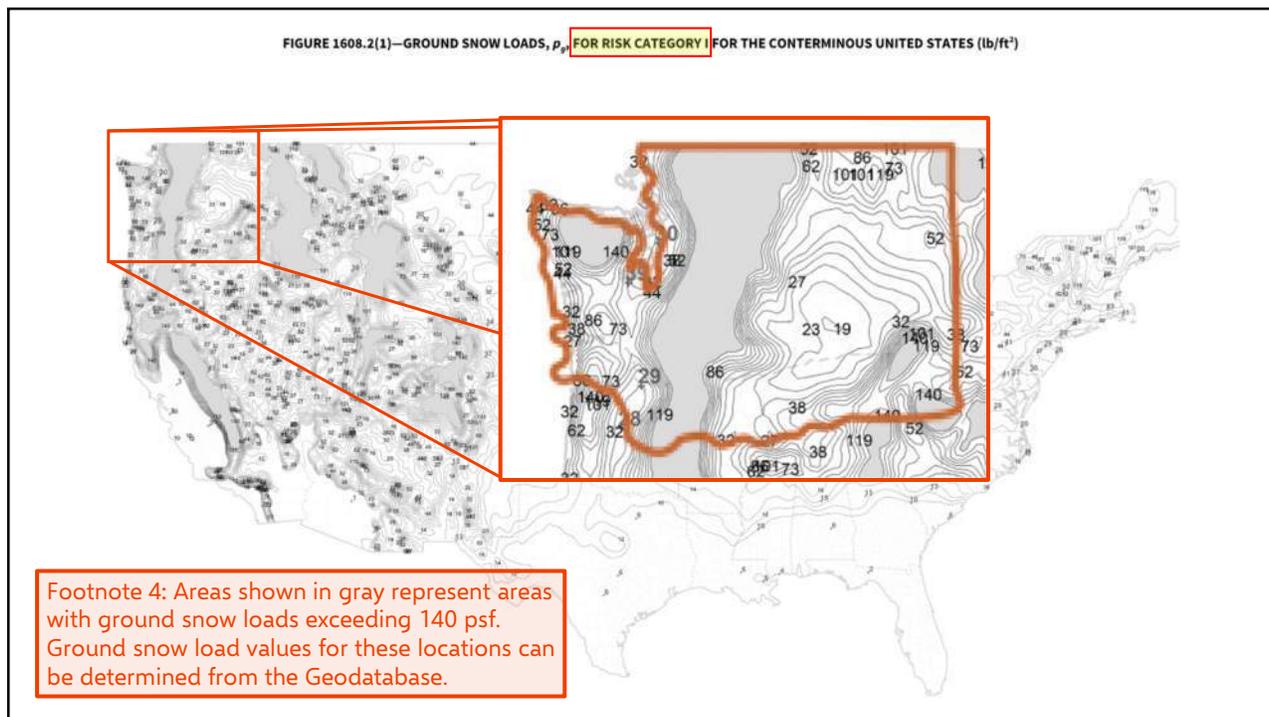
Snow Loads

- **IBC 1608.1:** Per Chapter 7 of ASCE 7
- **IBC 1608.2:** *Based on 2% annual chance of exceedance (i.e., 50-year event)* \rightarrow reliability-targeted as listed in Figures 1608.2(1)-1608.2(4)
- **Proposed:** References SEAW White Paper #8 for ground snow loads. This is then converted by dividing by 0.7. (ASD vs. LRFD)



Amendment



https://ascehazardtool.org/

ASCE HAZARD TOOL

Enter Structure Information

Enter Location Snap to Address

ADDRESS LAT/LONG FIND ON MAP

3711 196th St SW, Lynnwood

Requested Data

Standard Version ASCE/SEI 7-22 NEW ASCE/SEI 41 now available

Risk Category III Site Soil Class Default

Measurements

Customary SI

Load Types:

Wind Seismic

Ice Snow

Rain Flood

Tsunami Tornado

All data are per the requirements of published ASCE standards, local requirements may vary.

ASCE

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Snow Details

Ground Snow Load, p_g	64 lb/ft ²
20-year MRI Value, p_g	12.89 lb/ft ²
Winter Wind Parameter, W_z	0.35
Mapped Elevation	403.4 ft
Data Source	ASCE/SEI 7-22, Figures 7.6-1 and 7.6-2 A-D

Values provided are ground snow loads. In areas designated "case study required," extreme local variations in ground snow loads preclude mapping at this scale. Numbers in parentheses represent the upper elevation limits in feet for the ground snow load values presented. Site-specific case studies are required to establish ground snow loads at elevations not covered.

Snow load values are mapped to a 0.5 mile resolution. This resolution can create a mismatch between the mapped elevation and the site-specific elevation in topographically complex areas. Engineers should consult the local authority having jurisdiction in locations where the reported 'elevation' and 'mapped elevation' differ significantly from each other.

Ground Snow Loads for IRC only, $p_g(IRC)$	44.8 lb/ft ²
--	-------------------------

City of Lynnwood, Bureau of Land Mana

Building Code Solutions ©

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Wind Loads

- **IBC 1609.1.1:** Per Chapters 26-32 of ASCE 7-22
- Two key criteria: Design wind speed & exposure
- **Wind speed** → IBC Figures 1609.3(1-4)
 - Use ASCE 7 Hazard Tool
 - IBC 1609.3.1: ASD → $V_{ASD} = V(0.6)^{0.5}$



Leifiga Tree by Legnoro Neumann Cluffo CCAttribution2.0 Generic



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Wind Loads

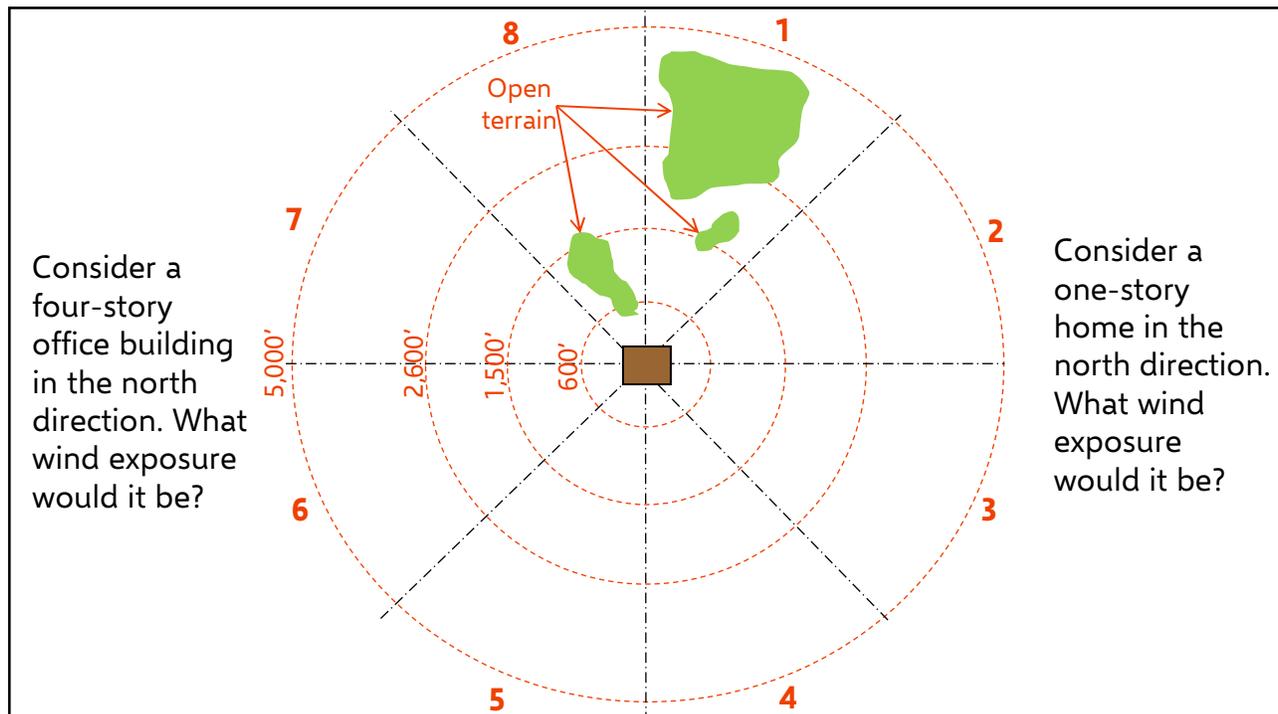
- **IBC 1609.4:** *Exposure Category*
 - **Exposure B:**
 - ≤ 30-foot roof → Closely spaced obstructions for ≥ 1,500 feet
 - > 30-foot roof → Closely spaced obstructions for ≥ 2,600 feet
 - **Exposure C:** Not B or D
 - **Exposure D:** No obstructions for 5,000 feet
 - If obstructions occur w/in 600-feet, but then none then Exposure D



Wind Loads

o IBC 1609.4: Exposure Category

- The exposure category shall be determined for each wind direction.
- Each of the two upwind sectors extending 45-degrees in the selected direction shall be considered.
- Too often we just say Exposure B or Exposure C for our jurisdiction. The design wind pressures vary significantly based on exposure.





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Soil Loads

○ IBC 1610.1: *Lateral Pressures*

- Table 1610.1 should be used as the minimum lateral soils loads unless a geotechnical report is provided.
- Retaining walls → active pressure
- Foundation walls → at-rest pressure
 - Exception: If ≤ 8 -feet and flexible diaphragm → active pressure allowed
- Lateral pressure from surcharge loads should be added
- Designed for full hydrostatic pressure unless a drainage provided.

TABLE 1610.1—LATERAL SOIL LOAD

DESCRIPTION OF BACKFILL MATERIAL ^c	UNIFIED SOIL CLASSIFICATION	DESIGN LATERAL SOIL LOAD ^a (pound per square foot per foot of depth)	
		Active pressure	At-rest pressure
Well-graded, clean gravels; gravel-sand mixes	GW	30	60
Poorly graded clean gravels; gravel-sand mixes	GP	30	60
Silty gravels, poorly graded gravel-sand mixes	GM	40	60
Clayey gravels, poorly graded gravel-and-clay mixes	GC	45	60
Well-graded, clean sands; gravelly sand mixes	SW	30	60
Poorly graded clean sands; sand-gravel mixes	SP	30	60
Silty sands, poorly graded sand-silt mixes	SM	45	60
Sand-silt clay mix with plastic fines	SM-SC	45	100
Clayey sands, poorly graded sand-clay mixes	SC	60	100
Inorganic silts and clayey silts	ML	45	100
Mixture of inorganic silt and clay	ML-CL	60	100
Inorganic clays of low to medium plasticity	CL	60	100
Organic silts and silt clays, low plasticity	OL	Note b	Note b
Inorganic clayey silts, elastic silts	MH	Note b	Note b
Inorganic clays of high plasticity	CH	Note b	Note b
Organic clays and silty clays	OH	Note b	Note b

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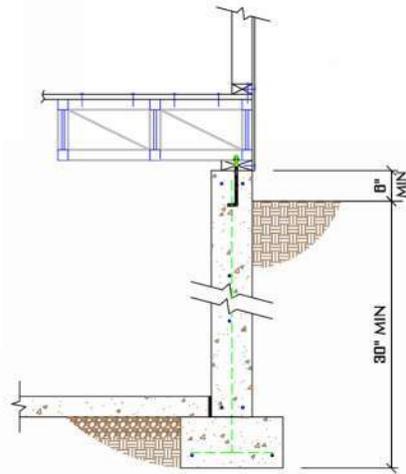
Soil Loads

What are potential surcharge loads?

Soil Loads

1.03 ≈ 1.5

- **IBC 1610.1:** *Lateral Pressures*
 - Foundation wall provisions assume "restraint".
 - If in SDC 'D-F', and...
 - Retaining > 6-feet of soil...
 - Seismic lateral earth pressure must be considered! (IBC 1803.5.12 & 1807.2.2)
 - Safety factor ≥ 1.5 for sliding & overturning (IBC 1807.2.3)



Soil Loads

- **IBC 1806.2:** *Presumptive Load-Bearing Values*
 - Values shall not exceed those in IBC table 1806.2 unless data to substantiate is provided.

TABLE 1806.2—PRESUMPTIVE LOAD-BEARING VALUES

CLASS OF MATERIALS	VERTICAL FOUNDATION PRESSURE (psf)	LATERAL BEARING PRESSURE (psf/ft below natural grade)	LATERAL SLIDING RESISTANCE	
			Coefficient of friction ^a	Cohesion (psf) ^b
1. Crystalline bedrock	12,000	1,200	0.70	—
2. Sedimentary and foliated rock	4,000	400	0.35	—
3. Sandy gravel and gravel (GW and GP)	3,000	200	0.35	—
4. Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000	150	0.25	—
5. Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1,500	100	—	130

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Soil Loads

○ **IBC 1806.2:** *Presumptive Load-Bearing Values*

- Would you allow the following?
 - 9. Allowable Soil Bearing Pressure: 2500 psf (assumed),
- How about this?
 - bearing pressure of 100,000 psf may be used.

SOIL ANALYSIS

A soil sample was obtained from the site, using a bucket and a shovel. The soil sample was analyzed in the geotechnical laboratory. Testing consisted of moisture content and sieve analysis tests. The sieve analysis resulted in a soil classification of Silty Sand with Gravel (SM). The fine content of the sample was 33% with the fines classification as silt (ML). The moisture content of the soil was 18%. The laboratory results are attached to this letter.



Rain Loads

○ **IBC 1611.1:** *Design Rain Loads*

- The previous requirements and figures have all changed.
- The design rainfall is now based upon Risk Category.
- It is still a 15-minute duration, but the storm event changes for RC III or IV.

TABLE 1611.1—DESIGN STORM RETURN PERIOD BY RISK CATEGORY

RISK CATEGORY	DESIGN STORM RETURN PERIOD
I & II	100 years
III	200 years
IV	500 years



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Rain Loads

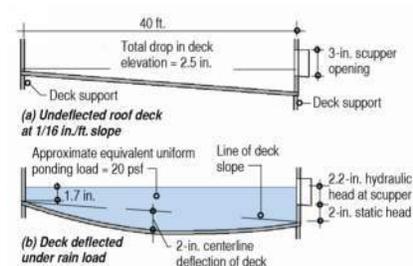
- Rain Load Equation:

$$R = 5.2 (d_s + d_h + d_p)$$

d_s : Static head – depth of water up to SDSL inlet

d_h : Hydraulic head – depth of water above the SDSL inlet

d_p : **Ponding head** – depth of water in deflected roof areas



International Institute of Building Enclosure Consultants (IIBEC), <https://iibec.org/asce-7-standard-low-slope-roof/>



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Flood Loads

- **IBC 1612.1: General**

- If located in Flood Hazard Area (FHA), “...shall be designed and constructed to resist the effects of flood hazards and flood loads.”
- Design → Chapter 5 of ASCE 7 & ASCE 24
- FHA is based upon adopted F.I.R.M.



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Flood Loads

- **IBC 1612.4:** *Flood Hazard Documentation*
 - Must be prepared and sealed by registered design professional
 - **Standard FHA:**
 - Elevation of lowest floor
 - Enclosed areas below design flood elevation → designed per ASCE 24
 - Dry floodproofing → designed per ASCE 24



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Earthquake Loads

Three Categories:
Building Structure
Nonbuilding Structure
Nonstructural Components

- **IBC 1613.1:** *Scope*
 - “Every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions in accordance with Chapters 11, 12, 13, 15, 17 and 18 of ASCE 7, as applicable.”



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Earthquake Loads

○ Section 15.1.1, ASCE 7-22: *Nonbuilding Structures*

- "...unoccupied nonbuilding structures and buildings whose primary purpose is to enclose equipment or machinery and whose occupants are engaged in maintenance or monitoring of that equipment, machinery, or their processes."

- Steel storage racks
- Building frame systems
- Tanks, vessels, bins, hoppers
- Silos
- Chimneys, stacks
- Trussed towers
- Cooling towers
- Telecommunication towers
- Amusement structures
- Cantilevered walls & fences



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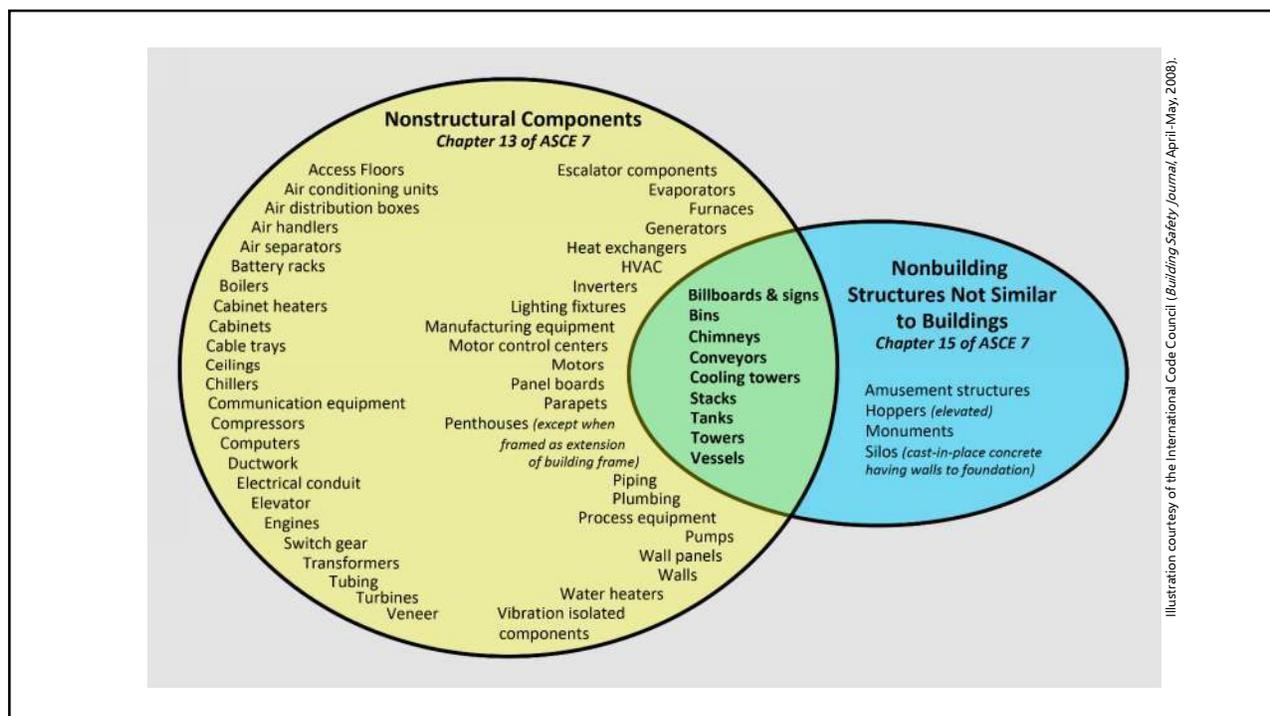
Earthquake Loads

○ Section 11.2, ASCE 7-22: *Nonstructural Components*

- "A part of an architectural, mechanical, or electrical system within or without a building or nonbuilding structure."
- Includes items such as:

- Nonstructural walls & partitions
- Parapets & chimneys
- Exterior wall elements
- Veneer and cladding
- Penthouses
- Ceilings
- Cabinets
- Laboratory equipment
- Signs & billboards
- Mechanical & electrical components
- Mechanical & electrical systems
- Distribution systems





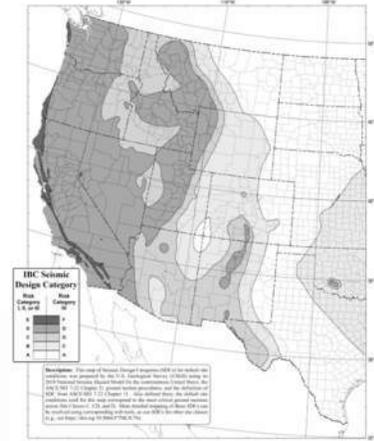
90

Earthquake Loads

- If in SDC 'C-F', Chapter 17 includes numerous special inspection items for nonstructural components.
 - **IBC 1705.13.4** – Designated Seismic Systems
 - **IBC 1705.13.5** – Architectural Components
 - **IBC 1705.13.6** – MEP Components
 - **IBC 1705.13.7** – Racking
 - **IBC 1705.14.2** – Nonstructural Components
 - **IBC 1705.14.3** – Designated Seismic Systems

Earthquake Loads

- o **IBC 1613:** Completely re-written.
- o Can use Figures 1613.2(1) thru 1613.2(7) or ASCE 7 to determine the SDC.
- o Figures consider most critical default site conditions considering Site Classes C, CD and D.



Earthquake Loads

- o **Section 11.4.2:** *New Soil Site Classes!*

Table 20.2-1. Site Classification

Site Class	Shear Wave Velocity Profile (ft/s)
A. Hard rock	> 5,000
B. Medium hard rock	> 3,000 to 5,000
BC. Soft rock	> 2,100 to 3,000
C. Very dense sand or hard clay	> 1,450 to 2,100
CD. Dense sand or very stiff clay	> 1,000 to 1,450
D. Medium dense sand or stiff clay	> 700 to 1,000
DE. Loose sand or medium stiff clay	> 500 to 700
E. Very loose sand or soft clay	≥ 500
F. Soils requiring SRA per Section 21.1	See Section 20.2.1

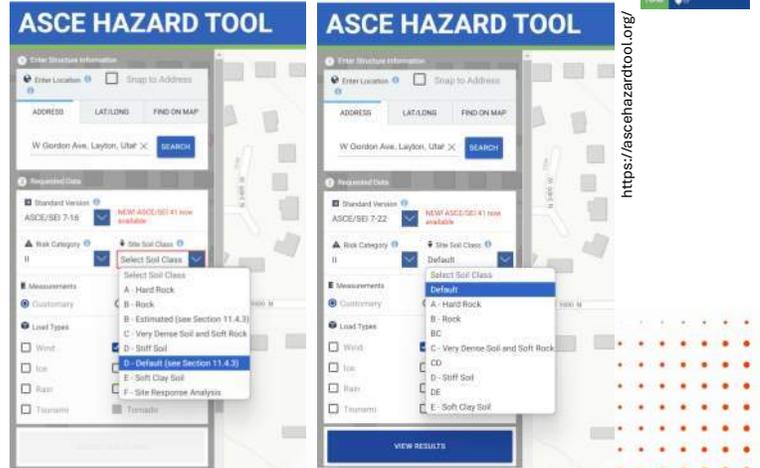
American Society of Civil Engineers (ASCE), ASCE 7-22©



Earthquake Loads

o Section 11.4.2.1:

- o Previously, the default soil site class was 'D'.
- o Now it is most critical of C, CD and D.



Earthquake Loads



o IBC 1613.4: Amendments to ASCE 7

- 1613.4.1 – Increased structural height limit for steel braced frames, steel plate shear walls and reinforced concrete shear walls.
- 1613.4.2 – Revised permitted structural analysis procedures
- 1613.4.3 – Use of USGS Geodatabase
- 1613.4.4 – Multiperiod design response spectrum
- 1613.4.5 – Site classification procedure
- 1613.4.6 – Alternate minimum design spectral response accelerations



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Atmospheric Ice Loads

- **IBC 1614.1:** *General*
 - Ice-sensitive structures shall be designed for atmospheric ice loads per Chapter 10 of ASCE 7-22.
- **IBC 202:** *Ice-Sensitive Structure*
 - This includes, but is not limited to, lattice structures, guyed masts, overhead lines, light suspension and cable-stayed bridges, aerial cable systems (e.g., for ski lifts or logging operations), amusement rides, open catwalks and platforms, flagpoles and signs.



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Tsunami Loads

- **IBC 1615:** *Tsunami Loads*
 - Applies only to Risk Category III or IV
 - Requires compliance with Chapter 6 of ASCE 7, and...
 - Washington Tsunami Design Zone maps (WA-TDZ)
 - <https://www.dnr.wa.gov/wa-tdz>



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Structural Integrity

- **IBC 1616.1:** *General*
 - Only applies to high-rise buildings that are Risk Category III or IV



111 S Main, Salt Lake City, Utah



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Construction Documents

- **IBC 1603.1:** "...shall show the size, section and relative locations of structural members with floor levels, column centers and offsets dimensioned."
- "The design loads and other information pertinent to structural design required by Sections 1603.1.1 through 1603.1.9 **shall** be indicated on the construction documents."



Construction Documents

- A key part of the structural plan review!
- IBC 1603 requires the basis of the structural design to be listed on the plans.



