IBC Code Mapping for Architects

2 Hours/ 2 CE Hours/ 2 LU/HSW Hours

AIAPDH195

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ANSWER SHEET

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IBC CODE MAPPING – AIAPDH195

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IBC Code Mapping for Architects
Final Exam

1. What organization writes today's model codes?

   a. ICBO (International Conference of Building Officials)
   b. BOCA (Building Officials and Code Administrators International, Inc.)
   c. ANSI (American National Standards Institute)
   d. ICC (the International Code Council)

2. What is the acronym AMMC?

   a. Alternate Means and Methods of Construction
   b. Alternate Methods and Machines of Construction
   c. Alternate Materials and Methods of Construction
   d. Alternate Materials and Means of Construction

3. What level of building construction does the IBC provide?

   a. Minimum level of safeguards and standards for construction
   b. Average level of safeguards and standards for construction
   c. Maximum level of safeguards and standards for construction
   d. Innovative level of safeguards and standards for construction

4. A restaurant is included in what Use Classification?

   a. A-1
   b. A-2
   c. A-3
   d. A-4

5. Which adjacent occupancies require a fire separation per Table 508.4?

   a. Occupancy R - Occupancy S-1
   b. Occupancy B - Occupancy M
   c. Occupancy S-2 - Occupancy U
   d. Occupancy A - Occupancy E

6. The upcoming 2021 IBC has significant revisions for which Construction Type?

   a. Type l
   b. Type lll
   c. Type lV
   d. Type V

7. Per Table 506.2, a building equipped with an automatic sprinkler system allows for?

   a. Reduced fire rating
   b. Increase in building floor area
   c. Elimination of required occupancy separation
   d. Increase in number of occupants

8. Per Section 506.3.2, what is the minimum frontage distance between a building and a public way to be eligible for building floor area increase?

   a. 10 feet
   b. 15 feet
   c. 20 feet
   d. 30 feet

9. Per Table 601, what building elements are not required to be fire rated in a Construction Type VA building?

   a. Structural Frame
   b. Bearing Exterior Walls
   c. Nonbearing Interior Walls
   d. Floor Construction

10. Per Table 1004.5, the Occupant Load Factor for an Assembly without fixed seats Unconcentrated (tables and chairs) is?

    a. 5 net
    b. 7 net
    c. 15 net
    d. None of the above

11. What component of the Means of Egress is the portion that leads to the entrance of an exit?

    a. Exit Access
    b. Exit
    c. Exit Discharge

d. Public Way

12. Per Section 1007.1.1, what is the minimum distance apart for Two Exits or Exit Access Doorways in a building equipped with an automatic sprinkler system?

    a. 200 feet
    b. 300 feet
    c. 1/2 of the length of the max. overall diagonal dimension of the building or area served measured in a straight line between them.
    d. 1/3 of the length of the max. overall diagonal dimension of the area served

13. Per Table 1020.1, what 4 factors determine if a Corridor is required to have a fire-resistance rating?

    a. Occupancy, Occupant Load, Without Sprinkler System, With Sprinkler System
    b. Occupancy, Occupant Load, Without Sprinkler System, Corridor Length
    c. Occupancy, Occupant Load, With Sprinkler System, Number of Exits
    d. Occupancy, Occupant Load, Without Sprinkler System, Number of Exits

14. Which is not a component of the Accessible Means of Egress System?

    a. Accessible Restroom Door
    b. Stairway
    c. Ramp
    d. Elevator

15. Chapter 11 includes codes affecting which building component?

    a. Fire Protection and Life Safety
    b. Interior Environment
    c. Interior Finishes
    d. Accessibility

IBC Code Mapping for Architects

Tuvia Poliskin, AIA, LEED AP BD+C, PSM

Navigating the International Building Code (IBC) can be somewhat complicated, puzzling, and time consuming. This course, *IBC Code Mapping