DESIGN CRITERIA

1. GOVERNING BUILDING CODE(S) RISK CATEGORY	2021 INTERNATIONAL BUILDING CODE II
2. SEISMIC LOADS SEISMIC IMPORTANCE FACTOR, I _s SEISMIC DESIGN CATEGORY	1.0 D
2.1. SOIL SITE CLASS	D
2.2. MAPPED SPECTRAL ACCELERATION	S _s = 1.12 S ₁ = 0.39
2.3. SOIL SITE COEFFICIENTS	F _a = 1.05 F _v = 1.91
2.4. 5% DAMPED ACCELERATION	S _{DS} = 203 * F _a * S _s + 0.79 S _{DI} = 203 * F _v * S ₁ + 0.50
2.5. BASIC SFRS RESPONSE MOD. COEFFICIENT SYSTEM OVER-STRENGTH FACTOR DEFLECTION AMPLIFICATION FACTOR	SPEC. REINF. CMU SHEAR WALLS R = 5.0 D = 2.5 C _d = 3.5
2.6. SEISMIC RESPONSE COEFFICIENT	C _s = S _{DI} * I _s / R
2.7. W	DEAD LOADS OF STRUCTURE
2.8. BASE SHEAR	V = C _s * W = 0.22 * W (STRENGTH)
2.9. ANALYSIS PROCEDURE	EQUVALENT LATERAL FORCE
3. WIND LOADS	
3.1. WIND VELOCITY (3 SECOND GUST)	100 MPH (STRENGTH) 85 MPH (ALLOWABLE (L _r = 1.0))
3.2. EXPOSURE TYPE	C
3.3. INTERNAL PRESSURE COEFF. GC _p	+/- 0.18
3.4. TOPOGRAPHIC FACTOR, K _{zt}	1.0
4. SNOW LOADS	
4.1. GROUND SNOW LOAD	P _g = 34 psf
4.2. SNOW IMPORTANCE FACTOR	I _s = 1.1
4.3. SNOW EXPOSURE COEFFICIENT	C _e = 1.0
4.4. THERMAL EXPOSURE COEFFICIENT	C _t = 1.0
4.5. ROOF SNOW LOAD	P _f = 0.7 * C _e * C _t * I _s * P _g = 26 PSF PLUS SNOW DRIFT
5. FLOOR LIVE LOADS	
5.1. OFFICE	50 PSF + 20 PSF PARTITION
5.2. CLASSROOMS	40 PSF
5.3. EXIT FACILITIES AND CORRIDORS	100 PSF
5.4. MECHANICAL ROOMS	150 PSF

Construction Documents

- IBC 1603.1.1: Floor Live Load
 - Both uniform live loads **and** concentrated live loads used in the design should be indicated.
 - If live load reductions are used, it shall be indicated for each type of live load used in the design.



DESIGN CRITERIA

1. GOVERNING BUILDING CODE(S) RISK CATEGORY	2021 INTERNATIONAL BUILDING CODE II
2. SEISMIC LOADS SEISMIC IMPORTANCE FACTOR, I _s SEISMIC DESIGN CATEGORY	1.0 D
2.1. SOIL SITE CLASS	D
2.2. MAPPED SPECTRAL ACCELERATION	S _s = 1.12 S ₁ = 0.39
2.3. SOIL SITE COEFFICIENTS	F _a = 1.05 F _v = 1.91
2.4. 5% DAMPED ACCELERATION	S _{DS} = 203 * F _a * S _s + 0.79 S _{DI} = 203 * F _v * S ₁ + 0.50
2.5. BASIC SFRS RESPONSE MOD. COEFFICIENT SYSTEM OVER-STRENGTH FACTOR DEFLECTION AMPLIFICATION FACTOR	SPEC. REINF. CMU SHEAR WALLS R = 5.0 D = 2.5 C _d = 3.5
2.6. SEISMIC RESPONSE COEFFICIENT	C _s = S _{DI} * I _s / R
2.7. W	DEAD LOADS OF STRUCTURE
2.8. BASE SHEAR	V = C _s * W = 0.22 * W (STRENGTH)
2.9. ANALYSIS PROCEDURE	EQUVALENT LATERAL FORCE
3. WIND LOADS	
3.1. WIND VELOCITY (3 SECOND GUST)	100 MPH (STRENGTH) 85 MPH (ALLOWABLE (L _r = 1.0))
3.2. EXPOSURE TYPE	C
3.3. INTERNAL PRESSURE COEFF. GC _p	+/- 0.18
3.4. TOPOGRAPHIC FACTOR, K _{zt}	1.0
4. SNOW LOADS	
4.1. GROUND SNOW LOAD	P _g = 34 psf
4.2. SNOW IMPORTANCE FACTOR	I _s = 1.1
4.3. SNOW EXPOSURE COEFFICIENT	C _e = 1.0
4.4. THERMAL EXPOSURE COEFFICIENT	C _t = 1.0
4.5. ROOF SNOW LOAD	P _f = 0.7 * C _e * C _t * I _s * P _g = 26 PSF PLUS SNOW DRIFT
5. FLOOR LIVE LOADS	
5.1. OFFICE	50 PSF + 20 PSF PARTITION
5.2. CLASSROOMS	40 PSF
5.3. EXIT FACILITIES AND CORRIDORS	100 PSF
5.4. MECHANICAL ROOMS	150 PSF

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Construction Documents

o IBC 1603.1.2: Roof Live Load

TABLE 1607.1—MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, l_u , AND MINIMUM CONCENTRATED LIVE LOADS—continued

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (pounds)	ALSO SEE SECTION	
2B.	Roofs	Ordinary flat, pitched, and curved roofs (that are not occupiable)	20	Section 1607.14
		Roof areas used for assembly purposes	100*	
		Roof areas used for occupancies other than assembly	Same as occupancy served	
		Vegetative and landscaped roofs:		
		Roof areas not intended for occupancy	20	
		Roof areas used for assembly purposes	100*	
		Roof areas used for occupancies other than assembly	Same as occupancy served	
		Awnings and canopies:		
		Fabric construction supported by a skeleton structure	5*	
		All other construction, except one- and two-family dwellings	20	
2B.	Primary roof members exposed to a work floor:	Single panel point of lower chord of roof trusses or any point along primary structural members supporting roofs over manufacturing, storage warehouses, and repair garages	2,000	Section 1607.15
		All other primary roof members	300	
		All roof surfaces subject to maintenance workers	300	

DESIGN CRITERIA

1. GOVERNING BUILDING CODE(S) RISK CATEGORY	2021 INTERNATIONAL BUILDING CODE II
2. SEISMIC LOADS SEISMIC IMPORTANCE FACTOR, I_e SEISMIC DESIGN CATEGORY	1.0 D
2.1. SOIL SITE CLASS	D
2.2. MAPPED SPECTRAL ACCELERATION	$S_s = 1.12$
2.3. SOIL SITE COEFFICIENTS	$F_a = 0.38$ $F_v = 1.05$ $F_w = 1.91$
2.4. 3% DAMPED ACCELERATION	$S_{D1} = 23 * F_a * S_s = 0.73$ $S_{D2} = 23 * F_v * S_s = 0.50$
2.5. BASIC SFRS RESPONSE MOD. COEFFICIENT SYSTEM OVER-STRENGTH FACTOR DEFLECTION AMPLIFICATION FACTOR	SPEC. REINF. CMJ SHEAR WALLS $R = 5.0$ $Q = 2.5$ $C_d = 3.5$
2.6. SEISMIC RESPONSE COEFFICIENT	$C_s = S_{D1} * I_e / R$
2.7. W	DEAD LOADS OF STRUCTURE
2.8. BASE SHEAR	$V = C_s * W = 0.22 * W$ (STRENGTH) EQUIVALENT LATERAL FORCE
2.9. ANALYSIS PROCEDURE	
3. WIND LOADS	
3.1. WIND VELOCITY (3 SECOND GUST)	109 MPH (STRENGTH) 85 MPH (ALLOWABLE ($I_e = 1.0$))
3.2. EXPOSURE TYPE	C
3.3. INTERNAL PRESSURE COEFF. GCF_p	+/- 0.18
3.4. TOPOGRAPHIC FACTOR, K_{zt}	1.0
4. SNOW LOADS	
4.1. GROUND SNOW LOAD	$P_g = 34$ psf
4.2. SNOW IMPORTANCE FACTOR	$I_s = 1.1$
4.3. SNOW EXPOSURE COEFFICIENT	$C_e = 1.0$
4.4. THERMAL EXPOSURE COEFFICIENT	$C_t = 1.0$
4.5. ROOF SNOW LOAD	$P_f = 0.7 * C_e * C_t * P_g = 26$ PSF PLUS SNOW DRIFT
5. FLOOR LIVE LOADS	
5.1. OFFICE	50 PSF + 20 PSF PARTITION
5.2. CLASSROOMS	40 PSF
5.3. EXIT FACILITIES AND CORRIDORS	100 PSF
5.4. MECHANICAL ROOMS	100 PSF

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Construction Documents

o IBC 1603.1.3: Roof Snow Load Data

- Ground snow load (P_g), if > 10psf must also list...
- Flat roof snow load (P_f)
- Risk Category
- Snow exposure factor (C_e)
- Snow thermal factor (C_t)
- Slope factor(s) (C_s)
- If P_f and drift surcharge (P_d) > 30psf...
 - Snow drift load (P_d), drift width
 - Winter wind parameter (W_2)

DESIGN CRITERIA

1. GOVERNING BUILDING CODE(S) RISK CATEGORY	2021 INTERNATIONAL BUILDING CODE II
2. SEISMIC LOADS SEISMIC IMPORTANCE FACTOR, I_e SEISMIC DESIGN CATEGORY	1.0 D
2.1. SOIL SITE CLASS	D
2.2. MAPPED SPECTRAL ACCELERATION	$S_s = 1.12$
2.3. SOIL SITE COEFFICIENTS	$F_a = 0.38$ $F_v = 1.05$ $F_w = 1.91$
2.4. 3% DAMPED ACCELERATION	$S_{D1} = 23 * F_a * S_s = 0.73$ $S_{D2} = 23 * F_v * S_s = 0.50$
2.5. BASIC SFRS RESPONSE MOD. COEFFICIENT SYSTEM OVER-STRENGTH FACTOR DEFLECTION AMPLIFICATION FACTOR	SPEC. REINF. CMJ SHEAR WALLS $R = 5.0$ $Q = 2.5$ $C_d = 3.5$
2.6. SEISMIC RESPONSE COEFFICIENT	$C_s = S_{D1} * I_e / R$
2.7. W	DEAD LOADS OF STRUCTURE
2.8. BASE SHEAR	$V = C_s * W = 0.22 * W$ (STRENGTH) EQUIVALENT LATERAL FORCE
2.9. ANALYSIS PROCEDURE	
3. WIND LOADS	
3.1. WIND VELOCITY (3 SECOND GUST)	109 MPH (STRENGTH) 85 MPH (ALLOWABLE ($I_e = 1.0$))
3.2. EXPOSURE TYPE	C
3.3. INTERNAL PRESSURE COEFF. GCF_p	+/- 0.18
3.4. TOPOGRAPHIC FACTOR, K_{zt}	1.0
4. SNOW LOADS	
4.1. GROUND SNOW LOAD	$P_g = 34$ psf
4.2. SNOW IMPORTANCE FACTOR	$I_s = 1.1$
4.3. SNOW EXPOSURE COEFFICIENT	$C_e = 1.0$
4.4. THERMAL EXPOSURE COEFFICIENT	$C_t = 1.0$
4.5. ROOF SNOW LOAD	$P_f = 0.7 * C_e * C_t * P_g = 26$ PSF PLUS SNOW DRIFT
5. FLOOR LIVE LOADS	
5.1. OFFICE	50 PSF + 20 PSF PARTITION
5.2. CLASSROOMS	40 PSF
5.3. EXIT FACILITIES AND CORRIDORS	100 PSF
5.4. MECHANICAL ROOMS	100 PSF

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Construction Documents

- **IBC 1603.1.4: Wind & Tornado Data**
 - Basic design wind speed (V)
 - Allowable stress design wind (V_{asd})
 - Risk category
 - Wind exposure (Could be more than one!)
 - Applicable internal pressure coefficient
 - Exterior component & cladding loads

DESIGN CRITERIA	
1. GOVERNING BUILDING CODE(S) RISK CATEGORY	2021 INTERNATIONAL BUILDING CODE II
2. SEISMIC LOADS SEISMIC IMPORTANCE FACTOR, I _s SEISMIC DESIGN CATEGORY	1.0 D
2.1. SOIL SITE CLASS	D
2.2. MAPPED SPECTRAL ACCELERATION	S _s = 1.12 S ₁ = 0.38
2.3. SOIL SITE COEFFICIENTS	F _a = 1.05 F _v = 1.91
2.4. 3% DAMPED ACCELERATION	S _{DS} = 23 * F _a * S _s = 0.71 S _{D1} = 23 * F _a * S ₁ = 0.50
2.5. BASIC SPRS RESPONSE MOD. COEFFICIENT SYSTEM OVER-STRENGTH FACTOR DEFLECTION AMPLIFICATION FACTOR	SPEC. REINF. CMJ SHEAR WALLS R = 5.0 D = 2.5 C _d = 3.5
2.6. SEISMIC RESPONSE COEFFICIENT	C _s = S _{DS} * I _s / R
2.7. W	DEAD LOADS OF STRUCTURE
2.8. BASE SHEAR	V = C _s * W = 6.22 * W (STRENGTH)
2.9. ANALYSIS PROCEDURE	EQUVALENT LATERAL FORCE
3. WIND LOADS	
3.1. WIND VELOCITY (3 SECOND DUST)	109 MPH (STRENGTH) 85 MPH (ALLOWABLE (L + 1.0))
3.2. EXPOSURE TYPE	C
3.3. INTERNAL PRESSURE COEFF. GC _p	+/- 0.18
3.4. TOPOGRAPHIC FACTOR, K _{zt}	1.0
4. SNOW LOADS	
4.1. GROUND SNOW LOAD	P _g = 34 psf
4.2. SNOW IMPORTANCE FACTOR	I _s = 1.1
4.3. SNOW EXPOSURE COEFFICIENT	C _e = 1.0
4.4. THERMAL EXPOSURE COEFFICIENT	C _t = 1.0
4.5. ROOF SNOW LOAD	P _r = 0.7 * C _e * C _t * P _g = 26 PSF PLUS SNOW DRIFT
5. FLOOR LIVE LOADS	
5.1. OFFICE	50 PSF + 20 PSF PARTITION
5.2. CLASSROOMS	40 PSF
5.3. EXIT FACILITIES AND CORRIDORS	100 PSF
5.4. MECHANICAL ROOMS	100 PSF

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Construction Documents

- **IBC 1603.1.5: Earthquake Design Data**
 - Risk category
 - Seismic importance factor (I_e)
 - Soil site class
 - Mapped ground motions (S_S & S₁)
 - Design ground motions (S_{DS} & S_{D1})
 - Seismic Design Category
 - ...

DESIGN CRITERIA	
1. GOVERNING BUILDING CODE(S) RISK CATEGORY	2021 INTERNATIONAL BUILDING CODE II
2. SEISMIC LOADS SEISMIC IMPORTANCE FACTOR, I _s SEISMIC DESIGN CATEGORY	1.0 D
2.1. SOIL SITE CLASS	D
2.2. MAPPED SPECTRAL ACCELERATION	S _s = 1.12 S ₁ = 0.38
2.3. SOIL SITE COEFFICIENTS	F _a = 1.05 F _v = 1.91
2.4. 3% DAMPED ACCELERATION	S _{DS} = 23 * F _a * S _s = 0.71 S _{D1} = 23 * F _a * S ₁ = 0.50
2.5. BASIC SPRS RESPONSE MOD. COEFFICIENT SYSTEM OVER-STRENGTH FACTOR DEFLECTION AMPLIFICATION FACTOR	SPEC. REINF. CMJ SHEAR WALLS R = 5.0 D = 2.5 C _d = 3.5
2.6. SEISMIC RESPONSE COEFFICIENT	C _s = S _{DS} * I _s / R
2.7. W	DEAD LOADS OF STRUCTURE
2.8. BASE SHEAR	V = C _s * W = 6.22 * W (STRENGTH)
2.9. ANALYSIS PROCEDURE	EQUVALENT LATERAL FORCE
3. WIND LOADS	
3.1. WIND VELOCITY (3 SECOND DUST)	109 MPH (STRENGTH) 85 MPH (ALLOWABLE (L + 1.0))
3.2. EXPOSURE TYPE	C
3.3. INTERNAL PRESSURE COEFF. GC _p	+/- 0.18
3.4. TOPOGRAPHIC FACTOR, K _{zt}	1.0
4. SNOW LOADS	
4.1. GROUND SNOW LOAD	P _g = 34 psf
4.2. SNOW IMPORTANCE FACTOR	I _s = 1.1
4.3. SNOW EXPOSURE COEFFICIENT	C _e = 1.0
4.4. THERMAL EXPOSURE COEFFICIENT	C _t = 1.0
4.5. ROOF SNOW LOAD	P _r = 0.7 * C _e * C _t * P _g = 26 PSF PLUS SNOW DRIFT
5. FLOOR LIVE LOADS	
5.1. OFFICE	50 PSF + 20 PSF PARTITION
5.2. CLASSROOMS	40 PSF
5.3. EXIT FACILITIES AND CORRIDORS	100 PSF
5.4. MECHANICAL ROOMS	100 PSF

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Construction Documents

o **IBC 1603.1.6: Geotechnical Information**

- The design load-bearing values shall be provided on the plans.

FOUNDATION AND EARTHWORK NOTES

<p>1. SOILS INFORMATION / REPORT</p> <p>1.1. SOILS REPORT BY SOILS REPORT PROJECT NUMBER DATED</p> <p>1.2. SOIL BEARING CAPACITY (PSF)</p> <p>1.3. FROST PROTECTION (TO BOTTOM OF FOOTING) CONTRACTOR SHALL ENSURE THAT THE FOOTING ELEVATIONS WILL PROVIDE MINIMUM FROST PROTECTION BELOW THE FINAL GRADES.</p> <p>1.4. LATERAL SOIL PRESSURES (EQUIVALENT FLUID DENSITY)</p> <p>1.4.1. ACTIVE (RETAINING WALLS)</p> <p>1.4.2. AT REST (RIGID FOUNDATION WALLS)</p> <p>1.4.3. PASSIVE</p> <p>1.5. COEFFICIENT OF FRICTION</p>	<p>CMT TECHNICAL SERVICES 20884 10/05/2023</p> <p>2,500, ON COMPACTED FILL OR SUITABLE NATIVE SOILS</p> <p>30 INCHES MINIMUM</p> <p>37 PCF</p> <p>56 PCF</p> <p>300 PCF</p> <p>0.40</p>
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DESIGN CRITERIA

<p>1. GOVERNING BUILDING CODE(S) RISK CATEGORY</p> <p>2. SEISMIC LOADS SEISMIC IMPORTANCE FACTOR, I SEISMIC DESIGN CATEGORY</p> <p>2.1. SOIL SITE CLASS</p> <p>2.2. MAPPED SPECTRAL ACCELERATION</p> <p>2.3. SOIL SITE COEFFICIENTS</p> <p>2.4. 5% DAMPED ACCELERATION</p> <p>2.5. BASIC SFRS RESPONSE MOD. COEFFICIENT SYSTEM OVER-STRENGTH FACTOR DEFLECTION AMPLIFICATION FACTOR</p> <p>2.6. SEISMIC RESPONSE COEFFICIENT</p> <p>2.7. W</p> <p>2.8. BASE SHEAR</p> <p>2.9. ANALYSIS PROCEDURE</p> <p>3. WIND LOADS 3.1. WIND VELOCITY (3 SECOND GUST)</p> <p>3.2. EXPOSURE TYPE</p> <p>3.3. INTERNAL PRESSURE COEFF. G_{CF}</p> <p>3.4. TOPOGRAPHIC FACTOR, K_{zt}</p> <p>4. SNOW LOADS 4.1. GROUND SNOW LOAD</p> <p>4.2. SNOW IMPORTANCE FACTOR</p> <p>4.3. SNOW EXPOSURE COEFFICIENT</p> <p>4.4. THERMAL EXPOSURE COEFFICIENT</p> <p>4.5. ROOF SNOW LOAD</p> <p>5. FLOOR LIVE LOADS 5.1. OFFICE</p> <p>5.2. CLASSROOMS</p> <p>5.3. EXIT FACILITIES AND CORRIDORS</p> <p>5.4. MECHANICAL ROOMS</p>	<p>2021 INTERNATIONAL BUILDING CODE II</p> <p>1.0 D</p> <p>$S_B = 1.12$ $S_1 = 0.38$ $F_a = 1.05$ $F_v = 1.91$</p> <p>$S_{D1} = 23 * F_a * S_1 = 0.71$ $S_{D2} = 23 * F_a * S_1 = 0.50$</p> <p>SPEC. REINF. CMU SHEAR WALLS $R = 5.0$ $Q = 2.5$ $C_d = 3.5$ $C_e = S_{D1} * L / R$</p> <p>DEAD LOADS OF STRUCTURE $V = G * W = 6.22 * W$ (STRENGTH) EQUIVALENT LATERAL FORCE</p> <p>109 MPH (STRENGTH) 85 MPH (ALLOWABLE ($L_s + 1.0$))</p> <p>C</p> <p>+/- 0.18</p> <p>1.0</p> <p>$P_g = 34 \text{ psf}$ $L_s = 1.1$ $C_e = 1.0$ $C_t = 1.0$</p> <p>$PI = 0.7 * C_d * C_e * C_{p1} * P_g = 26 \text{ PSF}$ PLUS SNOW DRIFT</p> <p>50 PSF + 20 PSF PARTITION 40 PSF 100 PSF 150 PSF</p>
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Construction Documents

o **IBC 1603.1.7: Flood Design Data**

- If located within a Flood Hazard Area...
- The plans must list the following in reference to the FIRM datum:
 - Design flood class (per ASCE 24)
 - Most areas → elevation of lowest floor
 - Coastal high hazard or Coastal zone A:
 - Elevation of lowest horizontal structural member, and...
 - Elevation of dry floodproofing (nonresidential)

DESIGN CRITERIA

<p>1. GOVERNING BUILDING CODE(S) RISK CATEGORY</p> <p>2. SEISMIC LOADS SEISMIC IMPORTANCE FACTOR, I SEISMIC DESIGN CATEGORY</p> <p>2.1. SOIL SITE CLASS</p> <p>2.2. MAPPED SPECTRAL ACCELERATION</p> <p>2.3. SOIL SITE COEFFICIENTS</p> <p>2.4. 5% DAMPED ACCELERATION</p> <p>2.5. BASIC SFRS RESPONSE MOD. COEFFICIENT SYSTEM OVER-STRENGTH FACTOR DEFLECTION AMPLIFICATION FACTOR</p> <p>2.6. SEISMIC RESPONSE COEFFICIENT</p> <p>2.7. W</p> <p>2.8. BASE SHEAR</p> <p>2.9. ANALYSIS PROCEDURE</p> <p>3. WIND LOADS 3.1. WIND VELOCITY (3 SECOND GUST)</p> <p>3.2. EXPOSURE TYPE</p> <p>3.3. INTERNAL PRESSURE COEFF. G_{CF}</p> <p>3.4. TOPOGRAPHIC FACTOR, K_{zt}</p> <p>4. SNOW LOADS 4.1. GROUND SNOW LOAD</p> <p>4.2. SNOW IMPORTANCE FACTOR</p> <p>4.3. SNOW EXPOSURE COEFFICIENT</p> <p>4.4. THERMAL EXPOSURE COEFFICIENT</p> <p>4.5. ROOF SNOW LOAD</p> <p>5. FLOOR LIVE LOADS 5.1. OFFICE</p> <p>5.2. CLASSROOMS</p> <p>5.3. EXIT FACILITIES AND CORRIDORS</p> <p>5.4. MECHANICAL ROOMS</p>	<p>2021 INTERNATIONAL BUILDING CODE II</p> <p>1.0 D</p> <p>$S_B = 1.12$ $S_1 = 0.38$ $F_a = 1.05$ $F_v = 1.91$</p> <p>$S_{D1} = 23 * F_a * S_1 = 0.71$ $S_{D2} = 23 * F_a * S_1 = 0.50$</p> <p>SPEC. REINF. CMU SHEAR WALLS $R = 5.0$ $Q = 2.5$ $C_d = 3.5$ $C_e = S_{D1} * L / R$</p> <p>DEAD LOADS OF STRUCTURE $V = G * W = 6.22 * W$ (STRENGTH) EQUIVALENT LATERAL FORCE</p> <p>109 MPH (STRENGTH) 85 MPH (ALLOWABLE ($L_s + 1.0$))</p> <p>C</p> <p>+/- 0.18</p> <p>1.0</p> <p>$P_g = 34 \text{ psf}$ $L_s = 1.1$ $C_e = 1.0$ $C_t = 1.0$</p> <p>$PI = 0.7 * C_d * C_e * C_{p1} * P_g = 26 \text{ PSF}$ PLUS SNOW DRIFT</p> <p>50 PSF + 20 PSF PARTITION 40 PSF 100 PSF 150 PSF</p>
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Construction Documents

- **IBC 1603.1.8: Special Loads**
 - To ensure that they have been considered, the plans should clearly note special loads such as...
 - Machinery
 - Equipment
 - PV and rack support systems





DESIGN CRITERIA	
1. GOVERNING BUILDING CODE(S) RISK CATEGORY	2021 INTERNATIONAL BUILDING CODE II
2. SEISMIC LOADS SEISMIC IMPORTANCE FACTOR, I SEISMIC DESIGN CATEGORY	1.0 D
2.1. SOIL SITE CLASS	D
2.2. MAPPED SPECTRAL ACCELERATION	$S_s = 1.12$
2.3. SOIL SITE COEFFICIENTS	$F_a = 1.05$ $F_v = 1.91$
2.4. 3% DAMPED ACCELERATION	$S_{DS} = 2(3 * F_a * S_s + 0.7)$ $S_{D1} = 2(3 * F_a * S_s + 0.5)$
2.5. BASIC SPRS RESPONSE MOD. COEFFICIENT SYSTEM OVER-STRENGTH FACTOR DEFLECTION AMPLIFICATION FACTOR	SPEC. REINF. CMJ SHEAR WALLS $R = 5.0$ $Q = 2.5$ $C_d = 3.5$
2.6. SEISMIC RESPONSE COEFFICIENT	$C_s = S_{DS} * I / R$
2.7. W	DEAD LOADS OF STRUCTURE
2.8. BASE SHEAR	$V = C_s * W = 0.22 * W$ (STRENGTH)
2.9. ANALYSIS PROCEDURE	EQUVALENT LATERAL FORCE
3. WIND LOADS	
3.1. WIND VELOCITY (3 SECOND DUST)	109 MPH (STRENGTH) 85 MPH (ALLOWABLE (L + 1.0))
3.2. EXPOSURE TYPE	C
3.3. INTERNAL PRESSURE COEFF. GCF_i	+/- 0.18
3.4. TOPOGRAPHIC FACTOR, K_{zt}	1.0
4. SNOW LOADS	
4.1. GROUND SNOW LOAD	$P_g = 34$ psf
4.2. SNOW IMPORTANCE FACTOR	$I_s = 1.1$
4.3. SNOW EXPOSURE COEFFICIENT	$C_e = 1.0$
4.4. THERMAL EXPOSURE COEFFICIENT	$C_t = 1.0$
4.5. ROOF SNOW LOAD	$P_f = 0.7 * C_e * C_t * C_i * P_g = 26$ PSF PLUS SNOW DRIFT
5. FLOOR LIVE LOADS	
5.1. OFFICE	50 PSF + 20 PSF PARTITION
5.2. CLASSROOMS	40 PSF
5.3. EXIT FACILITIES AND CORRIDORS	100 PSF
5.4. MECHANICAL ROOMS	100 PSF

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Construction Documents

- **IBC 1603.1.9: Roof Rain Load Data**
 - The rain intensity ('i' in inches/hour) should be shown regardless of whether it governs the design.
 - The roof drain, scupper and overflow locations.



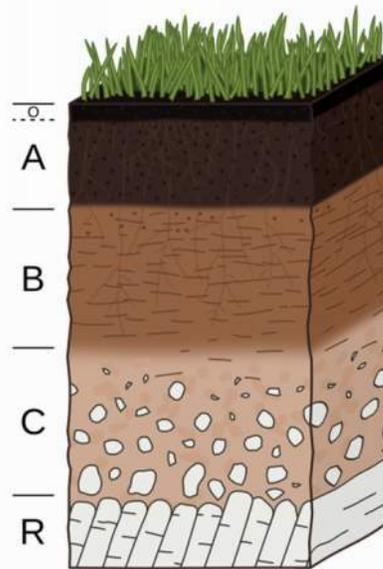
DESIGN CRITERIA	
1. GOVERNING BUILDING CODE(S) RISK CATEGORY	2021 INTERNATIONAL BUILDING CODE II
2. SEISMIC LOADS SEISMIC IMPORTANCE FACTOR, I SEISMIC DESIGN CATEGORY	1.0 D
2.1. SOIL SITE CLASS	D
2.2. MAPPED SPECTRAL ACCELERATION	$S_s = 1.12$
2.3. SOIL SITE COEFFICIENTS	$F_a = 1.05$ $F_v = 1.91$
2.4. 3% DAMPED ACCELERATION	$S_{DS} = 2(3 * F_a * S_s + 0.7)$ $S_{D1} = 2(3 * F_a * S_s + 0.5)$
2.5. BASIC SPRS RESPONSE MOD. COEFFICIENT SYSTEM OVER-STRENGTH FACTOR DEFLECTION AMPLIFICATION FACTOR	SPEC. REINF. CMJ SHEAR WALLS $R = 5.0$ $Q = 2.5$ $C_d = 3.5$
2.6. SEISMIC RESPONSE COEFFICIENT	$C_s = S_{DS} * I / R$
2.7. W	DEAD LOADS OF STRUCTURE
2.8. BASE SHEAR	$V = C_s * W = 0.22 * W$ (STRENGTH)
2.9. ANALYSIS PROCEDURE	EQUVALENT LATERAL FORCE
3. WIND LOADS	
3.1. WIND VELOCITY (3 SECOND DUST)	109 MPH (STRENGTH) 85 MPH (ALLOWABLE (L + 1.0))
3.2. EXPOSURE TYPE	C
3.3. INTERNAL PRESSURE COEFF. GCF_i	+/- 0.18
3.4. TOPOGRAPHIC FACTOR, K_{zt}	1.0
4. SNOW LOADS	
4.1. GROUND SNOW LOAD	$P_g = 34$ psf
4.2. SNOW IMPORTANCE FACTOR	$I_s = 1.1$
4.3. SNOW EXPOSURE COEFFICIENT	$C_e = 1.0$
4.4. THERMAL EXPOSURE COEFFICIENT	$C_t = 1.0$
4.5. ROOF SNOW LOAD	$P_f = 0.7 * C_e * C_t * C_i * P_g = 26$ PSF PLUS SNOW DRIFT
5. FLOOR LIVE LOADS	
5.1. OFFICE	50 PSF + 20 PSF PARTITION
5.2. CLASSROOMS	40 PSF
5.3. EXIT FACILITIES AND CORRIDORS	100 PSF
5.4. MECHANICAL ROOMS	100 PSF

Part 6. Materials



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Soils



Soil Profile by Tomas Kebert CC BY-SA 4.0 Wikimedia



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IBC Chapter 18

- **IBC 1803** – Geotechnical investigation
- **IBC 1809** – Shallow foundations
- **IBC 1810** – Deep foundations



Example of soil boring profile, Massachusetts Dept. of Environmental protection, flickr.com



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Geotechnical Investigation

- When is one required?
- **IBC 1803.5:**
 - Questionable soil
 - Expansive soil
 - Groundwater w/in 5-feet
 - Deep foundations*
 - Rock Strata
 - Excavations near foundation
 - Compacted fill or CLSM
 - Alternate setbacks & clearances



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Geotechnical Investigation

o IBC 1803.5 (cont.):

- SDC 'C-F' → shall include an investigation of the following geologic and seismic hazards...
 - Slope instability
 - Liquefaction
 - Total and differential settlement
 - Surface displacement

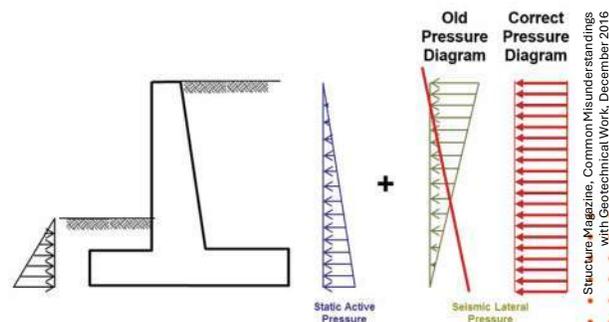


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Geotechnical Investigation

o IBC 1803.5 (cont.):

- SDC 'D-F' → shall include the following...
 - Seismic lateral earth pressure
 - Liquefaction potential
 - Liquefaction consequences
 - Liquefaction mitigation



Geotechnical Investigation

o IBC 1803.5 (cont.):

Liquefaction

The site is located in an area of high liquefaction potential (Anderson and others, 1994). Based on the subsurface conditions encountered and our understanding of the geology of the area, liquefaction is likely a hazard at this site and could result in significant liquefaction-induced settlement. Evaluation of the liquefaction hazard is beyond the scope of this study.

liquefaction induced settlement ranged from 0.3 to 1.0 inch. We assume that mitigation for liquefaction or lateral spread will not be required for the small structures planned at this site. Consideration for mitigation of liquefaction should be considered if 6 inches of liquefaction induced settlement would create an unsafe condition at a structure planned within about 200 feet of Boring 4. Additional investigations would be required for design of liquefaction mitigation.



SOIL ANALYSIS

A soil sample was obtained from the site, using a bucket and a shovel. The soil sample was analyzed in the geotechnical laboratory. Testing consisted of moisture content and sieve analysis tests. The sieve analysis resulted in a soil classification of Silty Sand with Gravel (SM). The fine content of the sample was 33% with the fines classification as silt (ML). The moisture content of the soil was 18%. The laboratory results are attached to this letter.

Geotechnical Investigation

o How many borings/test pits are needed?

- **IBC 1803.3.1:** "The scope of the geotechnical investigation including the number and types of borings or soundings, the equipment used to drill or sample, the in-situ testing equipment and the laboratory testing program shall be determined by a registered design professional."



Wired, A Rare Peek Inside Amazon's Massive Wish-Fulfilling Machine, June 16, 2014



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Geotechnical Investigation

○ What needs to be provided?

- Plot noting locations of borings/tests
- Log of boring/test sample
- Soil profile
- Elevation of water table
- Foundation recommendations
- ...



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Geotechnical Investigation

○ What needs to be provided? *(cont.)*

- Deep foundation requirements (IBC 1803.5.5)
- Expected total & differential settlement
- Special requirements for foundations on expansive soils
- Compacted fill/CLSM requirements



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Geotechnical Investigation

○ What needs to be provided? (cont.)

- IBC 1803.3 states that the investigation may need to "...evaluate **slope stability**, soil strength, position and adequacy of load-bearing soils, the effect of moisture variation on soil-bearing capacity, compressibility, liquefaction and expansiveness."
- Have you been provided with everything that is needed for the project site?

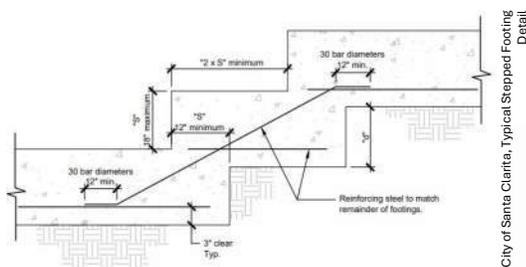


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Shallow Foundations

○ IBC 1809.3: Stepped Footings

- The top surface of footings must be level.
- The bottom surface cannot be sloped more than 1:10 (10%)



Shallow Foundations

IBC 1809.4: Depth & Width

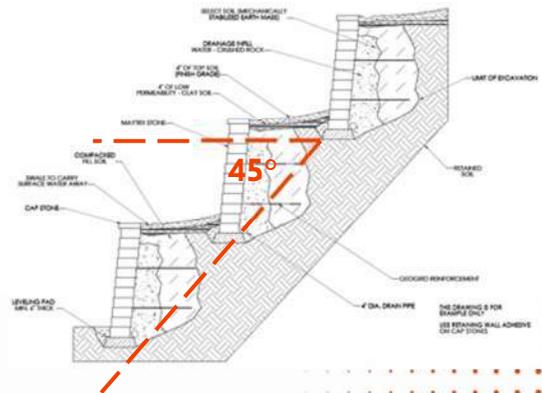
- Minimum footing width = 12-inches
- Minimum depth below undisturbed soil = 12-inches
- Frost protection: Shall comply with one of the following...
 - Extend down to local frost depth
 - Constructed per ASCE 32
 - Erected on solid rock
 - Risk Category I + $\leq 400 \text{ ft}^2$ (600 ft^2 for light-frame) + 10-foot eave height



Shallow Foundations

IBC 1809.6: Locations

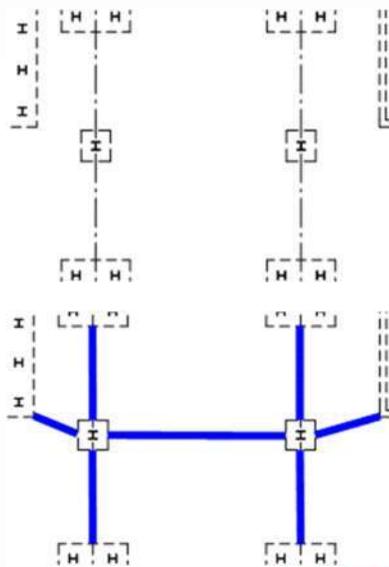
- If granular soil, adjoining footings shall not have a slope steeper than 30° degrees with horizontal.
- Unless braced or otherwise laterally supported in an approved manner or per an engineered analysis.



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Shallow Foundations

- **IBC 1809.13:** *Footing Seismic Ties*
 - If located in SDC 'D-F', and...
 - Soil site class E or F...
 - Individual spot footings **must** be interconnected by seismic ties

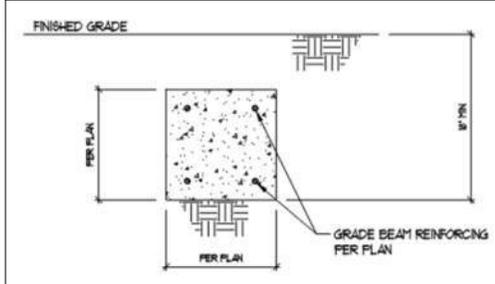
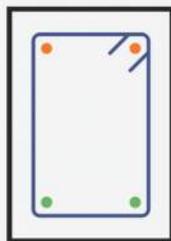




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Shallow Foundations

- **IBC 1809.14:** *Grade Beams*
 - Shall comply with ACI 318
 - Section 18.13.4.4 requires grade beams that act as seismic ties to...
 - Have enclosed seismic ties at a spacing of ≤ 0.5 smallest dimension or 12" o.c., whichever is less.

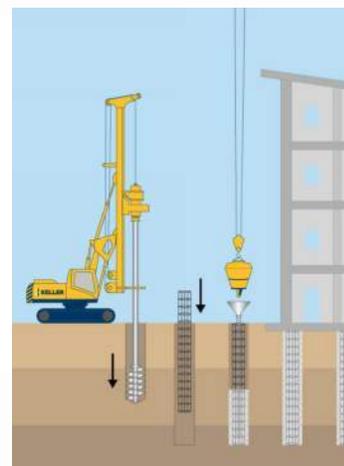


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Deep Foundations

- **IBC 1810.1: General**
 - **Shall** be designed on the basis of a geotechnical investigation.
 - **Column or foundation?** → If standing unbraced in air, water or fluid soils shall be designed as a column until sufficient lateral restraint is provided.



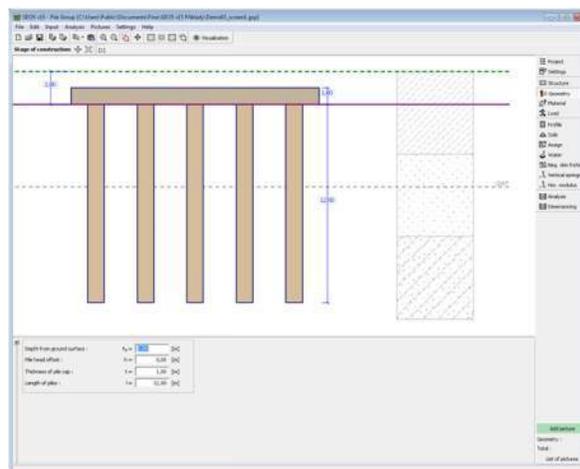
Hayward Baker, Deep Foundations



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Deep Foundations

- **IBC 1810.2: Analysis**
 - Must address...
 - Lateral support*
 - Stability*
 - Settlement*
 - Lateral loads*
 - Group effects



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Deep Foundations

- **IBC 1810.2.1:** *Lateral Support*
 - Soil, other than fluid soil, provides lateral support
 - Lateral support is needed for standard design of deep foundation elements and to prevent buckling
 - Unbraced sections are considered braced once 5-feet into stiff soil or 10-feet into soft soils.



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Deep Foundations

- **IBC 1810.2.2:** *Stability*
 - Elements must be braced to provide lateral stability in all directions
 - ≥ 3 elements connected to a pile cap are braced
 - 2 elements are braced along the axis in which they are connected
 - Wall elements shall be placed under the C.G. for the wall.
 - Methods of bracing shall be approved by B.O.



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Deep Foundations

- **IBC 1810.2.3:** *Settlement*
 - Shall be estimated by “approved” methods.
 - Shall not cause distortion or instability to the structure.
 - Shall not cause any element to be loaded beyond capacity.

Settlement Within the Pier Zone (inch)	Settlement Below the Pier Zone (inch)	Total Expected Settlement (inch)
0.40	0.18	0.58
0.63	0.26	0.89
0.52	0.33	0.85
0.57	0.36	0.93



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Deep Foundations

- **IBC 1810.2.4:** *Lateral Loads*
 - Shall be checked for moment, shear, and lateral deflection and consider soil interaction.
 - Also, if SDC ‘D-F’, and...
 - Site Class ‘E or F’...
 - Must be designed to withstand **maximum curvatures** due to earthquake ground motions



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Deep Foundations

Sample Comment:

Please confirm that deep foundation elements have been designed to withstand the maximum imposed curvatures due to seismic ground motions as required by IBC 1810.2.4.1.

Sample Comment:

IBC 1810.2.2 requires deep foundation elements to be braced if there are less than three elements connected by a rigid pile cap. The foundation plans currently show several individual piles without proper restraint. Interconnection by means of grade beams, or another approved method, must be provided. Please address.

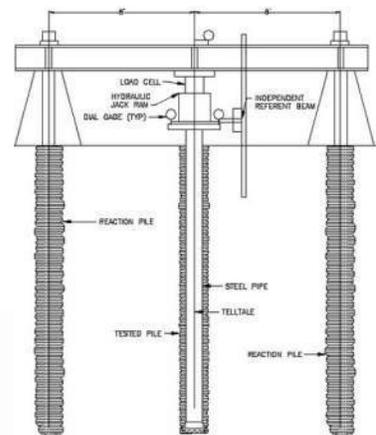


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Deep Foundations

IBC 1810.3.3: Allowable Loads

- The “allowable” load is specified by the SER
- The “ultimate” load is required to have F.S. of 2.0
- This applies to axial, uplift, and lateral loads
- Load tests should be provided if...
 - Noted in geotechnical report
 - Design compressive stresses > Table 1803.2.6
 - CIP elements have an enlarged base
 - Capacity is questionable



Concrete



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Concrete Construction

- Shallow foundations (footings & foundation walls)
- Deep foundations
- Shear & bearing walls
- Retaining walls
- Columns
- Diaphragms
- Slabs-on-grade
- Precast / Tilt-up
- Post- or pre-tensioned



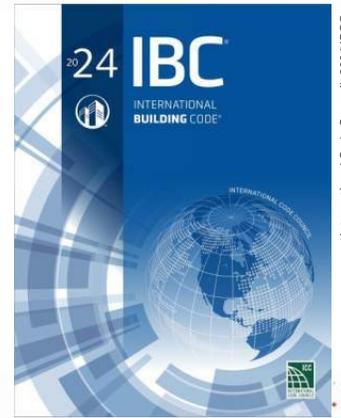
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IBC Chapter 19

- 1901 – General
- 1904 – Durability



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Concrete – General

- **IBC 1901.3:** *Anchoring to Concrete*
 - Anchoring to concrete shall comply with ACI 318-19 (Chapter 17).
 - Applies to cast-in, post-installed expansion, undercut, screw and adhesive anchors.



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Concrete – General

o IBC 1901.5: Construction Documents

- Concrete compressive strengths
- Strength & grade of reinforcement
- Size & location of structural elements, reinforcing & anchors
- Magnitude & location of prestressing forces
- Lap splice lengths & anchorage lengths
- ...

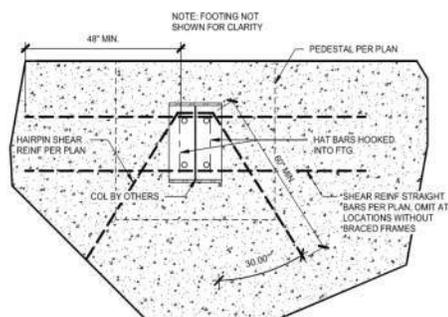


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Concrete – General

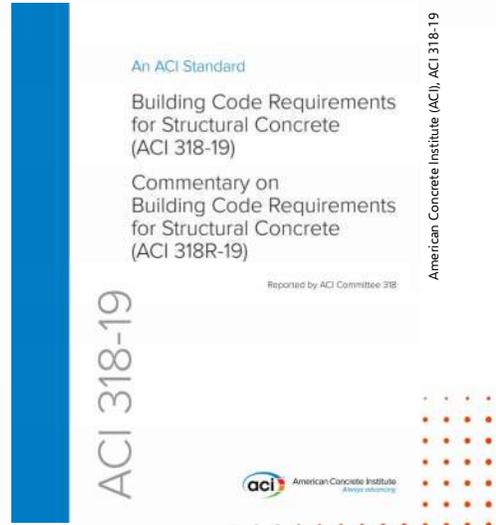
o IBC 1901.5: Construction Documents (cont.)

- Type & location of mechanical and welded splices
- Contraction & isolation joint details
- Strength & stressing sequence for posttensioning
- SDC "D-F" → Statement if slab on grade is a structural diaphragm



Concrete – Durability

- **IBC 1904: Durability Requirements**
 - Shall conform to ACI 318-19
 - *Exception:* R-2 & R-3 ≤ 3-stories
 - Strength and durability provisions are two different things.



Concrete – Durability

○ Section 19.3.1 of ACI 318-19:

- | | |
|-----------------------------------|--------------------|
| • Freezing (F0, F1, F2, & F3) | 0 = Not applicable |
| • Sulfate (S0, S1, S2, & S3) | 1 = Moderate |
| • Permeability (P0, P1, P2, & P3) | 2 = Severe |
| • Corrosive (C0, C1, & C2) | 3 = Very severe |



Table 19.3.1.1—Exposure categories and classes

Category	Class	Condition	
Freezing and thawing (F)	F0	Concrete not exposed to freezing-and-thawing cycles	
	F1	Concrete exposed to freezing-and-thawing cycles with limited exposure to water	
	F2	Concrete exposed to freezing-and-thawing cycles with frequent exposure to water	
	F3	Concrete exposed to freezing-and-thawing cycles with frequent exposure to water and exposure to deicing chemicals	
Sulfate (S)		Water-soluble sulfate (SO ₄ ²⁻) in soil, percent by mass ^[1]	Dissolved sulfate (SO ₄ ²⁻) in water, ppm ^[2]
	S0	SO ₄ ²⁻ < 0.10	SO ₄ ²⁻ < 150
	S1	0.10 ≤ SO ₄ ²⁻ < 0.20	150 ≤ SO ₄ ²⁻ < 1500 or seawater
	S2	0.20 ≤ SO ₄ ²⁻ ≤ 2.00	1500 ≤ SO ₄ ²⁻ ≤ 10,000
	S3	SO ₄ ²⁻ > 2.00	SO ₄ ²⁻ > 10,000

In contact with water (W)	W0	Concrete dry in service
	W1	Concrete in contact with water where low permeability is not required
	W2	Concrete in contact with water where low permeability is required
Corrosion protection of reinforcement (C)	C0	Concrete dry or protected from moisture
	C1	Concrete exposed to moisture but not to an external source of chlorides
	C2	Concrete exposed to moisture and an external source of chlorides from deicing chemicals, salt, brackish water, seawater, or spray from these sources

American Concrete Institute, ACI 318-19©

Table 19.3.2.1—Requirements for concrete by exposure class

Exposure class	Maximum w/cm ^[1,2]	Minimum f _c , psi	Additional requirements			Limits on cementitious materials
			Air content			
F0	N/A	2500	N/A			N/A
F1	0.55	3500	Table 19.3.3.1 for concrete or Table 19.3.3.3 for shotcrete			N/A
F2	0.45	4500	Table 19.3.3.1 for concrete or Table 19.3.3.3 for shotcrete			N/A
F3	0.40 ^[3]	5000 ^[3]	Table 19.3.3.1 for concrete or Table 19.3.3.3 for shotcrete			26.4.2.2(b)
			Cementitious materials ^[4] — Types			Calcium chloride admixture
			ASTM C150	ASTM C595	ASTM C1157	
S0	N/A	2500	No type restriction	No type restriction	No type restriction	No restriction
S1	0.50	4000	II ^{[5][6]}	Types with (MS) designation	MS	No restriction
S2	0.45	4500	V ^[6]	Types with (HS) designation	HS	Not permitted
S3	Option 1	4500	V plus pozzolan or slag cement ^[7]	Types with (HS) designation plus pozzolan or slag cement ^[7]	HS plus pozzolan or slag cement ^[7]	Not permitted
	Option 2	5000	V ^[8]	Types with (HS) designation	HS	Not permitted

American Concrete Institute, ACI 318-19©

W0	N/A	2500	None		
W1	N/A	2500	26.4.2.2(d)		
W2	0.50	4000	26.4.2.2(d)		
			Maximum water-soluble chloride ion (Cl⁻) content in concrete, percent by mass of cementitious materials^[9,10]		Additional provisions
			Nonprestressed concrete	Prestressed concrete	
C0	N/A	2500	1.00	0.06	None
C1	N/A	2500	0.30	0.06	
C2	0.40	5000	0.15	0.06	Concrete cover ^[11]

American Concrete Institute, ACI 318-19C

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Concrete – Durability

- **IBC 1904:** *Durability Requirements (cont.)*
 - Section 19.3.1.1 of ACI 318-19: “Licensed design professional shall assign exposure classes in accordance with the severity of the anticipated exposures...”

<u>CONCRETE ELEMENT:</u>	<u>STRENGTH:</u>	<u>EXPOSURE CLASS:</u>
FOOTINGS & FOUNDATION WALLS:	4000 PSI	(F1, S0, W0, C1)
TILT-UP CONCRETE WALL PANELS	4500 PSI	(F2, S0, W1, C1)
INTERIOR SLABS ON GRADE:	3500 PSI	(F0, S0, W0, C0)
SITE CONCRETE:	4500 PSI	(F3, S0, W1, C2)

BCS

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Concrete – Durability

Sample Comment:

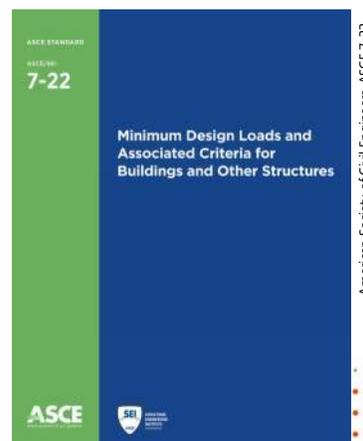
Section 19.3.1.1 of ACI 318-19 requires the design professional to assign exposure classes to structural concrete members in accordance with Table 19.3.1.1. Please address.



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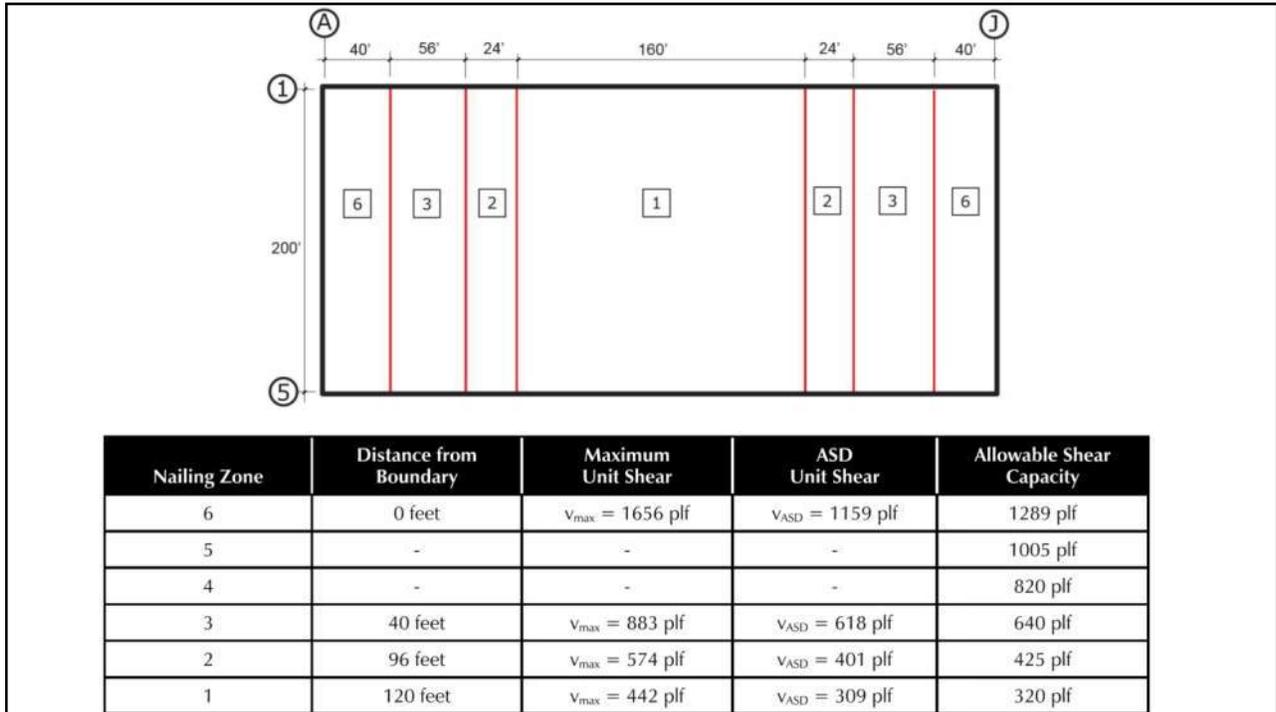
ASCE 7-22

- **Wall Anchorage Requirements:**
 - Section 12.11.2.1
 - If concrete or masonry walls in SDC "C-F"...



ASCE 7-22

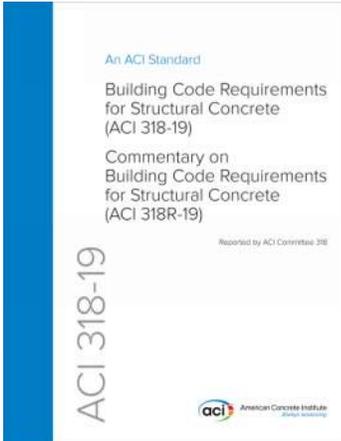
- “Diaphragms shall be provided with continuous ties or struts between diaphragm chords to distribute these anchorage forces into the diaphragms... Added chords are permitted to be used to form subdiaphragms to transmit the anchorage forces to the main continuous crossies.”
- **Wood diaphragms** → Diaphragm sheathing shall not be considered effective for providing ties or struts required by this section.
- **Metal deck diaphragm** → Metal deck shall not be considered as the continuous tie in the direction perpendicular to the deck span.



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ACI 318-19

- **Key Items:**
 - Anchoring
 - Concrete Details

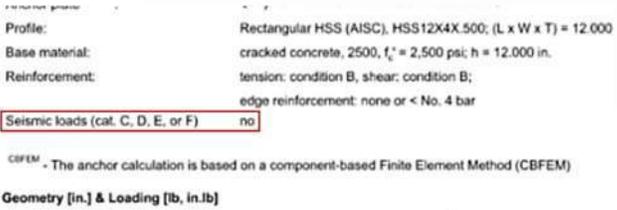




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ACI 318-19

- **Anchoring:**
 - SDC "C-F":
 - Special provisions in §17.10 for these anchors.
 - Post-installed anchors must be qualified per ACI 355.2 or ACI 355.4.
 - Horizontal or upwardly inclined adhesive anchors shall be qualified for such application by ACI 355.4. These also require installer qualification and special inspections.



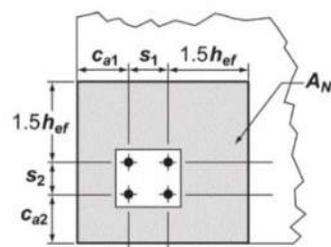


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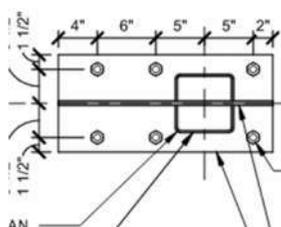
ACI 318-19

○ Anchoring:

- Pay special attention to the edge distances.
- Often the designer will list an infinite value, but the anchors are within a few inches from the edge of concrete.



American Concrete Institute, ACI 318-19©



Cut at footing F7.5
which is 18" thick

(6) 7/8"Ø GR. 55 ANCHOR
BOLTS W/ 24" MIN
EMBEDMENT

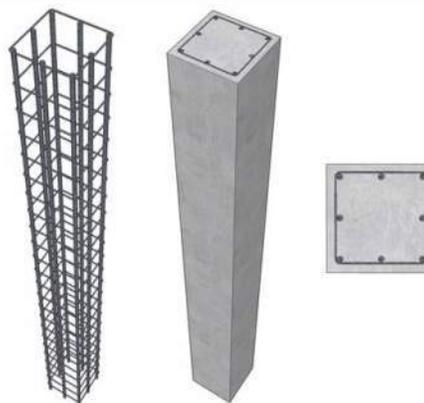
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ACI 318-19

○ Concrete Details:

• Section 25.7.2: Ties

- Minimum Bar Size
 - < #10 vertical bar → #3 ties
 - #11, 14 or 18 → #4 ties
- Maximum Vertical Spacing
 - $16d_b$ vertical bars (e.g. #5 = 10")
 - $48d_b$ tie bars (e.g. #3 = 18")
 - Least dimension of member



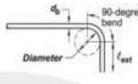
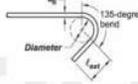
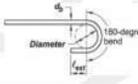
ACI 318-19

Concrete Details:

Section 25.7.2: Ties

- Seismic hooks, used to anchor stirrups, ties, hoops, and crossties shall...
 - Have a minimum 90-degree bend for circular hoops, or...
 - 135-degree bend for all other hoops, and...
 - Hook shall engage longitudinal bar and extend 6db, but a minimum of 3-inches, into the interior of the stirrup or hoop

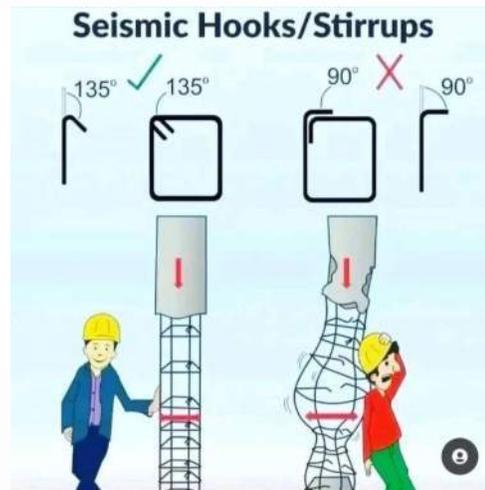
Table 25.3.2—Minimum inside bend diameters and standard hook geometry for stirrups, ties, and hoops

Type of standard hook	Bar size	Minimum inside bend diameter, in.	Straight extension ⁽¹⁾ l_{ext} in.	Type of standard hook
90-degree hook	No. 3 through No. 5	$4d_b$	Greater of $6d_b$ and 3 in.	
	No. 6 through No. 8	$6d_b$	$12d_b$	
135-degree hook	No. 3 through No. 5	$4d_b$	Greater of $6d_b$ and 3 in.	
	No. 6 through No. 8	$6d_b$	$12d_b$	
180-degree hook	No. 3 through No. 5	$4d_b$	Greater of $4d_b$ and 2.5 in.	
	No. 6 through No. 8	$6d_b$	$12d_b$	



American Concrete Institute, ACI 318-19

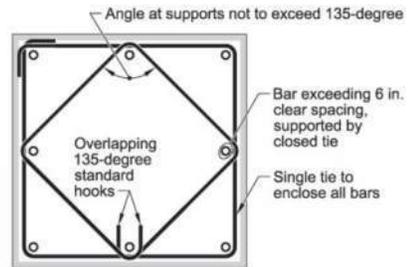
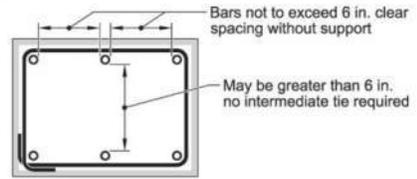
ACI 318-19



ACI 318-19

Concrete Details:

- **Section 25.7.2: Ties**
- "Every corner or alternate longitudinal bar shall have lateral support provided by the corner of a tie... No bar shall be further than 6" clear... from such a laterally supported bar."



American Concrete Institute, ACI 318-19 ©



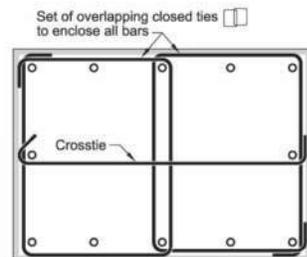
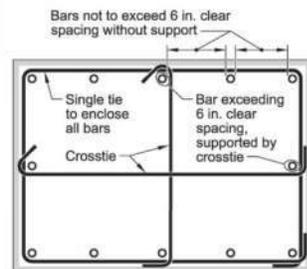
ACI 318-19

Concrete Details:

- **Section 25.7.2: Ties**

Sample Comment:

Please review the lateral tie requirements shown in the concrete column details. Vertical bars should be tied in such a fashion as to ensure the maximum distance between laterally tied bars is less than or equal to 6-inches. See Section 25.7.2.3 of ACI 318-19.



American Concrete Institute, ACI 318-19 ©



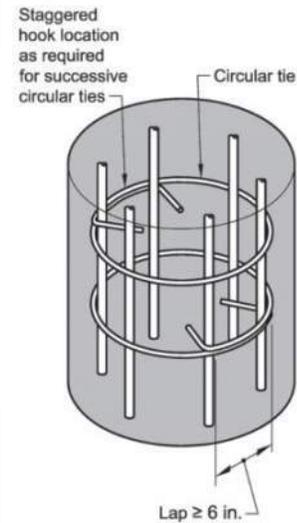
161

ACI 318-19

Concrete Details:

Section 25.7.2: Ties

- Circular ties permitted at circular cross sections.
- Ends must overlap 6-inches
- Shall terminate in standard hooks and engage vertical bar
- Overlaps of adjacent circular ties must be staggered



American Concrete Institute, ACI 318-19 ©



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ACI 318-19

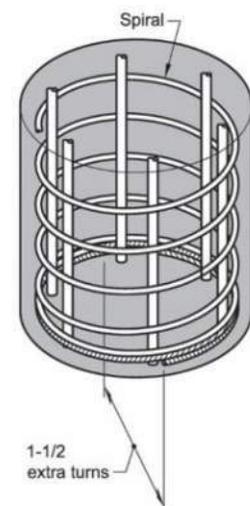
Concrete Details:

Section 25.7.3: Spirals

- Consists of $3/8''\text{Ø}$ continuous bar with clear spacing meeting both...
 - Greater of 1-inch and $(4/3)d_{agg}$ & not $>$ 3-inches
- Anchored by 1.5 extra turns at each end

Sample Comment:

A spiral spacing of 6-inches is currently specified. Section 25.7.3.1 of ACI 318-19 does not allow a spiral clear spacing of more than 3-inches. Please address.



American Concrete Institute, ACI 318-19 ©

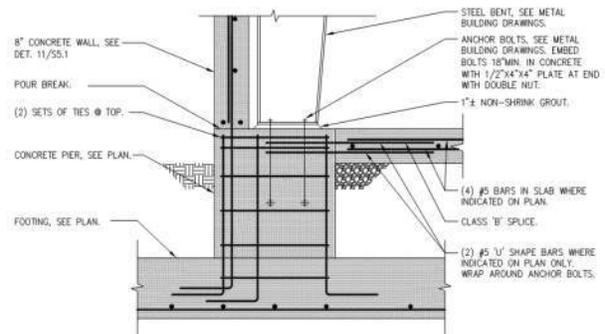


ACI 318-19

Concrete Details:

Section 10.7.6.1.5: Anchor Bolts in Column/Pedestal

- Anchor bolts placed in the top of column or pedestal shall be enclosed by ties surrounding at least four vertical bars.
- Ties shall consist of...
 - (2) #4 or (3) #3 ties
 - Distributed within top 5"



ACI 318: Nonprestressed CIP

Exposure	Member	Reinforcement	Cover (in.)
Cast against and permanently in contact with ground	All	All	3
Exposed to weather or in contact with ground	All	No. 6 thru 18	2
		WWF or ≤ No. 5	1.5
Not exposed to weather or in contact with ground	Slabs, joists, and walls Beams, columns, pedestals, and tension ties	No. 14 & No. 18	1.5
	Beams, columns, pedestals, and tension ties	≤ No. 11	0.75
	Beams, columns, pedestals, and tension ties	Primary reinforcement, stirrups, ties, spirals, and hoops	1.5



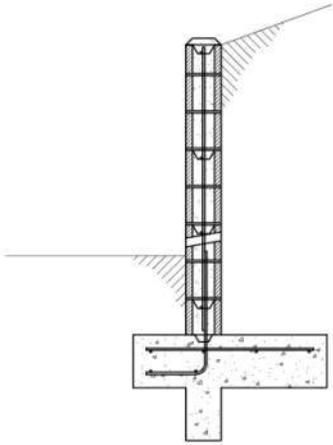
Masonry

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Masonry Construction

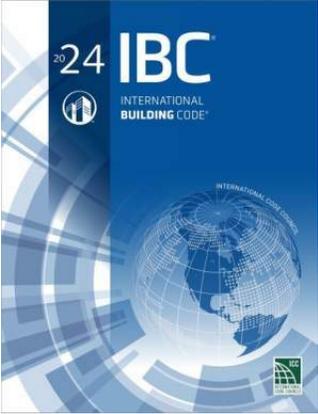
- Shear & bearing walls
- Retaining walls
- Columns & pilasters
- Beams, deep beams, lintels
- Veneer



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IBC Chapter 21

- 2101 – General
- 2103 – Materials



BCS

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Masonry – General

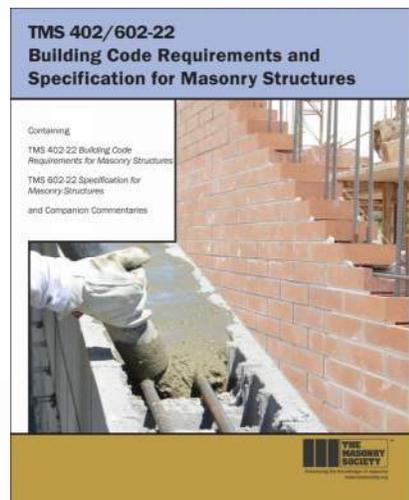
- **IBC 2101.1:** *Scope*
 - Chapter 21 addresses materials, design, construction and quality of masonry.
- **IBC 2101.2.1:** *Masonry Veneer*
 - Per IBC Chapter 14 → Requires compliance with TMS 402
- **IBC 2101.3:** *Special Inspection*
 - Per IBC Chapter 17 → Requires compliance with TMS 402 & 602

BCS

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Masonry – General

- **IBC 2101.2:** *Design Methods*
- Design shall comply with either...
 - **TMS 402** – Building Code for Masonry Structures
 - **TMS 403** – Direct Design Handbook
 - **TMS 404** – Design of Architectural Cast Stone



The Masonry Society (TMS), TMS 402/602-22 ©

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Masonry – Materials

- **IBC 2103:** *Materials*
 - Masonry Units → Article 2.3 of TMS 602
 - Mortar → Article 2.1 & 2.6A of TMS 602
 - Grout → Article 2.2 of TMS 602 → **≥ CMU, but ≥ 2,000psi**
 - Metal Reinforcement → Article 2.4 of TMS 602

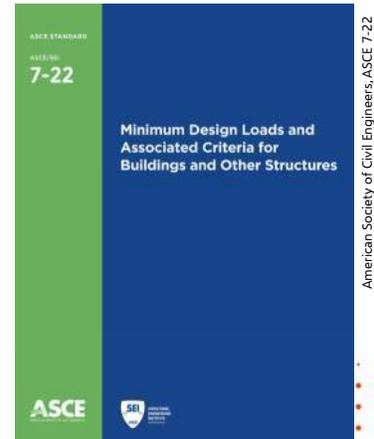


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ASCE 7-22

○ Wall Anchorage Requirements:

- Section 12.11.2.1
- If concrete or masonry walls in SDC "C-F"...

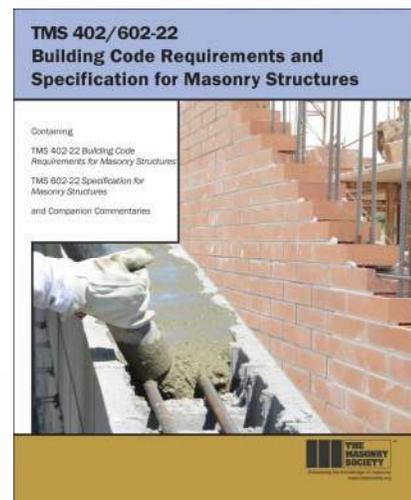


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TMS 402/602

○ Key Items

- Construction Documents*
- Quality Assurance Program
- Seismic Design Requirements*
- Veneer



TMS 402/602

o Section 1.2: Construction Documents

- Loads used for design
- Specified compressive strength of masonry
- Size & location of structural members
- Details of anchorages, including the type, size & location
- Details of reinforcement, size, grade, type, lap splice length & location
- If reinforcing bars are to be welded & their requirements
- Size & permitted locations of conduits, pipes & sleeves
- Shall specify the quality assurance plan



TMS 402/602

o Seismic Design Requirements

- Shear wall type is dependent upon the SDC
- Table CC-7.3.2-1 outlines the SDC limitations

Table CC-7.3.2-1: Requirements for Masonry Shear Walls Based on Shear Wall Designation

Shear Wall Designation	Design Methods	Reinforcement Requirements	Permitted In
Ordinary Plain Masonry Shear Walls	Section 8.2 or Section 9.2	None	SDC A and B
Detailed Plain Masonry Shear Walls	Section 8.2 or Section 9.2	Section 7.3.2.2.1	SDC A and B
Ordinary Reinforced Masonry Shear Walls	Section 8.3 or Section 9.3	Section 7.3.2.2.1	SDC A, B, and C
Intermediate Reinforced Masonry Shear Walls	Section 8.3 or Section 9.3	Section 7.3.2.4	SDC A, B, and C
Special Reinforced Masonry Shear Walls	Section 8.3 or Section 9.3	Section 7.3.2.5	SDC A, B, C, D, E, and F
Ordinary Plain AAC Masonry Shear Walls	Section 11.2	Section 7.3.2.6.1	SDC A and B
Detailed Plain AAC Masonry Shear Walls	Section 11.2	Section 7.3.2.7.1	SDC A and B
Ordinary Reinforced AAC Masonry Shear Walls	Section 11.3	Section 7.3.2.8	SDC A, B, C, D, E, and F
Ordinary Plain Prestressed Masonry Shear Walls	Chapter 10	None	SDC A and B
Intermediate Reinforced Prestressed Masonry Shear Walls	Chapter 10	Section 7.3.2.10	SDC A, B, and C
Special Reinforced Prestressed Masonry Shear Walls	Chapter 10	Section 7.3.2.11	SDC A, B, C, D, E, and F

The Masonry Society, TMS 402/602-22©



TMS 402/602

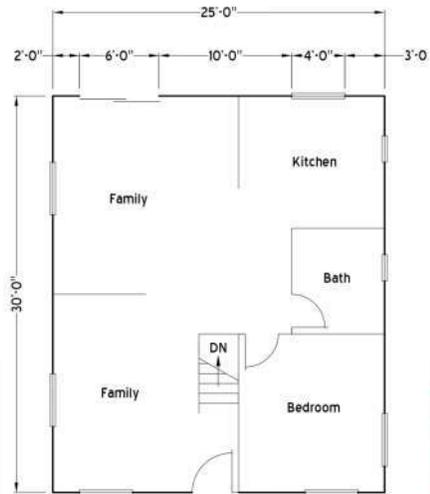
○ Seismic Design Requirements

- **Section 7.3.2.5:**
- Maximum reinforcement spacing
 - 1/3 length of wall, or...
 - 1/3 height of wall, or...
 - 48"o.c.

EXAMPLE

Given: 9-foot walls

- $25'/3 = 8.33'$
- $9'/3 = 3.0'$
- 48"



TMS 402/602

○ Seismic Design Requirements

- Ratio of reinforcing
 - $\rho_{min} \geq 0.0007$ in each direction (ρ_h & ρ_v)
 - $\rho_{total} \geq 0.002$ ($\rho_h + \rho_v$)

Actual Reinforcing Steel Ratio (ρ_{act})

	A_g (in ²)	#4 bars ($A_s=0.20in^2$)					#5 bars ($A_s=0.31in^2$)				
		8"o.c.	16"o.c.	24"o.c.	32"o.c.	48"o.c.	8"o.c.	16"o.c.	24"o.c.	32"o.c.	48"o.c.
4" block	43.5	0.00690	0.00345	0.00230	0.00172	0.00115	0.01069	0.00534	0.00356	0.00267	0.00178
6" block	67.5	0.00444	0.00222	0.00148	0.00111	0.00074	0.00689	0.00344	0.00230	0.00172	0.00115
8" block	91.5	0.00328	0.00164	0.00109	0.00082	0.00055	0.00508	0.00254	0.00169	0.00127	0.00085
10" block	115.5	0.00260	0.00130	0.00087	0.00065	0.00043	0.00403	0.00201	0.00134	0.00101	0.00067
12" block	139.5	0.00215	0.00108	0.00072	0.00054	0.00036	0.00333	0.00167	0.00111	0.00083	0.00056





Sample Comment:

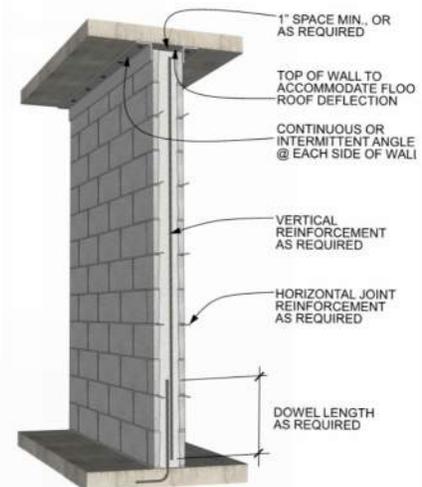
Section 7.3.2.5 of TMS 402-22 requires a minimum reinforcement ratio of 0.002 times the gross cross-sectional area of the wall, with a minimum vertical and horizontal steel ratio of 0.0007. Currently the typical wall reinforcing is called out as a single #5 vertical bar at 32"o.c. and single #4 horizontal bar at 48"o.c. This results in a total steel ratio of less than 0.002 and a horizontal steel ratio of less than 0.0007. Please address.

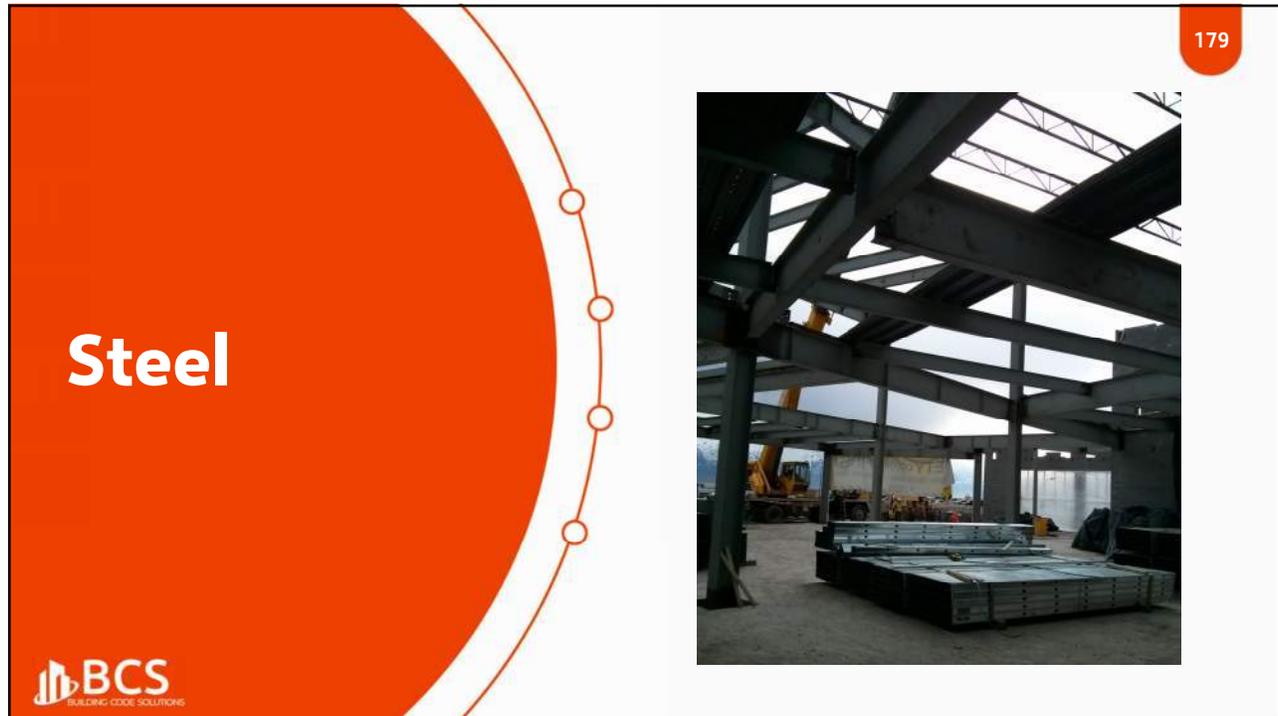
TMS 402/602

○ Seismic Design Requirements

• Nonparticipating Elements:

- If not intended to resist lateral forces...
- Must be isolated in their own plane (§7.3.1)
- Exception: A deformation compatibility analysis can be provided.





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Steel



BCS
BUILDING CODE SOLUTIONS

This slide features a large orange semi-circle on the left side with the word "Steel" in white. On the right, there is a photograph of a steel structure under construction, showing a network of beams and columns. The BCS logo is in the bottom left corner, and the number 179 is in a small orange circle in the top right corner.



180

Steel Construction

- Columns
- Beams
- Diaphragms
- Braced Frames
- Moment Frames
- Cantilevered Columns
- Shear Walls
- Miscellaneous Components

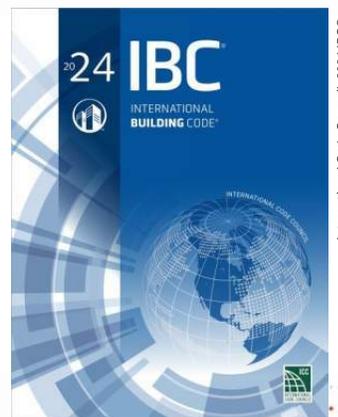
BCS

This slide has a decorative pattern of orange dots in the top left and bottom right corners. The title "Steel Construction" is in bold black text. Below it is a list of eight items, each preceded by a small circle. The BCS logo is in the bottom left corner, and the number 180 is in a small orange circle in the top right corner.

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IBC Chapter 22

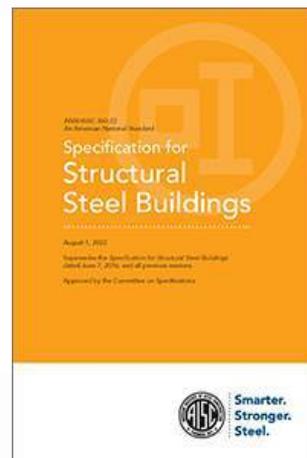
- 2202 – Structural steel & composite
- 2204 – Cold-formed steel
- 2206 – Cold-formed steel, light-frame
- 2207 – Steel joists
- 2208 – Steel decks
- 2209 – Steel storage racks
- 2210 – Metal building systems



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Structural Steel

- **IBC 2202:** *Structural Steel & Composite*
 - Design, fabrication and erection per AISC 360.
 - SDC "D-F" → AISC 341
 - SDC "B-C" → AISC 341 is only required if an "R" from Table 12.2-1 of ASCE 7 is used. Otherwise → R, Cd, $\Omega_0 = 3.0$
 - <https://www.aisc.org/publications/steel-standards/>



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Cold-Formed Steel

○ IBC 2204: *Cold-Formed Steel*

- Free download at <https://www.buildusingsteel.org/>
- CFS Structural Members → Design per AISI S100
- CFS diaphragms → AISI S310
- CFS Seismic Design → Two new sections
 - IBC 2204.2.1: CFS Special Bolted Moment Frame
 - R from Table 12.2-1 → design per AISI S400
 - IBC 2204.2.2: CFS SFRS
 - R from Table 12.2-1 for “not specifically detailed for seismic resistance” → design per AISI S100



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CFS Light-Frame

○ IBC 2206: *CFS Light-Frame Construction*

- Systems, members and connections → per AISI S240
- Seismic design & detailing → AISI S400
- Prescriptive → AISI S230
- CFS Trusses → AISI S202
- Nonstructural → AISI S220
- All free at <https://www.buildusingsteel.org/>



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Steel Joists

○ IBC 2207: *Steel Joists*

- Design, fabrication & use per SJI 100 or SJI 200
- Free download at <https://steeljoist.org/>
- EOR shall...
 - Note joist and girder designations
 - Show joist layout, end supports, anchorages & bridging
 - Special loads should be noted
 - Special considerations such as extended ends should be noted
 - Live & total load deflections specified if different from SJI standard



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Steel Decks

○ IBC 2208: *Steel Decks*

- New steel deck standard → SDI SD
- Previously:
 - Noncomposite floor deck → SDI-NC1.0
 - Roof deck → SDI-RD1.0
 - Composite floor deck → SDI-C
- Steel decks: (Free download at <https://sdi.org/>)



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Steel Storage Racks

- **IBC 2209:** *Steel Storage Racks*
 - Design, testing & utilization → ANSI MH16.1
 - Cantilevered racks → ANSI MH16.3
 - Seismic design → Section 15.5.3 of ASCE 7-22
 - SDC 'D-F' and ≥ 8 -feet → Certificate of compliance and additional special inspection requirements (see Table 1705.13.7)!



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Metal Buildings

- **IBC 2210:** *Metal Building Systems*
 - Structural steel → per IBC 2202
 - CFS → per IBC 2204
 - Steel joists → per IBC 2207
 - Steel cable → per IBC 2214
 - Seismic design → per IBC 2202.2

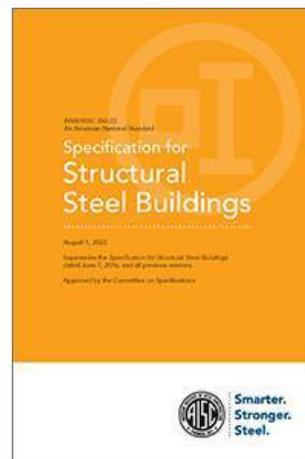


189

AISC 360 Requirements

○ Key Elements:

- Chapter A – General Provisions
- Chapter B – Design Requirements
- Chapter C – Stability
- Chapter D – Tension
- Chapter E – Compression
- Chapter F – Flexure
- Chapter G – Shear
- Chapter H – Combined Forces
- Chapter I – Composite Members
- Chapter N – Quality Control & Quality Assurance



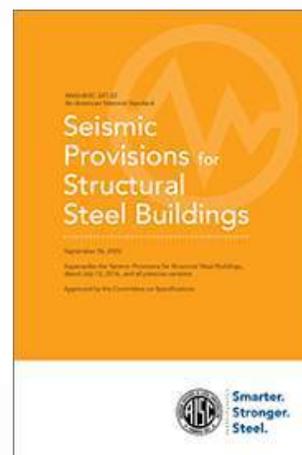
American Institute of Steel Construction, AISC 360-22 ©

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AISC 341 Requirements

○ Key Elements:

- Chapters A-D – General Provisions
- Chapter E – Moment Frames
- Chapter F – Braced Frames
- Chapter J – Quality Control & Quality Assurance



American Institute of Steel Construction, AISC 341-22 ©

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AISC 341 Requirements

○ General Provisions:

- **Demand Critical Welds** (§A3.4b)
- These are welds that...
 - Are subject to yield-level stresses, and...
 - Could cause catastrophic results if they fail
- DCW's shall be made with filler metals complying with clauses 6.1, 6.2, and 6.3 of AWS D1.8.
 - CVN toughness of 20 ft-lbf at 0°F, and...
 - CVN toughness of 40 ft-lbf at 70°F
- Ultrasonic testing of DSW's required in Chapter J of AISC 341



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AISC 341 Requirements

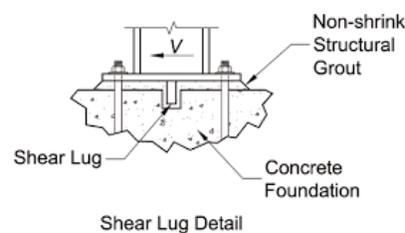
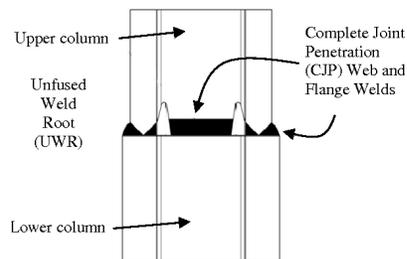
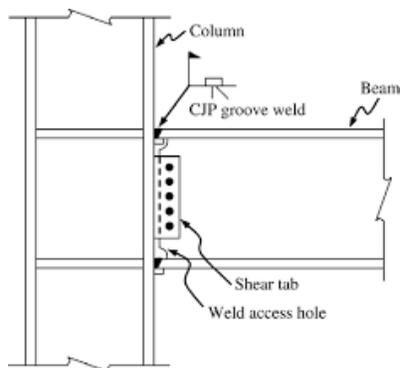
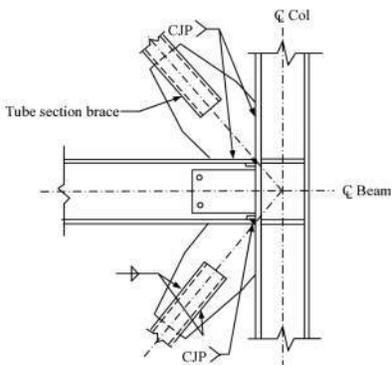
○ General Provisions:

- **Demand Critical Welds** (cont.)
- AISC 341 requires drawings show the demand critical welds for...
 - Special Steel Moment Frames
 - Intermediate Steel Moment Frames
 - Special Concentrically Braced Frames
 - Eccentrically Braced Frames
 - Column Splices
 - Column Anchorages



Sample Comment:

Per IBC 2202.2.1.2, structural steel structures located within high seismic regions shall be designed and detailed in accordance with AISC 341-22. Per Section A4.2 of AISC 341, the drawings must clearly call out all demand critical welds, in addition to noting the specific weld filler and testing requirements. Please ensure that this is all clearly addressed on the plans.



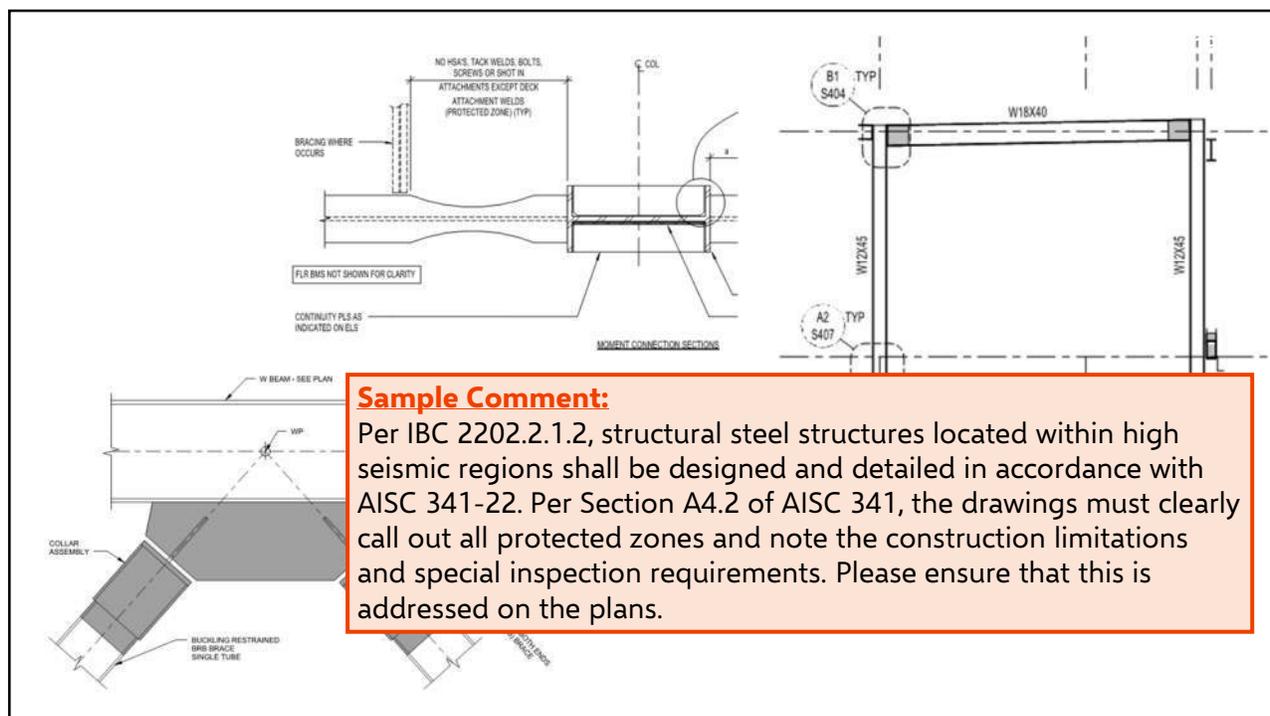
194

AISC 341 Requirements

○ General Provisions:

- **Protected Zones** (§D1.3)
 - Areas of expected yielding
 - Fabrication discontinuities are repaired
 - Detrimental attachments are not permitted
 - AISC 341 requires drawings to show protected zones for...
 - Special Steel Moment Frames
 - Intermediate Steel Moment Frames
 - Special Concentrically Braced Frames
 - Eccentrically Braced Frames
 - Buckling Restrained Braced Frames

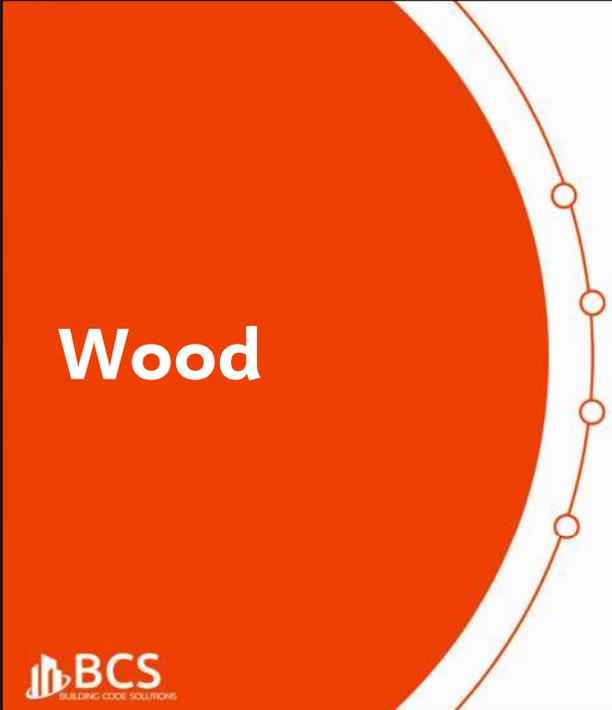




AISC 341 Requirements

○ General Provisions:

- **Design Drawings** (§A4)
 - The applicable building code & AISC standards should be noted.
 - The plans should clearly indicate the following:
 - Designation of the LFRS
 - Identification of members and connections that are part of LFRS
 - Locations & dimensions of protected zones
 - Locations of demand critical welds
 - Connection of concrete diaphragms and steel elements of LFRS
 - Shop drawing or erection drawing requirements not addressed



Wood



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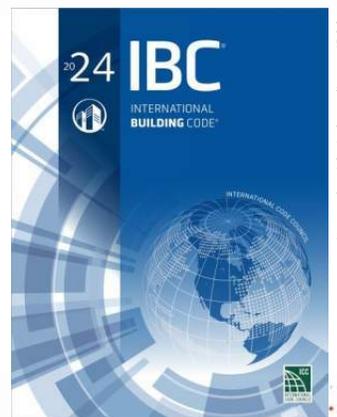
Wood Construction

- Bearing & Shear Walls
- Columns
- Beams
- Diaphragms
- Cantilevered Columns
- Miscellaneous Components



IBC Chapter 23

- 2303 – Minimum Standards
- 2304 – General Construction
- 2305 – LFRS Design
- 2308 – Conventional Construction



Wood – Minimum Standards

- **IBC 2303:** *Minimum Standards*
 - Provides manufacturing standards, specification criteria, and use applications for wood products.
 - Includes:

○ Structural sawn lumber	○ Fiberboard sheathing	○ Structural composite lumber
○ End-jointed lumber	○ Hardboard siding	○ Timber poles and piles
○ I-joists	○ Particleboard	○ Rim board
○ Glued-laminated timber	○ Preservative-treated	○ Wood trusses
○ Cross-laminated timber	○ Fire-retardant-treated	○ Joist hangers
○ Wood structural panels	○ Structural log members	○ Nails & staples



Wood – Minimum Standards

- **IBC 2303.2: Fire-Retardant-Treated Wood**
 - Must be tested per ASTM E84 or UL 723
 - The use of paints, coating or stains are not approved
 - Strength adjustment is required!

Table 3: Flame Tech Treated Lumber Adjustment Factors When Used at or Near Room Temperatures

Property	Lumber Treatment Adjustment Factors ^(1,2)			
	SPF	Southern Pine	Douglas Fir	Other Wood Species
Bending MOR	0.95	0.82	1.00	0.82
Bending MOE	1.00	0.87	0.99	0.87
Tension Parallel to Grain	0.95	0.98	1.00	0.98
Shear Parallel to Grain	1.00	0.95	1.00	0.95
Compression Parallel to Grain	0.96	0.96	0.96	0.96
Compression Perpendicular to Grain ⁽³⁾	0.95	0.95	0.96	0.95
Fasteners / connectors ⁽⁴⁾	0.90	0.90	0.90	0.90

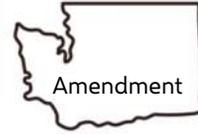


Flame Tech™, Fire-Retardant-Treated Wood

Wood – General

- **IBC 2304: General Requirements**
 - Wall & floor framing should comply with IBC 2308
 - Bottom plates → Minimum 2x and same width as studs
 - Framing over openings → Adequate size to transfer loads to vertical members
 - Connectors in preservative-treated or fire-retardant → galvanized, stainless steel, silicone bronze or copper.





Wood – General

o **IBC 2304: General Requirements (cont.)**

- Wood columns and posts shall have full end bearing and shall resist lateral and uplift forces.
- Load path (IBC 2304.10.6) → Members shall be secured
- If staples are used the allowable bending moment must be listed on the plans.



41 connections defined

DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER*	SPACING AND LOCATION
Roof		
1. Blocking between ceiling joists, rafters or trusses to top plate or other framing below	4-8d box (2 1/2" x 0.113"); or 3-8d common (2 1/2" x 0.131"); or 3-10d box (3" x 0.128"); or 3-3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	Each end, toenail
Blocking between rafters or truss not at the wall top plate, to rafter or truss	2-8d common (2 1/2" x 0.131") 2-3" x 0.131" nails 2-3" 14 gage staples	Each end, toenail
	2-16 d common (3 1/2" x 0.162") 3-3" x 0.131" nails 3-3" 14 gage staples	End nail
Flat blocking to truss and web filler	16d common (3 1/2" x 0.162") @ 6" o.c. 3" x 0.131" nails @ 6" o.c. 3" x 14 gage staples @ 6" o.c.	Face nail
2. Ceiling joists to top plate	4-8d box (2 1/2" x 0.113"); or 3-8d common (2 1/2" x 0.131"); or 3-10d box (3" x 0.128"); or 3-3" x 0.131" nails; or 3-3" 14 gage staples, 7/16" crown	Each joist, toenail
3. Ceiling joist not attached to parallel rafter, lap thrust) (see Section 2308.11.3.1, Table 2308.11.3.1)		
4. Ceiling joist attached to parallel rafter (heel joint) (see Section 2308.11.3.1, Table 2308.11.3.1)		
5. Collar tie to rafter	4-10d box (3" x 0.128"); or 4-3" x 0.131" nails; or 4-3" 14 gage staples, 7/16" crown	Face nail

International Code Council, 2024 IBC®

Remember the load path!

- #1: Eave blocking to top plate, toenail (3-8d)
- #12: Top plate to top plate, face nail (16d @ 16" o.c.)
- #15: Bottom plate to blocking, face nail (2-16d)

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Wood – General

○ IBC 2304.3.3: *Shrinkage*

- Wood walls supporting > two floors and a roof must provide an analysis of the potential shrinkage.



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Wood – General

○ IBC 2304.3.3: *Shrinkage*

Sample Comment:

No calculations were included for the analysis of wood shrinkage in the proposed structure. Per IBC 2304.3.3, a wood-framed structure supporting the framing of more than two floors and a roof must provide an adequate shrinkage analysis to the building official. Please provide a satisfactory analysis.

- Shrinkage Calculators:
 - <http://www.strongtie.com/webapps/woodshrinkage/>
 - <http://www.cwc.ca/dimensioncalc/>



Wood – General

o **IBC 2304.11: Heavy Timber**

- Minimum dimensions per Table 2304.11
- Columns shall be continuous or superimposed throughout all stories and appropriately connected.
- Approved wall plate boxes or hangers shall be used for members resting on concrete or masonry walls.
- Exterior walls may consist of 4-inch CLT. (WA - 3.5")
- Interior walls: Solid wood, 4-inch CLT, or 1-hour construction (WA - 3.5")
- Floors and roofs shall not have concealed spaces.
- 4-inch CLT floors and 3-inch CLT roofs are permitted. (WA - 3.5" & 2.5")



Minimum Dimensions

SUPPORTING	HEAVY TIMBER STRUCTURAL ELEMENTS	MINIMUM NOMINAL SOLID SAWN SIZE		MINIMUM GLUED-LAMINATED NET SIZE		MINIMUM STRUCTURAL COMPOSITE LUMBER NET SIZE	
		Width, inch	Depth, inch	Width, inch	Depth, inch	Width, inch	Depth, inch
Floor loads only or combined floor and roof loads	Columns; Framed sawn or glued-laminated timber arches that spring from the floor line; Framed timber trusses	8	8	6 ^{3/4}	8 ^{1/4}	7	7 ^{1/2}
	Wood beams and girders	6	10	5	10 ^{1/2}	5 ^{1/4}	9 ^{1/2}
Roof loads only	Columns (roof and ceiling loads); Lower half of: wood-frame or glued-laminated arches that spring from the floor line or from grade	6	8	5	8 ^{1/4}	5 ^{1/4}	7 ^{1/2}
	Upper half of: wood-frame or glued-laminated arches that spring from the floor line or from grade	6	6	5	6	5 ^{1/4}	5 ^{1/2}
	Framed timber trusses and other roof framing; ^a Framed or glued-laminated arches that spring from the top of walls or wall abutments	4 ^b	6	3 ^b	6 ^{7/8}	3 ^{1/2} ^b	5 ^{1/2}

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Wood – General

o **IBC 2304.12:** *Naturally Durable or Preservative-Treated*

- Joists & Girders: 18-inches & 12-inches from exposed ground
- Exterior Foundation Walls: < 8-inches from exposed earth
- Sleepers & Sills: Sleepers or sills on slab in contact with earth
- Wood Siding: < 6-inch clear of earth, or < 2-inch clear to concrete
- Posts or columns supported by concrete in direct contact with earth
- Structural supports exposed to weather.
- Structural members supporting moisture-permeable floors*
- Heavy termite hazard → crawlspace floors and decks/balconies



Wood – General

o **IBC 2304.12:** *Naturally Durable or Preservative-Treated*

- Lumber reduction for incised lumber
- Fasteners shall be galvanized or stainless steel
- Required unless impervious floor covering

4.3.8 Incising Factor, C_i

Reference design values shall be multiplied by the following incising factor, C_i, when dimension lumber is incised parallel to grain a maximum depth of 0.4", a maximum length of 3/8", and density of incisions up to 1100/r². Incising factors shall be determined by test or by calculation using reduced section properties for incising patterns exceeding these limits.

Table 4.3.8 Incising Factors, C_i

Design Value	C _i
E, E _{min}	0.95
F _b , F _t , F _c , F _v	0.80
F _c	1.00

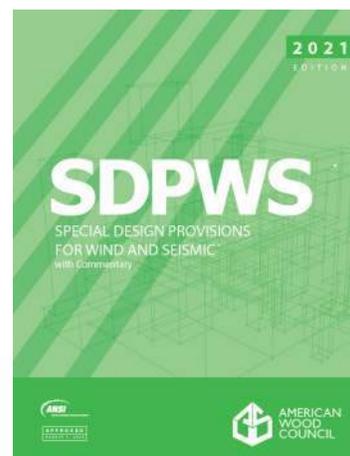
American Wood Council, 2018 NDS©



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Wood – LFRS Design

- **IBC 2305:** *Lateral Force-Resisting Systems*
 - Designed per AWC SDPWS
 - Free view-only version: <https://awc.org/publications/2021-sdpws/>
 - Also provides optional diaphragm and shear wall deflection calculations for staples.



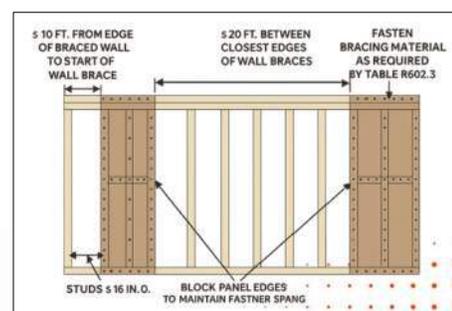
American Wood Council, 2021 SDPWS®



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IBC Requirements

- **IBC 2308:** *Conventional Light-Frame Construction*
 - Remember 2304 refers to 2308 for wall and floor framing provisions
 - Includes story and allowable floor-to-floor height limitations
 - Provides braced wall provisions, but numerous limitations.



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SDPWS Requirements

Section 4.2: Wood-Frame Diaphragms

- Aspect Ratio:

Table 4.2.2 Maximum Diaphragm Aspect Ratios

(Flat or Sloped Diaphragms)

Sheathed Wood-Frame Diaphragm Assemblies	Maximum L/W Ratio
Wood structural panel, unblocked	3:1
Wood structural panel, blocked	4:1
Single-layer horizontally-sheathed lumber	2:1
Single-layer diagonally-sheathed lumber	3:1
Double-layer diagonally-sheathed lumber	4:1

American Wood Council, 2021 SDPWS©



SDPWS Requirements

Section 4.2: Wood-Frame Diaphragms

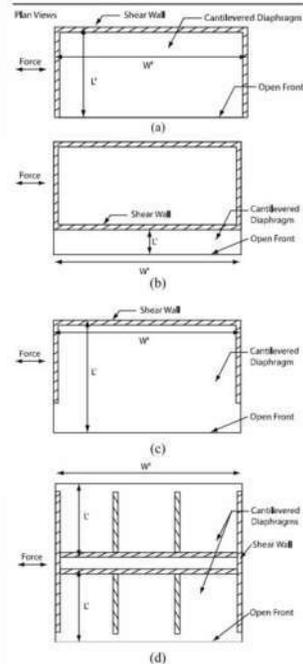
- Open Front Structures:**
 - L' / W' ratio limited to 1.5:1.0
 - Cantilevered diaphragm length \leq 35-feet
 - Exception:* 6-foot cantilever allowed

Sample Comment:

Please verify that the requirements of Section 4.2.6 in AWC SDPWS for "open front structures" have been met at locations where the roof diaphragm cantilevers beyond the lateral resisting elements.



Figure 4A Examples of Open Front Structures



American Wood Council, 2021 SDPWS©

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SDPWS Requirements

○ Section 4.3: Wood-Frame Shear Walls

- Anchor Bolts: 0.229" x 3" x 3", shall extend to within 1/2-inches of wall sheathing where nominal shear capacity is > 400plf for wind or seismic
- Panels \geq 4'x8' except at boundaries & changes in framing
- Nails shall be \geq 3/8-inch from panel edges
- Nailing:
 - Edge spacing \leq 6-inches (same at intermediate framing members & blocking)
 - Field spacing \leq 6-inches (12-inches if > 7/16-inch sheathing or studs < 24"o.c.)



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SDPWS Requirements

○ Section 4.3: Wood-Frame Shear Walls

- 3x if...
 - 2-inch edge nailing
 - 10d nails & 3-inch edge nailing
 - > 980plf nominal shear capacity in SDC "D-F"
- Double 2x allowed (Stitched together \rightarrow 16d @ 24"o.c.)
- Framing at 24"o.c. maximum



SDPWS Requirements

Section 4.3: Wood-Frame Shear Walls

- Aspect Ratio:

Table 4.3.3 Maximum Shear Wall Aspect Ratios

Sheathed Wood-Frame Shear Wall System	Maximum h/b Ratio
Wood structural panels, unblocked	2:1
Wood structural panels, blocked	3.5:1
Particleboard, blocked	2:1
Diagonally-sheathed lumber	2:1
Gypsum wallboard	2:1 ^{1,2}
Portland cement plaster	2:1 ¹
Structural Fiberboard	3.5:1

American Wood Council, 2021 SDPWS®

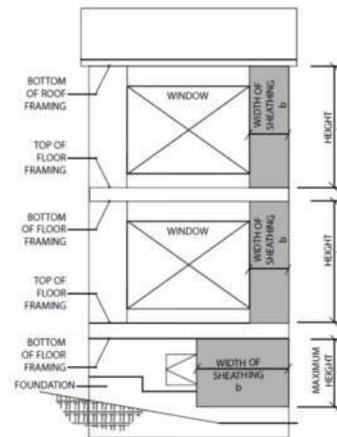


SDPWS Requirements

Segmented Shear Walls:

- While Table 4.3.3 allows a 3.5:1 aspect ratio, walls with ratios > 2:1 have reduced capacity
 - $(WSP) = 1.25 - 0.125h/b$
- Example: 9-foot wall
 - 2:1 → 4.5 feet
 - 3.5:1 → 2.57 feet
 - 43% reduction in capacity!

Figure 4D Typical Individual Full-Height Wall Segments Height-to-Width Ratio



American Wood Council, SDPWS 2021 ©



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SDPWS Requirements

- **Segmented Shear Walls:**
 - Collectors shall transfer shear forces between the diaphragms and the individual full-height wall segments.

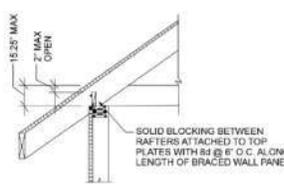


FIGURE R602.10.8.2(1)
BRACED WALL PANEL CONNECTION
TO PERPENDICULAR RAFTERS

For SI: 1 inch = 25.4 mm.





International Code Council, 2021 IRC®

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SDPWS Requirements

- **Segmented Shear Walls:**

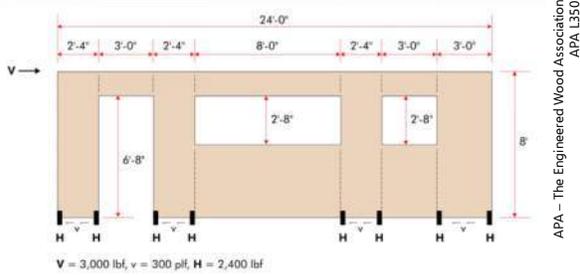
Sample Comment:
There are numerous shear walls that appear to exceed an aspect ratio of 2:1. Please confirm that no walls exceed an aspect ratio of 3.5:1 and that these walls have been checked for a reduced capacity in accordance with Section 4.3.3.2 of AWC SDPWS.



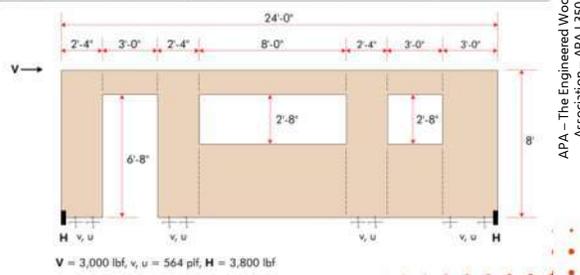
SDPWS Requirements

○ Perforated Shear Walls:

BUILDING ELEVATION FOR SEGMENTED SHEAR WALL EXAMPLE



BUILDING ELEVATION FOR PERFORATED SHEAR-WALL EXAMPLE

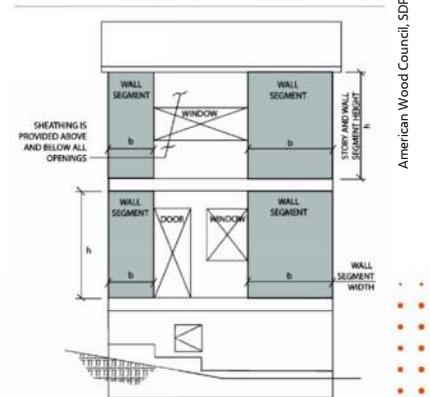


SDPWS Requirements

○ Perforated Shear Walls:

- Not designed for force transfer around opening
- Aspect ratio \rightarrow 3.5:1
- Segment required at each end
- Out-of-plane offsets not allowed
- Full-length collectors
- Uniform top and bottom of wall
- 20-foot maximum height

Figure 4F Typical Shear Wall Height-to-Width Ratio for Perforated Shear Walls



Shear Capacity Adjustment

Table 4.3.5.6 Shear Capacity Adjustment Factor, C_o ¹

Percent Full-Height Sheathing (A_{fhs}/A_{wall})	Percentage Wall Area Openings (A_o / A_{wall})									
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%
	Shear Capacity Ratio, C_o									
10%	1.00	1.00	1.00	1.00	0.77	0.63	0.53	0.45	0.40	0.36
20%	1.00	1.00	1.00	0.91	0.71	0.59	0.50	0.43	0.38	-
30%	1.00	1.00	1.00	0.83	0.67	0.56	0.48	0.42	-	-
40%	1.00	1.00	1.00	0.77	0.63	0.53	0.45	-	-	-
50%	1.00	1.00	0.91	0.71	0.59	0.50	-	-	-	-
60%	1.00	1.00	0.83	0.67	0.56	-	-	-	-	-
70%	1.00	1.00	0.77	0.63	-	-	-	-	-	-
80%	1.00	0.91	0.71	-	-	-	-	-	-	-
90%	1.00	0.83	-	-	-	-	-	-	-	-
100%	1.00	-	-	-	-	-	-	-	-	-

American Wood Council SDPWS 2021 ©

SDPWS Requirements

- Force-Transfer Around Openings (FTAO) Shear Walls:



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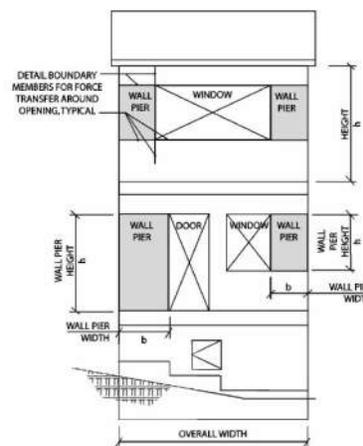
SDPWS Requirements

○ Force-Transfer Shear Walls:

- Each wall pier ≥ 2 -feet
- Aspect Ratio $\rightarrow 3.5:1$
- Full-height wall segment at each end
- No out-of-plane offsets
- Collectors between diaphragms and shear wall shall be the full length of FTAO shear wall



Figure 4E Typical Shear Wall Height-to-Width Ratio for Shear Walls Designed for Force Transfer Around Openings (FTAO)



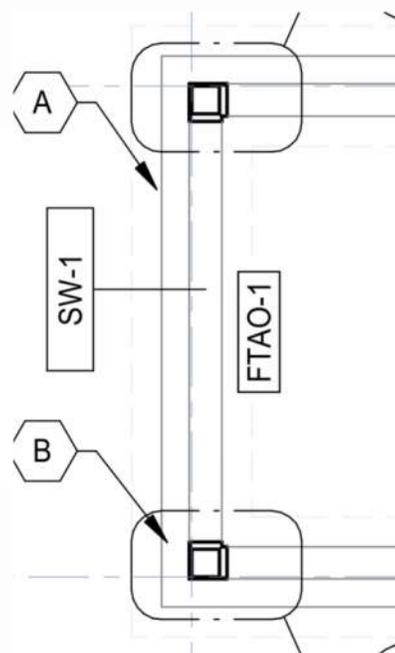
American Wood Council, SDPWS 2021 ©

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SDPWS Requirements

○ Force-Transfer Shear Walls:

- Real-world project...
- Called out as FTAO shear wall
- Piers are only 7-inches wide
- Does this work?
- Are there any alternatives?



SDPWS Requirements

o Force-Transfer Shear Walls:

- Requires rational analysis
 - <https://www.apawood.org/ftao>
- Must define blocking, straps and hold downs

Force Transfer Around Openings Calculator
FTAO Calculator

Project Information
Code: 2018 IRC
Designer: AIA
Client:
Project: Design Example Published in APA Technical Note - Design for Force Transfer Around Openings (FTAO), Form No. 1330A.

Shear Wall Calculation Variables

Opening 1	Opening 2	Adj. Factor Method	Depth
L1: 4.00 ft	L2: 4.00 ft	W1: 1.33 W2: 1.33 W3: 1.33	8 ft
L1: 8.00 ft	L2: 8.00 ft	W1: 1.67 W2: 1.67 W3: 1.67	N/A
L1: 8.00 ft	L2: 4.00 ft	W1=0.5L1+0.5L2=0.87	N/A
L1: 8.00 ft	L2: 8.00 ft	W1=0.5L1+0.5L2=0.76	N/A

1. Hold down forces $H = V_u A_{v, req}$
 First opening: $H1 = 0.5 \times V1 \times W1 = 288 \text{ lbf}$
 Second opening: $H2 = 0.5 \times V2 \times W2 = 288 \text{ lbf}$

2. Total boundary force above + below openings
 First opening: $B1 = V1 \times L1 = 1776 \text{ lbf}$
 Second opening: $B2 = V2 \times L2 = 1776 \text{ lbf}$

3. Corner forces
 $F1 = 0.5L1/V1 = 42 \text{ in.}$
 $F2 = 0.5L2/V2 = 42 \text{ in.}$

4. Shear brace forces
 $S1 = V1 \times L1 = 1776 \text{ lbf}$
 $S2 = V2 \times L2 = 1776 \text{ lbf}$
 $S3 = V3 \times L3 = 864 \text{ lbf}$



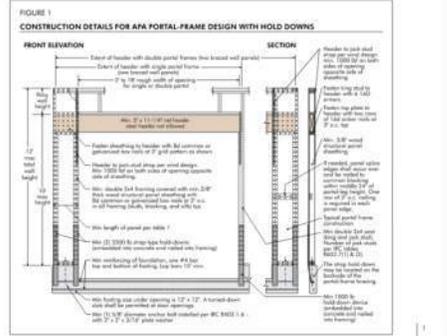
Engineered Wood Association (APA), FTAO Calculator ©

APA Technical Topics

TT-100H MAY 2020

A Portal Frame with Hold Downs for Engineered Applications

The APA portal frame design, as shown in Figure 1, was envisioned primarily for use as bracing in conventional light frame construction. However, it can also be used in engineered applications, as described in this technical topic. The portal frame is not actually a narrow shear wall because it transfers shear by means of a semi-rigid, moment-resisting frame. The extended header is integral in the function of the portal frame, thus, the effective frame width is more than just the wall segment, but includes the header length that extends beyond the wall segment. For this shear transfer mechanism, the wall aspect ratio requirements of the code do not apply to the wall segment of the APA portal frame.



Part 6. Plan Review Fundamentals

“Winners don’t just learn the fundamentals, they master them. Everything I did – Everything I achieved, can be traced back to the way I approached the fundamentals.”

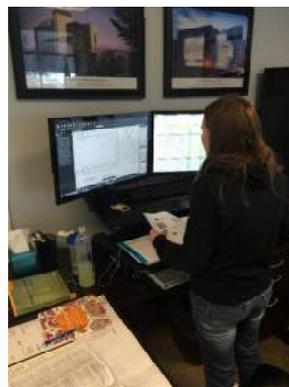
– Michael Jordan



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Fundamentals

- Every reviewer is different!



Plan Review Philosophy

- My white bible
- Created by SEAW & WABO
- "...intended to lay out a common approach by establishing a suggested uniform approach or philosophy that can be used by plan reviewers..."



<p>WABOSEAW Liaison Committee Washington Association of Building Officials & Structural Engineers Association of Washington</p>		<p>WHITE PAPER 1-2020</p>	
<p>Title: Guidelines - Structural Plan Review Philosophy</p>		<p>Date: May 11, 2020 Issue Date: June 30, 2020</p>	
<p>Abstract: This white paper is intended to establish a guideline for a uniform approach to structural plan review of the construction documents submitted for a building permit</p>		<p>Committee Members: Dan Jensen (SEAW Co-Chair), Lee Kiser (WABO Co-Chair), Shelia Probstler (SEAW), Nancy Pevora (WABO), Larry Lindell (SEAW), Dick Finn (SEAW), Mary Kate McGee (WABO), Cheryl Burnett (WABO), Steve Rebeck (WABO), Steve Bellal (WABO), Charles Gingles (SEAW)</p>	
<p>Committee Mission Statement:</p> <ul style="list-style-type: none"> • Improve communication between the public jurisdictions that administer building codes and the engineering design community that prepares construction documents. • Improve consistency and quality of engineering submittals and project reviews. • Build consensus between the engineering design community and building officials with regard to code interpretation and submittal requirements. 			

Approved & published November 15, 2020

INTRODUCTION:
SEAW and WABO share a common interest in building safety. Both organizations recognize the importance of plan review. However, individual engineers and reviewers may not always agree on what a plan reviewer should cover in his or her review. Although the level of review varies from jurisdiction to jurisdiction, some building departments feel they have a responsibility to verify to a high level of detail that the plans comply with the code. On the other side of the counter, some licensed engineers feel that since they are taking on the liability through their seal and signature, building departments should not review their work at all. The following guideline and commentary are intended to lay out a common approach by establishing a suggested uniform approach or philosophy that can be used by plan reviewers working for the local jurisdiction.

While the words "reasonable" and "adequate" are used many times throughout this white paper, they are not defined further than in a dictionary, and deliberately so. The intent is that the commentary gives a general flavor for what the committee felt was "reasonable" or "adequate."

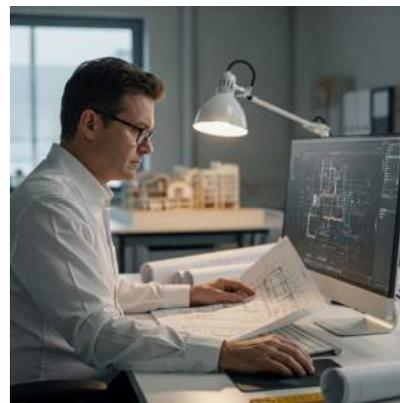
It should be emphasized that this document is not a rule with the force of law behind it. Nobody

Page 1

<https://www.wabo.org/white-papers>

Plan Review Philosophy

- **6 Items Discussed:**
 - Purpose of Plan Review*
 - Character of Plan Review
 - Scope of Review*
 - Level of Review
 - Engineering Judgment*
 - Plan Review Judgment*



Google, Gemini Created Image



Plan Review Philosophy

○ Purpose of Plan Review:

- “The plan reviewer’s job is to conduct a verification that the plans are in substantial compliance with the code, with the goal of protecting the general health, safety, and welfare of the public.”

○ Scope of Review

- “...all information necessary to determine a design complies with the code should be on the plans.”
- “...it should not necessarily be the reviewer’s primary focus to check the mathematical accuracy of the submitted calculations.”



Plan Review Philosophy

○ Engineering Judgment:

- “Many engineers feel that a reviewer should defer to his or her judgment on engineering issues, particularly reviewers without engineering backgrounds.”
- “...if reasonably justified..., deference should be given to a design engineer’s unique solution to a problem.”
- “Incorrect application of engineering principles is always an appropriate issue for a reviewer to raise.”
- “It is appropriate for a reviewer to ask an engineer to justify a design that directly contradicts a code requirement.”

SHEET TITLE

ENGINEERING
JUDGEMENT

Plan Review Philosophy

○ Plan Reviewer Judgment:

- “In exercising his/her judgment, however, the plan reviewer should refrain from imposing his/her own idea of what constitutes ‘best practices’ on the design engineer.”

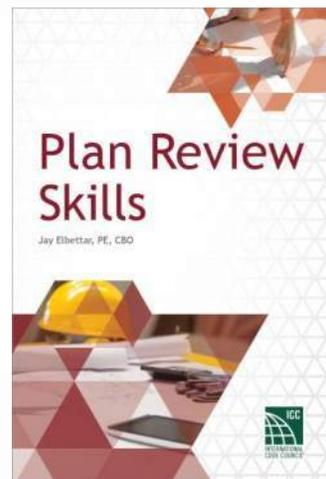
d. Please learn engineering. The calculations show 1#4 cont at the roof line on sheet 42. That is why the details 1 and 2 call for 2#4 continuous at the anchors to the ledgers. The design is correct as submitted.



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Plan Review Skills

- Much of this course focuses on the **hard skills** of plan review... “What does the code require?”
- It is just as important that we focus on the **soft skills** that will help us to succeed.
- ICC recently published a book on this topic, “Plan Review Skills”.



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Comment Letter Formatting

- Note the plan review cycle
- Comment #
- Location (Sheet xx; Detail xx)
- Comment
- Code reference
- Can it be read by anyone?

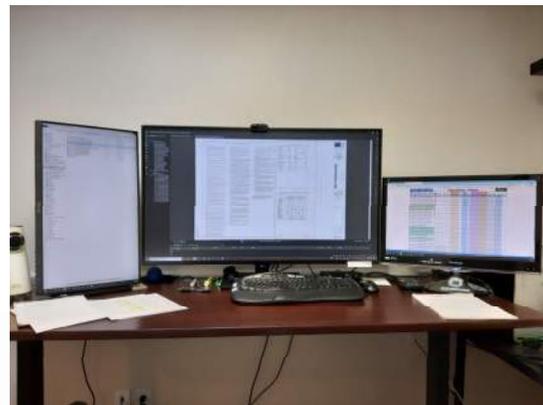
A15. Sheet A402: The Stair in Detail 1 is new construction and must have handrails on both sides as per IBC 1011.11.



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Equipment

- Code books!
- Standards/guides
- Electronic review software
- High-definition dual monitors
- Sit/stand desk
- The right keyboard & mouse
- Ergonomic chair



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What have they gone through?

- Establishing contracts
- Numerous meetings with owner & design team
- Coordinating revisions with all disciplines
- Numerous hours and late nights prior to permit submission



Pickpick.com, Royalty-Free photo



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And now...

- They **have to** deal with you.
- They cannot shop for the best price or service.
- We tell them it will be so long before we can look at it.
- We spend a few hours on it and provide a long list of issues.



Pickpick.com, Royalty-Free photo



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We should be...

- Professional
- Positive
- A Facilitator
- Good Listeners
- Empathetic
- Honest

Table 3-1 Conversations with Difficult People

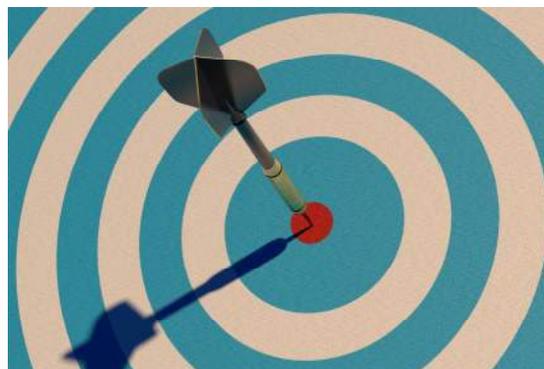
Do	Don't
Defuse	Escalate
Stay calm	Argue
Listen	Interrupt
Let them vent	Blame
Speak quietly	Raise your voice
Be objective	Criticize
Remain confident and positive	Take it personally

International Code Council, Plan Review Skills©



Work on the “Soft Skills”

- **“Small efforts sustained over time can produce significant results.”** – Devin G. Durrant



Microsoft 365, PowerPoint, Stock Images



Resources

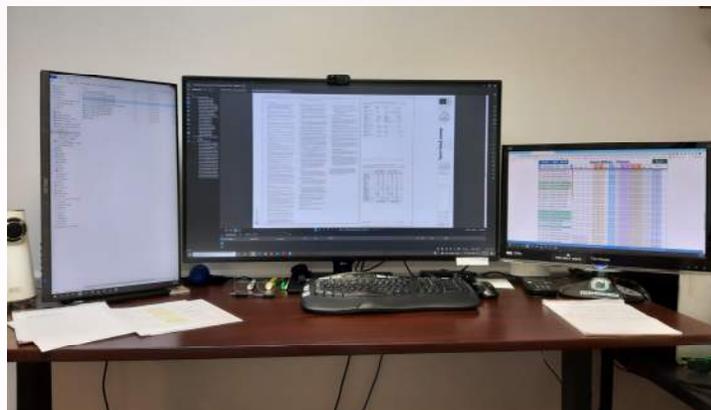
o LADBS Standard Plan Check Correction Lists:

- <https://dbs.lacity.gov/forms-publications/publications/standard-corrections-list>

	ID #	Title #	Size	
Residential	PC/STR/Corr.List.044	Supplemental Structural Correction Sheet Steel Brace Frame Design (2023 LABC)	1777 KB	View >
Building/Structural	PC/STR/Corr.List.115-2023	Supplemental Correction Sheet For Mass Timber (2023 LABC)	220 KB	View >
Disabled Access	PC/STR/Corr.List.037-2023	Supplemental Correction Sheet Curtain Wall (2023 LABC)	189 KB	View >
Electrical	PC/STR/Corr.List.036-2023	Supplemental Concrete Tilt Up Retrofit Plan Check Correction Sheet (2023 LABC)	180 KB	View >
Elevator/Pressure Vessel	PC/STR/Corr.List.033-2023	Supplemental Plan Check List for Chapter 95: Voluntary - Earthquake Hazard Reduction in existing Reinforced Concrete Buildings and Concrete Frame Building with Masonry Fill. (2023 LABC)	201 KB	View >
Green	PC/STR/Corr.List.053-2023	Supplemental Plan Check Correction Sheet for Unreinforced Masonry (URM) Retrofit (2023 LABC)	189 KB	View >
	PC/STR/Corr.List.035-2023	Supplemental Plan Check Correction Sheet for Concrete Special Moment Resist Frame (2023 LABC)	247 KB	View >



Part 7. The Plan Review



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Process

- Site Review
- Other Disciplines
- General Structural Notes
- Plan Sheets
- Section & Detail Sheets
- Calcs & Specifications



 BCS

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Site Review



 BCS

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Google Earth

- Why check Google Earth or a similar tool?



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Hazard Maps

- Are there geologic hazards in your jurisdiction?
- These could be...
 - FIRM
 - Faulting
 - Liquefaction
 - Landslides



ASCE 7 Hazard Tool

- o Check the base design criteria.
- o Snow, wind, tornado, seismic, rain, flood & tsunami all in one place!
- o <https://ascehazardtool.org/>



ASCE HAZARD TOOL

Enter Structure Information

Enter Location Snap to Address

ADDRESS: 3711 196th St SW, Lynnwood LAT/LONG: FIND ON MAP

Requested Data

Standard Version: ASCE/SEI 7-22 NEW ASCE/SEI 41 now available

Risk Category: III Site Soil Class: Default

Measurements: Customary SI

Load Types: Wind Seismic Ice Snow Rain Flood Tornado

VIEW RESULTS

All data are per the requirements of published ASCE standards; local requirements may vary.

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REPORT SUMMARY

Site Information

Address:	3711 196th St SW, Lynnwood, Washington, 98036
Elevation:	425 ft (NAVD 88)
Lat:	47.821271
Long:	-122.284036
Standard:	ASCE/SEI 7-22
Risk Category:	III
Soil Class:	Default

Wind

Wind Speed	105 Vmph
10-year MRI	67 Vmph
25-year MRI	74 Vmph
50-year MRI	78 Vmph
100-year MRI	83 Vmph
300-year MRI	92 Vmph
700-year MRI	98 Vmph
1,700-year MRI	105 Vmph
3,000-year MRI	109 Vmph
10,000-year MRI	118 Vmph
100,000-year MRI	136 Vmph
1,000,000-year MRI	154 Vmph

Seismic Data

S ₁	1.47
S ₁	0.54
S _{0.5}	1.66
S _{0.1}	1.13
S _{0.05}	1.11
S _{0.1}	0.75
T _L	6
PGA _{0.1}	0.69
V ₅₀₀	260
Seismic Design	0

ASCE Hazards Report
 Address: 3711 150th St SW, Lynnwood, Washington 98036
 Standard: ASCE/SEI 7-22
 Risk Category: II
 Soil Class: Default
 Latitude: 47.821371
 Longitude: -122.384538
 Elevation: 426.807505941800 ft (130.072 m)

ASCE Seismic
 Site Soil Class: Default
 Results:
 PSA₁: 0.89, T₁: 6, S₁: 1.47
 S₂: 1.13, S₃: 0.94
 S₄: 1.11, V_{max}: 260
 S₅: 0.75

Seismic Design Category: D

Multi-Period MCE Spectrum, Multi-Period Design Spectrum, Two-Period MCE Spectrum, Two-Period Design Spectrum

ASCE Snow
 Results:
 Ground Snow Load (p_g): 64.8 lb/ft²
 30-year MRF (p_g): 12.8 lb/ft²
 Winter Wind Parameter: 0.35
 Mapped Elevation: 403.4 ft
 Data Source: ASCE/SEI 7-22, Figures 7.8-1 and 7.8-2 A-D
 Date Accessed: Sat Feb 14 2026

Check Snow Load

- Based on WABO White Paper #8 and...
- SEAW Snow Load Analysis for Washington, 2nd Edition

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<p>WABO/SEAW Liaison Committee Washington Association of Building Officials & Structural Engineers Association of Washington</p>	<p>WHITE PAPER 8-2021</p>
<p>Title: Guidelines for snow load design in Washington State.</p>	<p>Date: December 9, 2010 Issue Date: January 31, 2021</p>
<p>Abstract: This white paper is intended to be a guideline for establishing a uniform approach to determining minimum ground snow loads, p_g, and roof snow loads, p_s, and other roof design considerations.</p>	<p>Committee Members: Matt Stross (SEAW Co-Chair), Lee Krantz (WABO Co-Chair), Shalini Prochaska (SEAW), Nancy Devine (WABO), Larry Lindell (SEAW), Rick Fine (SEAW), Mary Kate McGee (WABO), Cheryl Burwell (WABO), Chris Ricketts (WABO), Steve Belzok (WABO), Charlie Griffer (SEAW).</p>
<p>Committee Mission Statement:</p> <ul style="list-style-type: none"> • Improve communications between the public jurisdictions that administer building codes and the engineering design community that prepares construction documents. • Improve consistency and quality of engineering submittals and project reviews. • Build consensus between the engineering design community and building officials with regard to code interpretation and submittal requirements. 	

I. INTRODUCTION:

The requirements for snow loading are specified in the International Building Code (IBC) and the accompanying ASCE 7, "Minimum Design Loads for Buildings and Other Structures" which has a table with Ground Snow Loads for Selected Locations in Washington. The SEAW "Snow Load Analysis for Washington," second edition 1995 (SEAW Analysis), provides ground snow loads for additional locations in Washington as well as a method for determining ground snow loads in locations not listed in ASCE 7 or Appendix A of the SEAW Analysis.

The SEAW Analysis is based on data from the National Weather Service and the Soil Conservation Service and provides methods to determine basic ground snow load throughout the state. It has been used successfully by design professionals including building officials for many years. The first edition was published in 1975.

Check Snow Load

- o 2024 IBC snow loads are now strength based

STRUCTURAL CALCULATIONS: LYMAN DUPLEX
CITY OF ELKO, NEVADA - SEPTEMBER, 2025

DESIGN CRITERIA:
CODE: 2024 IBC
CONCRETE: F_c = 2,500 psi (for design purposes)
ALLOWABLE SOIL BEARING PRESSURE = 1500 psf
Risk Category II (table 1.5-1)

ROOF LOADS:
DEAD LOAD = 17 psf
SNOW = 30 psf (ASD)

A bottom chord live load of 20 psf shall be applied where uninhabitable attics with limited storage occur as defined per Table 1607.1

FLOOR LOADS:
DEAD LOAD = 20 psf
LIVE LOAD = 40 psf
LIVE BALCONY / DECK = 60 psf

WIND LOAD:
Envelope Procedure ASCE 7-22 Chpt 28
V_w = 115 mph
Risk Category II
K_e = 1.0
Exposure "C"
Enclosed
q_s = 0.00256 K_e K_z K_d K_f V_w²
q_s = 26.5 psf
K_e = 0.85 exposure coeff (table 26.10-1)
K_d = 1.0 (sec 26.8)

SNOW:
P_s = 51 psf
P_s = 0.7 C_s C_t I_s F_s C_e = 1.0 C_s = 1.2 I_s = 1.0 (table 1.5-2)
P_s = 42.8 psf
P_s = C_s P_s
P_s = 42.8 psf (strength)
P_s = 42.8 (0.7) = 30 psf (ASD)

WALL LOADS:
INTERIOR DEAD: 8 psf
EXTERIOR DEAD: 12 psf

WORKING BACKWARDS FROM 30 PSF I GET A P_s = 51 PSF STRENGTH LOADING



Rain Load

- o Only applies to flat roofs!
- o **IBC Equation 16-20:** $R = 2.5(d_s + d_h + d_p)$
- o Based upon 15-minute storm and Risk Category

TABLE 1611.1—DESIGN STORM RETURN PERIOD BY RISK CATEGORY

RISK CATEGORY	DESIGN STORM RETURN PERIOD
I & II	100 years
III	200 years
IV	500 years

International Code Council, 2024, IBC®



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Geotechnical Report

- Take time to review the geotechnical report.
- Are foundation recommendations noted on the plans?
- Allowable bearing pressure is based on...
 - Types of foundations
 - Applied loads
 - Soil type
 - Expected settlement.

FOUNDATION TYPE	BEARING PRESSURE (psf)	LOADING (pounds)	MINIMUM THICKNESS OF REPLACEMENT STRUCTURAL FILL (feet)
Spread	2,500	Up to 150,000	0.0
Spread	2,500	150,000+ to 250,000	1.0
Spread	2,500	250,000+ to 350,000	1.5
Spread	2,500	350,000+ to 400,000	2.0
Wall	2,500	Up to 8,000 pounds per lineal foot	0.0
Wall	2,500	8,000 to 10,000 pounds per lineal foot	1.0



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Other Disciplines



Microsoft 365, PowerPoint, Stock Images



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Why Review Other Disciplines?

- Look for items that may need to be considered by EOR.
- Are they all working from the same design set?
- Are the appropriate live loads considered?
- Look for “See Structural”.
- Are dimensions only on architectural?



Microsoft 365, PowerPoint, Stock Images



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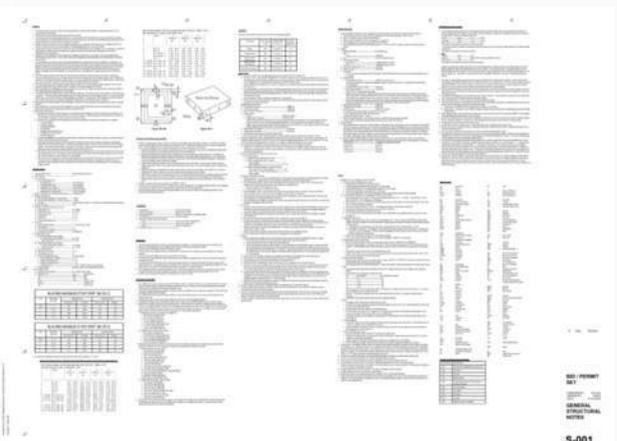
Things to Consider

- Are there “Fire Walls”?
 - Is structural stability provided?
- Are there site retaining walls?
 - Who provides design (i.e., Civil, EOR)?
 - Are supporting calculations provided?
- Are all deferred structural items clearly noted?
 - Canopies?



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General Structural Notes



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General Notes

- This may be the most important part of the structural review!
- **Items to discuss:**
 - Basis of design (IBC 1603)
 - Material notes
 - Statement of special inspections (SSI)
 - Deferred submittals



Basis of Design

- Already checked as part of our site review.
- Now verify that what they list matches “Hazard Tool”, and...
- All items required by IBC 1603 are provided.
- **Example:** Snow loads → IBC 1603.1.3
 - P_g , P_f , Risk category, C_e , C_t , C_s , P_d + width, W_2



DESIGN BASIS

GOVERNING DESIGN:

BUILDING CODE:	2021 INTERNATIONAL BUILDING CODE (IBC)
RISK CATEGORY:	II
DESIGN METHOD:	ASD

GRAVITY LOAD:

- ROOF LIVE LOAD (SNOW): 44 PSF
- ROOF DEAD LOAD: 15 PSF
- FLOOR LIVE LOAD: 40 PSF
- FLOOR DEAD LOAD: 10 PSF
- SOIL BEARING PRESSURE: 1,500 PSF (ASSUMED)

LATERAL LOAD:

- WIND SPEED: 105 MPH
- EXPOSURE CATEGORY: C
- SEISMIC SITE CLASS: D
- SEISMIC DESIGN CATEGORY: D

SEE STRUCTURAL CALCULATIONS FOR ADDITIONAL DESIGN COEFFICIENTS AND INFORMATION.

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Material Notes

- Is extraneous information provided?
- Are the specific material requirements specified?
- **Example:** Concrete → IBC 1901.5
 - Is the specified compressive strength(s) noted?
 - Are the concrete exposures listed? (i.e., durability)
 - Is the grade of reinforcement provided?
 - Are lap splice lengths given?
 - Is concrete cover noted?



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Material Notes

- Are the right versions of the standards referenced?

Standard	Version	Description
ASCE 7	2022	Minimum Design Loads for Buildings & Other Structures
ACI 318	2019	Building Code Requirements for Structural Concrete
TMS 402/602	2022	Building Code & Specification for Masonry Structures
AISC 360	2022	Specification for Structural Steel Buildings
AISC 341	2022	Seismic Provisions for Structural Steel Buildings
AISC 358	2022	Prequalified Connections for Steel Moment Frames
AWC NDS	2024	National Design Specific for Wood Construction
AWC SDPWS	2021	Special Design Provisions for Wind and Seismic



Statement of Special Inspections

- Where special inspections are required a “Statement of Special Inspections” must be submitted (IBC 107.1, IBC 1704.2.3, and IBC 1704.3).
- **This shall include:**
 - Materials, systems and components requiring inspection or testing.
 - Type or **extent** of each special inspection or test.
 - Additional items per 1705.12, 1705.13, and 1705.14
 - Identify the required **frequency** (i.e., continuous, periodic, or...)



Statement of Special Inspections

- The IBC provides us with *example* schedules...

TABLE 1705.2.6—SPECIAL INSPECTIONS OF METAL BUILDING SYSTEMS

TYPE	CONTINUOUS SPECIAL INSPECTION	PERIODIC SPECIAL INSPECTION
1. Installation of rafter/beam flange braces and column flange braces.	—	X
2. Installation of purlins and girts, including specified lapping.	—	X
3. Purlin and girt restraint/bridging/bracing.	—	X
4. Installation of X-bracing, tightened to remove any sag.	—	X

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Statement of Special Inspections

- It is **not** okay to simply duplicate these schedules.
 - **8 individual tables** are provided. Many more items requiring special inspections and tests are outlined in Chapter 17.
 - **Special cases** (IBC 1705.1.1) might exist.
 - Concrete (**IBC Table 1705.3**): Do all projects have cast-in-place, shotcrete, post-tensioned, precast, post-installed, special moment frames, etc.?
 - Many requirements are outlined in **referenced standards** (i.e., AISC 360, 341 & 370; TMS 402/602, etc.)



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Statement of Special Inspections

- **Let's simplify and restate...**
- The SSI **shall** include...
 - Materials, systems and components **requiring special inspection**
 - The **type or extent** of each inspection or test
 - The **frequency** of the inspections or tests



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Statement of Special Inspections

- **Real-World Example:** *Single-story masonry retail building*
 - What items require special inspections?
 - This is what was on the plans...

Special Inspection: Special inspection is required in accordance with IBC 1701.

- A. All concrete masonry units and reinforcing.
- B. Field welding.
- C. Epoxy bolts.



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Example S.S.I.

- **Single-story masonry retail building**



STATEMENT OF SPECIAL INSPECTIONS

1. Special inspections and structural testing shall be provided by an independent agency employed by the Owner for the items identified in this section and in other areas of the approved construction plans and specifications, unless waived by the Building Official (see IBC Chapter 17).
2. The names and credentials of the Special Inspectors to be used shall be submitted to the Building Official for approval.
3. Duties of the Special Inspector:
 - a. The Special Inspector shall review all work listed below for conformance with the approved construction plans and specifications and the 2024 IBC.
 - b. The Special Inspector shall furnish special inspection reports to the EOR, Contractor, Owner and Building Official on a weekly basis, or more frequently as required by the Building Official. All items not in compliance shall be brought to the immediate attention of the Contractor for correction, and if uncorrected, to the EOR and the Building Official.
 - c. Once corrections have been made by the Contractor, the Special Inspector shall submit a final signed report to the Building Official stating that the work requiring special inspection was, to the best of the Special Inspector's knowledge, in conformance with the approved construction plans and specifications as well as the applicable workmanship provisions of the 2024 IBC.

4. Duties and responsibilities of the Contractor:
 - a. The Contractor shall submit a written statement of responsibility to the Owner and the Building Official prior to the commencement of work. In accordance with IBC 1704.4, the statement of responsibility shall contain acknowledgement of the special inspection requirements contained within this "Statement of Special Inspections".
 - b. The Contractor shall notify the responsible Special Inspector that work is ready for inspection at least one working day (24 hours minimum) before such inspection is required.
 - c. All work requiring special inspection shall remain accessible and exposed until it has been observed by the Special Inspector.
5. Please see the "Special Inspection Schedule" for the types, extents and frequency of specific items requiring special inspections and structural tests as part of this project.

SPECIAL INSPECTION SCHEDULE			
Areas requiring special inspection:	Frequency		Comments:
	Continuous	Periodic	
FABRICATORS (IBC 1704.2.5)			
	◆	◆	If fabricator is approved, on-site inspection is not required but a certificate of completion must be provided to the B.O. (IBC 1704.2.5.1)
SOILS (IBC 1705.6)			
Verify adequate materials below footings		◆	Prior to placement of concrete.
Excavation extend to proper depth and materials		◆	Prior to placement of compacted fill or concrete.
Classification and testing of fill materials		◆	Check classification and gradations at each lift, but not less than once for each 10,000ft ² of surface area.
Verify proper fill materials, lift thicknesses and in-place densities	◆		
Verify properly prepared site and subgrade		◆	Prior to placement of concrete.
CONCRETE CONSTRUCTION (IBC 1705.3)			
Reinforcing steel placement		◆	Verify size, clearances, splices and proper ties.
Embedded bolts or plates	◆		
Verify required design mix		◆	Verify mix design meets strength and exposure requirements listed on approved plans.
Concrete placement/sampling	◆		Includes sampling for air, slump, strength and temperature techniques.
Inspect formwork		◆	Verify shape, location and member dimensions.
Post-installed anchors	◆	◆	In accordance with approved ICC-ES Report. Periodic inspections allowed if stated in ES Report.
COLD-FORMED STEEL CONSTRUCTION (IBC 1705.13.3)			
Components of wind- and seismic-force resisting systems.		◆	Verify proper screw attachment, bolting and anchoring of shear walls, braces and holdowns having a fastener spacing ≤ 4" o.c.

Material, system or component

Extent and type

Frequency

OTHER THAN STRUCTURAL STEEL (IBC 1705.2.2 – 1705.2.6)			
<i>Steel Roof & Floor Deck (see SDI QA/QC):</i>			
Material verification of steel deck		◆	Identification markings per applicable ASTM standard
Roof and deck welds		◆	Verify that welds conform to AWS D1.3.
<i>Open-Web Steel Joists & Girders:</i>			
Verify end conditions and bridging		◆	Per SJI specifications
<i>Welding of Reinforcing Steel:</i>			
Verification of weldability (except A706 bar)		◆	Verify material is able to conform to AWS D1.4.
STRUCTURAL STEEL CONSTRUCTION (IBC 1705.2, 1705.13.1, 1705.14.1)			
<i>Prior to Welding (Table N5.4-1, AISC 360-22):</i>	Observe	Perform	
Verify welder qualifications & welding procedures		◆	
Material identification	◆		Verify type and grade of material.
Welder identification	◆		Verify there is a system in place to identify the welder who has welded a joint or member.
Fit-up groove welds	◆		Verify joint preparation, dimensions, cleanliness, tacking and backing.
Access holes	◆		Verify configuration and finish.
Fit-up fillet welds	◆		Verify alignment, gaps at root, cleanliness of steel surfaces, tack weld quality and location.

Frequency

Continued on next page...

SPECIAL INSPECTION SCHEDULE (continued)			
Areas requiring special inspection:	Frequency		Comments:
	Observe	Perform	
STRUCTURAL STEEL CONSTRUCTION (continued)			
During Welding (Table N5.4-2, AISC 360-22):			
Control and handling of welding consumables	♦		Verify packaging and exposure control.
Cracked tack welds	♦		Verify welding is not over a cracked tack weld.
Environmental conditions	♦		Verify wind speed is within limits as well as precipitation and temperature.
WPS followed	♦		Verify items such as welding equipment settings, travel speed, welding materials, shielding gas type/flow rate, preheat applied, interpass temperature maintained, and proper position.
Welding techniques	♦		Verify interpass and final cleaning, each pass is within profile limitations, and quality of each pass.
Steel headed stud anchors		♦	Verify placement and installation.
After Welding (Table N5.4-3, AISC 360-22):			
Welds cleaned	♦		Verify that welds have been properly cleaned.
Size, length and location of welds		♦	
Welds meet visual acceptance criteria		♦	
Arc strikes		♦	
k-area		♦	
Backing & welding tabs removed		♦	
Repair activities		♦	
Document acceptance/rejection of weld		♦	
Prohibited	♦		Verify that welds have not been added w/out EOR approval.

Nondestructive Testing (N5.5, AISC 360-22):			
CJP welds (Risk Cat. II, III & IV)		♦	Ultrasonic testing shall be performed on 10% of CJP groove welds in butt, T- and corner joints subject to transversely applied tension loading in materials 5/16-inch thick or greater. All such welds in Risk Category III and IV must be tested.
Welded joints subject to fatigue		♦	When required by Table A-3.1 of AISC 360-16.
Documentation	♦		All NDT shall be documented.
Areas requiring special inspection:			
	Frequency		
	Observe	Perform	Comments:
MASONRY CONSTRUCTION (IBC 1705.4)			
Minimum Testing (Article 3.1, TMS-402/602-22):			
Verification of Slump Flow and Visual Stability Index (VSI) for self-consolidating grout.		♦	Compressive strength tests per ASTM C 1019 for slump flow and ASTM C 1611 for VSI.
Verification of f'_m .		♦	Determine compressive strength per "unit strength" or "prism test" as specified in Article C-32 of TMS-402/602-16 prior to construction.

Continued on next page...

SPECIAL INSPECTION SCHEDULE <i>(continued)</i>			
Areas requiring special inspection:	Frequency		Comments:
	Continuous	Periodic	
MASONRY CONSTRUCTION <i>(continued)</i>			
Prior to Construction <i>(Article 1.5, TMS-602-22):</i>			
Review material certificates, mix designs, test results and construction procedures		◆	Verify materials conform to approved construction documents. Mix design, test results, material certificates, and construction procedures should be submitted for review. Mortar mix designs shall conform to ASTM C 270 while grout shall conform to ASTM C 476. Material certificates shall be provided for the following: reinforcement; anchors, ties, fasteners, and metal accessories; masonry units; mortar and grout materials. Review cold-weather or hot-weather construction procedures.
As Construction Begins <i>(Table 4, TMS-602-22):</i>			
Proportions of site-prepared mortar		◆	Verify that mortar is type and color specified on approved plans, it conforms to ASTM C 270, and is mixed per Article 2.6.A of ACI 530.1.
Construction of mortar joints		◆	Verify mortar joints meet Article 3.3.B of ACI 530.1.
Location of reinforcement, connectors and anchorages.		◆	Verify reinforcement is placed in accordance with Article 3.4 of 530.1.

Prior to Grouting <i>(Table 4, TMS-602-22):</i>			
Grout space		◆	Verify grout space is free of mortar droppings, debris, loose aggregate, and other deleterious materials and that cleanouts are provided per Article 3.2.D and 3.2.F of ACI 530.1.
Grade, type and size of reinforcement, anchor bolts and anchorages.		◆	Verify reinforcement, joint reinforcement, anchor bolts and veneer anchors comply with approved plans and Section 1.6 of ACI 530.
Placement of reinforcement, connectors and anchorages.		◆	Verify reinforcement, joint reinforcement, anchor bolts and veneer anchors are installed per approved plans and Articles 3.2.E, 3.4, and 3.6.A of ACI 530.1.
Proportions of site-prepared grout.		◆	Verify grout proportions meet ASTM C 476 and a slump between 8-11 inches. Self-consolidated grout shall not be proportioned onsite.
Construction of mortar joints		◆	Verify mortar joints placed in accordance with Article 3.3.B of ACI 530.1.
During Construction <i>(Table 4, TMS-602-22):</i>			
Size and location of structural elements		◆	Verify locations of structural elements per approved plans and confirm tolerances meet Article 3.3.F of ACI 530.1.
Type, size and location of anchors, frames, etc.		◆	Verify correct anchorages and connections are provided per approved plans and Sections 1.16.4.3 and 1.17.1 of ACI 530.
Placement of grout.	◆		
Preparation, construction and protection of masonry during cold weather (<40°F) or hot weather (>90°F).		◆	Verify cold-weather construction complies with Article 1.8.C of ACI 530.1 and hot weather construction per Article 1.8.D of ACI 530.1.
Observation of grout specimens, mortar specimens, and/or prisms.		◆	Confirm specimens/prisms are performed as required by Article 1.4 of ACI 530.1.

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Example S.S.I.

- The sample provided only highlights the structural requirements.
- Many times, this is all that is provided on the plans.
- Are there any applicable nonstructural special inspection items?
- Where should these be noted?
- Can the SSI be a separate document?



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Deferred Submittals

- **IBC 107.3.4.1:**
 - Required for structural components in which the structural design has not been submitted.
 - Does the B.O. have to allow them?
 - Must be listed on the construction documents.
 - Designs must be submitted & approved by the EOR.
 - Shall not be installed until approved by the AHJ.
 - IBC 1704.3 requires supplemental SSI for deferred submittals.



Deferred Submittals

Should the following items be accepted as deferred submittals?

- Concrete mix designs
- Deep foundation systems
- Tilt-up panel lifting design
- Open web steel joists
- Prefabricated metal buildings



Do you have related AHJ forms?

YOUR LOGO HERE SPECIAL INSPECTION AGREEMENT

Project Name: _____
 Building No./Address: _____
 Inspector Name: _____

DECLARATION BY SIGNER OF RECORD

I, the undersigned, hereby certify that the information furnished herein is true and correct to the best of my knowledge and belief, and that I am duly licensed to practice in the State of Wisconsin.

DECLARATION BY SIGNER OF RECORD

I, the undersigned, hereby certify that the information furnished herein is true and correct to the best of my knowledge and belief, and that I am duly licensed to practice in the State of Wisconsin.

Item No.	Description	Inspected	Approved
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

YOUR LOGO HERE STRUCTURAL OBSERVATION PROGRAM

Project Name: _____
 Building No./Address: _____
 Inspector Name: _____

DECLARATION BY SIGNER OF RECORD

I, the undersigned, hereby certify that the information furnished herein is true and correct to the best of my knowledge and belief, and that I am duly licensed to practice in the State of Wisconsin.

YOUR LOGO HERE DEFERRED SUBMITTAL AGREEMENT

Project Name: _____
 Building No./Address: _____
 Inspector Name: _____

DECLARATION BY SIGNER OF RECORD

I, the undersigned, hereby certify that the information furnished herein is true and correct to the best of my knowledge and belief, and that I am duly licensed to practice in the State of Wisconsin.

YOUR LOGO HERE FABRICATOR'S CERTIFICATE OF COMPLIANCE

Project Name: _____
 Fabricator Name: _____
 Fabricator Address: _____
 City: _____ State: _____ Zip: _____

DECLARATION BY SIGNER OF RECORD

I, the undersigned, hereby certify that the information furnished herein is true and correct to the best of my knowledge and belief, and that I am duly licensed to practice in the State of Wisconsin.





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Construction Documents

- **IBC 107.2.1:** "...shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code... as determined by the B.O."

BCS

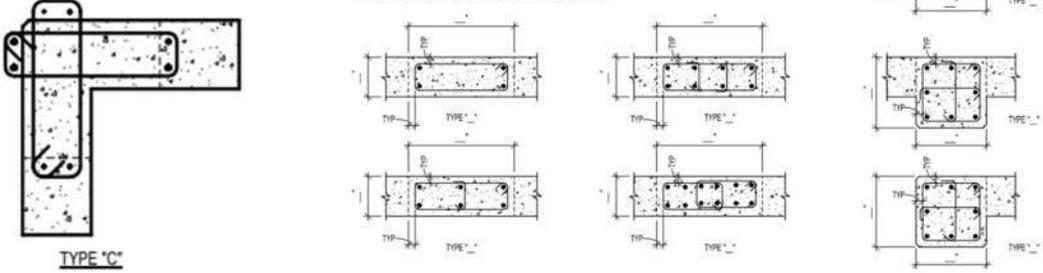


SOME KIND OF AWNING

MARK	PIER SIZE	REINFORCING		TYPE	COMMENTS
		VERTICAL	TES		
CP-4	12"x12"	() # ₄	() # ₄ AT 12"	---	
CP-4	12"x12"	() # ₄	() # ₄ AT 12"	---	
CP-4	12"x12"	() # ₄	() # ₄ AT 12"	---	

CONCRETE PIER NOTES:

- INSTALL (2) SETS OF TES WITHIN THE TOP 9" AT THE TOP OF ALL PIERS (AND)
- ALTERNATE POSITION OF HOOKS IN PLACING SUCCESSIVE SETS OF TES



TYPE "C"

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Foundation Plans

- Are all footings and foundations clearly called out?
- Are footings called out on the plans but not shown in the footing schedule?
- Are significant footings noted in the schedule but are not called out on the plans?

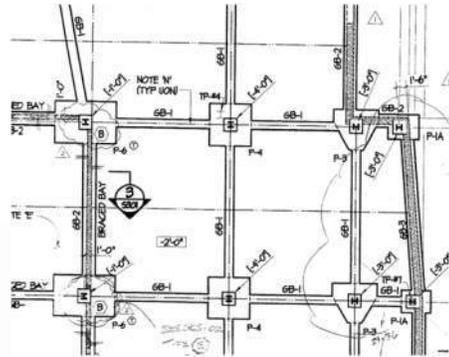
MARK	WIDTH	LENGTH	DEPTH	REINFORCING CROSSWISE				REINFORCING LENGTHWISE				COMMENTS	
				NO	SIZE	LENGTH	SPACING	NO	SIZE	LENGTH	SPACING		
12" MAT	10'-1"		12"										
FTD													
CRW-08	4'-0"		14"		#5	3'-6"	14"	4	#5	CONT	EQ		
CRW-10	5'-6"		14"		#5	3'-6"	14"	4	#5	CONT	EQ		
✓FC20	2'-0"		12"					3	#4	CONT	EQ		
✓FC30	3'-0"		12"		#5	2'-6"	14"	3	#5	CONT	EQ		
✓FC40	4'-0"		12"		#5	3'-6"	14"	4	#5	CONT	EQ		
✓FS30	3'-0"	3'-0"	12"	3	#5	2'-6"	EQ	3	#5	2'-6"	EQ		
✓FS35	3'-6"	3'-6"	12"	3	#5	3'-0"	EQ	3	#5	3'-0"	EQ		
✓FS40	4'-0"	4'-0"	12"	4	#5	3'-6"	EQ	4	#5	3'-6"	EQ		
FS45	4'-6"	4'-6"	12"	4	#5	4'-0"	EQ	4	#5	4'-0"	EQ		
✓FS50	5'-0"	5'-0"	12"	5	#5	4'-6"	EQ	5	#5	4'-6"	EQ		
✓FS55	5'-6"	5'-6"	12"	5	#5	5'-0"	EQ	5	#5	5'-0"	EQ		
✓FS60	6'-0"	6'-0"	14"	6	#5	5'-6"	EQ	6	#5	5'-6"	EQ		
✓FS65	6'-6"	6'-6"	15"	7	#5	6'-0"	EQ	7	#5	6'-0"	EQ		
✓FS70	7'-0"	7'-0"	16"	8	#6	6'-6"	EQ	8	#6	6'-6"	EQ		



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Foundation Plans

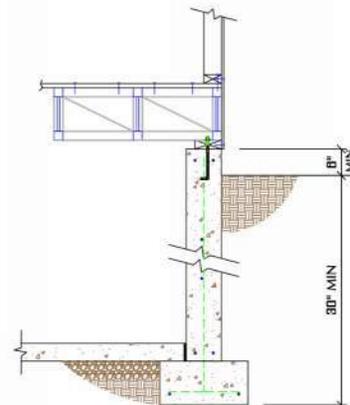
- Do plans call for proper depth of footings?
 - 12-inches or specified frost depth?
- Are hold downs, embeds and anchorages clearly noted?
- Site class 'E or F' soils?
- Are soils report requirement clear on plans?



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Foundation Plans

- Are foundation walls properly restrained?
- Is foundation and retaining wall drainage specified?
- Are there any apparent surcharge loads to foundation or retaining walls?
- Are foundations placed near slopes?



Floor Framing Plans

- Are all framing members called out?
 - Joists, beams, columns, wall framing
- Are the diaphragm requirements clearly specified?
- Uplift floor ties, anchorages, joist-to-wall or beam-to-column connections?

SHEATHING SCHEDULE AT ROOF AND FLOOR							
LOCATION	WOOD SHEATHING THICKNESS	NAIL SIZE	EDGE NAIL SPACING		FIELD NAIL SPACING	BOUNDARY NAIL SPACING	FULLY BLOCKED
			CONT EDGE **	OTHER EDGE			
L3, L4, ROOF	23/32"	10d	2"oc	3"oc	12"oc	2"oc	2x4 FLAT
LEVEL 02	23/32"	10d	(2) ROWS AT 2.5"oc	(2) ROWS AT 3"oc	12"oc	(2) ROWS AT 2.5"oc	3x4 FLAT
SEE PLAN	23/32"	10d	(3) ROWS AT 2.5"oc	(3) ROWS AT 3"oc	12"oc	(3) ROWS AT 2.5"oc	3x4 FLAT



Floor Framing Plans

- Are detail callouts appropriate?
- Are they provided where needed?
- Is blocking specified where needed?
- Are shear walls called out and do they meet aspect ratios?

[A] 107.2.1 Information on construction documents. Construction documents shall be dimensioned and drawn on suitable material. Electronic media documents are permitted to be submitted where approved by the building official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations, as determined by the building official.



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Floor Framing Plans

STEEL SHEATHING, SEE PLAN.

STUD WALL, SEE PLAN.

3/8" x 3" TITEN HD @ 32" O.C. WITH 1/4" x 3/32" WASHER.

CONCRETE ON METAL DECK, SEE PLAN.

L3x3x1/4 BETWEEN JOISTS WITH 3/4" TITEN HD @ 24" O.C. 5 1/2" MIN. EMBED.

STEEL JOIST, SEE PLAN.

3/4" x 5 1/2" x 1/2" BEARING PLATE WITH (2) 3/4" x 8" W.A.S.

MASONRY VENEER, SEE ARCH.

600T 125-54 TRACK ATTACH TO EACH JOIST WITH #10 TEK SCREW.

24" BOND BEAM WITH (2) # 5 TOP AND BOTTOM BELOW JOIST BEARING.

MASONRY WALL, SEE PLAN.

6
S5.2

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Roof Framing Plans

- Are all framing members called out?
 - Trusses, joists, beams, columns, wall framing
- Is the assumed truss layout provided?
- Are proper roof-to-wall connections specified?
- Are the diaphragm requirements clearly specified?
- Are rooftop units or roof projections accounted for?

Roof Framing Plans

- o If in snow country, are the following considered?
 - Unbalanced snow
 - Snow drift
 - Sliding snow



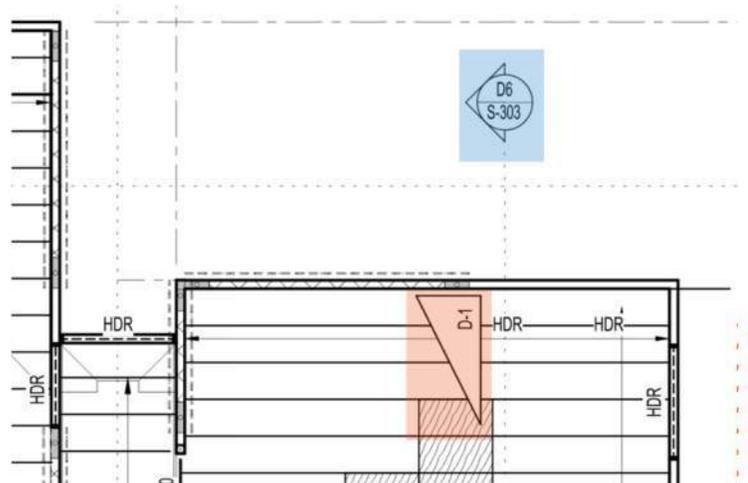
Roof Framing Plans

SNOW DRIFT LOADING DIAGRAM

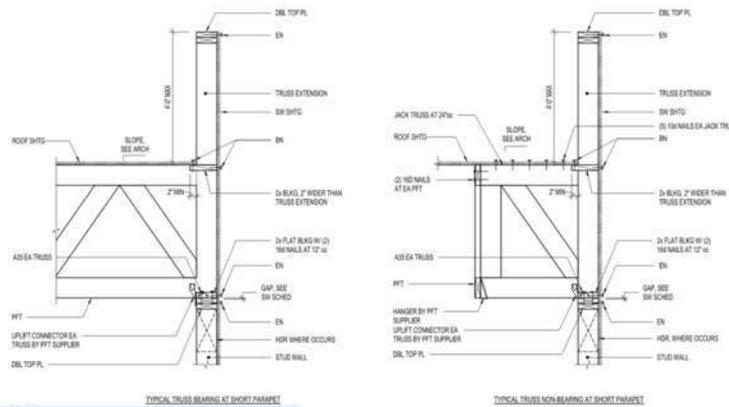
D-1	MAX = 30 PSF L = 6' - 6"	D-2	MAX = 80 PSF L = 16' - 9"
D-3	MAX = 113 PSF L = 22' - 0"		



WHERE 'L' EXCEEDS LENGTH OF LOWER ROOF,
DRIFT TAPERS TO 0 PSF AT THE FAR END OF LOWER ROOF



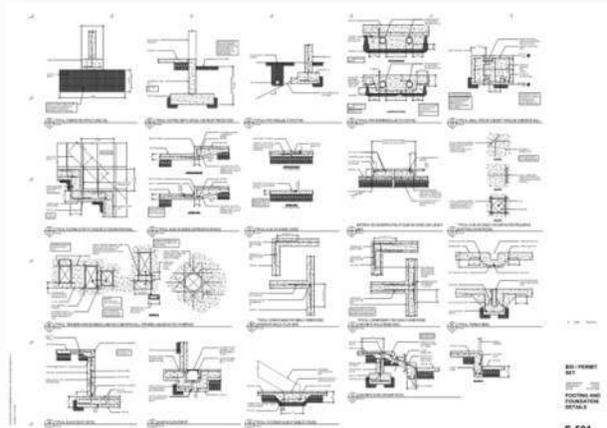
Roof Framing Plans



TYPICAL TRUSS BEARING AT SHORT PARAPET
D6 TYPICAL TRUSS DETAILS AT EXTERIOR WALLS
S-501 NO SCALE



Section & Detail Sheets



S-501



Structural Calculations

- Remember the WABO white paper → Our focus should not be on the “mathematical accuracy” of the calculations.
- **Items to check:**
 - Basis of design
 - Code/standard references
 - Do calculations match plans?
 - Are significant items missing?



Basis of Design

- We already checked this as part of the “Structural General Notes” review.

Determine wind & seismic pressure on screen wall (ASCE 7-10)

V =	90 mph	Figure 6-1 (pgs. 32-36)
Kz1 =	1	Figure 6-4 (pg. 45)
Kz =	0.57	Table 6-3 (pg. 79) ← Exp B (Case 2)
Kd =	0.85	Table 6-4 (pg. 80) For Screen Wall Only
I =	0.87	Table 6-1 (pg. 77)
G =	0.85	Section 6.5.8 (pg. 26)
q =	8.7 psf	Section 6.5.10, EQ 6-15 (pg. 27)

Seismic Load Factor = 0.581W

Allowable Soil Bearing (q) = 2000 psf

1. GOVERNING CODE		
A. Building Code:		2012 IBC -- International Building Code
B. Local Amendments:		Utah Amended Code
C. Structural Observations Required?		Yes
D. Special Inspections Final Report Required for Certificate of Occupancy?		Yes
2. ROOF LIVE LOAD		
A. Minimum Roof Live Load:		20 psf
3. SNOW LOAD		
A. Ground Snow Load, Pg:		45 psf
B. Can ground snow load be reduced per code:		Yes
4. WIND LOAD		
A. Design Wind Speed:		115 mph
B. Minimum Wind Load:		per code
5. SEISMIC LOAD		
A. Mapped Spectral Response Acceleration, Sa:		1.037 (short period, 0.2s)
B. Mapped Spectral Response Acceleration, S1:		0.349 (long period, 1.0s)
6. FROST DEPTH		
A. Minimum Bearing Depth:		30 in.



Code/Standard References

Rev: 5/10/02 User: KIM-0501746, Ver: 5.1.2, 13-Jun-1999, WI-32 © 1983-99 ENERCALC		Steel Column		Page 1 c:\documents and settings\lowner\desktop\donor	
Description C10- TS4X4X3/8 (64 kips max)					
General Information			Calculations are designed to AISC 9th Edition ASD and 1997 UBC Requirements		
Steel Section	TS4X4X3/8	Fy	46.00 ksi	X-X Sidesway :	Sway Allowed
		Duration Factor	1.000	Y-Y Sidesway :	Sway Allowed
Column Height	9.000 ft	Elastic Modulus	29,000.00 ksi		
End Fixity	Pin-Pin	X-X Unbraced	9.000 ft	Kxx	1.000
Live & Short Term Loads Combined		Y-Y Unbraced	9.000 ft	Kyy	1.000

Rev: 5/5/00/2 User: KIM-060216, Ver: 5.0.0, 1-Dec-2000 © 1983-2000 ENERCALC Engineering Software © 1983-2000 ENERCALC Engineering Software		Masonry Wall Design		Page 1 EXAMPLES ECW-Masonry Cases	
Description Typical wall section					
General Information					
Wall Height	10.50 ft	Seismic Factor	0.1400	f _m	1,500.0 psi
Parapet Height	0.00 ft	Calc of Em = f _m *	750.00	F _s	24,000.0 psi
Thickness	8.0 in	Duration Factor	1.330	No Special Inspection	
Rebar Size	4	Wall Wt Mult.	1.000	Grout @ Rebar Only	
Rebar Spacing	48 in			Normal Weight Block	
Depth to Rebar	3.810 in @ Center			Equivalent Solid Thickness	4.600 in



Code/Standard References

Sample Comment:

Many of the calculations were performed in reference to outdated building codes and standards. Please confirm that calculations meet the requirements of the 2024 IBC, and its referenced standards as listed in Chapter 35.



Do Calculations Match Plans?

FOUNDATION

- Soils Report by: CMT Technical Services
- Report Number & Date: 19341 November 3, 2022
- Soil Bearing Pressure: 2500 pcf, on Compacted Fill, see footing schedule
- Frost Protection: 30 inches minimum
- Lateral Soil Pressure Fluid Equivalent Density:
 - Active: 38 pcf, 33 pcf seismic (retaining walls)
 - At Rest: 59 pcf (rigid foundation walls)
 - Passive: 400 pcf, 190 pcf seismic
- Coefficient of Friction: 0.4

Concrete Use	Comp. Strength f'c (psi)	Exposure Classes per ACI 318 19.3.1 (a,b,c)	Nominal Max. Aggregate Size
Footings	3000	F0, S0, W0, C1	1 1/2"
Foundation Walls	3500	F1, S0, W0, C1	3/4"
Exterior Concrete, Unreinforced (g)	4500	F3, S0, W0, C0	3/4"
Exterior Concrete, Reinforced (g)	5000	F3, S0, W0, C2	3/4"
Interior Slab on Grade (d,e,f)	3500	F0, S0, W0, C0	3/4"

Wall Footing Project File: Clearfield - Concrete.ecb

LIC# KW-06915170, Build 20.24.03.04 © ENERCALC INC 1983-2023

DESCRIPTION: Interior Bearing Wall

Code References
Calculations per ACI 318-19, IBC 2021, ASCE 7-16
Load Combinations Used: IBC 2021

General Information

Material Properties	Soil Design Values
f _c - Concrete 28 day strength = 3.0 ksi	Allowable Soil Bearing = 2.50 ksf
f _y - Rebar Yield = 60.0 ksi	Increase Bearing By Footing Weight = Yes
E _c - Concrete Elastic Modulus = 3,122.0 ksi	Soil Passive Resistance (for Sliding) = 250.0 pcf
Concrete Density = 145.0 pcf	Soil/Concrete Friction Coeff. = 0.30
φ Values Flexure = 0.90	
Shear = 0.750	
Analysis Settings	
Min Steel % Bending Reinf. =	Increases based on footing Depth
Min Allow % Temp Reinf. = 0.00180	Reference Depth below Surface = ft
Min. Overturning Safety Factor = 1.0 : 1	Allow. Pressure Increase per foot of depth when base footing is below = ksf
Min. Sliding Safety Factor = 1.0 : 1	Increases based on footing Width
AutoCalc Footing Weight as DL : Yes	Allow. Pressure Increase per foot of width when footing is wider than = ksf
	Adjusted Allowable Bearing Pressure = 2.50 ksf

Dimensions

Footing Width = 2 ft	Footing Thickness = 12.0 in	Bars along X-X Axis
Wall Thickness = 5.50 in	Rebar Centerline to Edge of Concrete... at Bottom of footing = 3.0 in	Bar spacing = 9.00
Wall center offset from center of footing = 0 in		Reinforcing Bar Size = # 4

Reinforcing

Do Calculations Match Plans?

○ Perform a check of as many as possible.

CONCRETE FOOTING SCHEDULE													
MARK	WIDTH	LENGTH	DEPTH	REINFORCING CROSSWISE				REINFORCING LENGTHWISE				COMMENTS	
				NO	SIZE	LENGTH	SPACING	NO	SIZE	LENGTH	SPACING		
12" MAT FTG	10'-1"		12"										
CRW-08	4'-0"		14"	#5	3'-6"	14"	4	#5	CONT	EQ			
CRW-10	9'-6"		14"	#5	3'-6"	14"	4	#5	CONT	EQ			
FC2.0	2'-0"		12"				3	#4	CONT	EQ			
FC3.0	3'-0"		12"	#5	2'-6"	14"	3	#5	CONT	EQ			
FC4.0	4'-0"		12"	#5	3'-6"	14"	4	#5	CONT	EQ			
FS3.0	3'-0"	3'-0"	12"	3	#5	2'-6"	EQ	3	#5	2'-6"	EQ		
FS3.5	3'-6"	3'-6"	12"	3	#5	3'-0"	EQ	3	#5	3'-0"	EQ		
FS4.0	4'-0"	4'-0"	12"	4	#5	3'-6"	EQ	4	#5	3'-6"	EQ		

Do Calculations Match Plans?

Sample Comment:

The FC2.0 calculation calls for #4 crosswise reinforcement at 9" o.c. however, the footing schedule on sheet S-801 does not specify any crosswise reinforcement. Please address.



Do Calculations Make Sense?

Risk Category 1- Low Risk
 Type of Construction: VB
 Total Square Footage: 4400 Sq. Ft.
 Shop Area Square Footage: 3800 Sq. Ft. Occupancy Classification F-1 Occupant Load **38**
 Office Area Square Footage: 600 Sq. Ft. Occupancy Classification B Occupant Load **4**

S_s = Mapped spectral accel. **150%** [ASCE Fig 22-1]
 F = # of stories modifier, 1.0, 1.1, 1.2; 1, 2, 3 stories **1.1** [ASCE 12.14.8-1]
 R = Response mod factor **120.7** R_{wood} [ASCE Tbl 12.14-1]
1.25 R_{canli} [ASCE Tbl 12.2-1]
 W = The Effective Weights are as

*280 * > 1,330 **

LOAD CASES		Ed	Ed	S.R.	t / A
		psi	psi		
Gravity	DL + LL	941	483	0.51	-
	DL + SL	297	207	0.70	-
	DL + 0.75LL + 0.75SL	780	207	0.27	-
	DL+0.6WL(OBT)	297	307	0.99	1142
	DL+0.6WL(TN)	297	307	0.99	3379
With Wind	DL+0.75(LL+0.6WL(OBT)+SL)	780	489	0.63	715
	DL+0.75(LL+0.6WL(TN)+SL)	780	489	0.63	1063
	0.6DC+0.6WL(OBT)	178	225	0.35	1559
	0.6DC+0.6WL(TN)	178	225	0.35	3450
	DL+0.75Q	297	324	1.09	625
With Seismic	DL+0.75(LL+0.7EQ+SL)	780	540	0.70	384
	0.6DC+0.7EQ	178	241	0.35	869

Design is insufficient



Are Significant Items Missing?

Sample Comment:

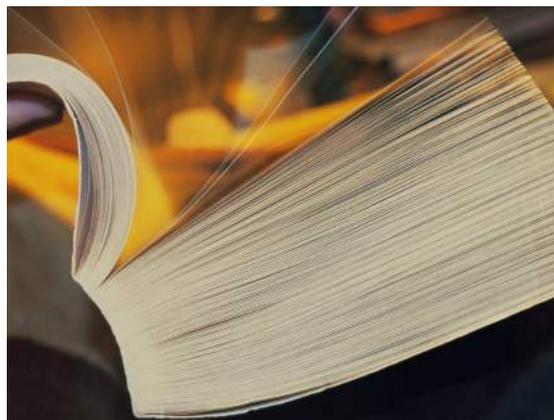
No supporting calculations could be found for the steel moment frame base plates and anchorages. Please show that these comply with Chapter 17 of ACI 318-19, as required by IBC 1901.3.



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Specifications

- Do they comply with the structural plans, structural calculations, and geotechnical report?
- **Example:** *Concrete*
 - Do concrete compressive strength(s) on the plans match what is listed in CSI 03 30 00?



#book, <https://pixabay.com>, CCO-1.0



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Final Thoughts!

1. Our primary responsibility is life safety.
2. Do not be afraid to question the EOR.
3. Make sure correct gravity loads are used.
4. Are complete gravity and lateral load paths provided?
5. Is there a clear Statement of Special Inspections?
6. Verify material-specific items whenever possible.



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Thank You!

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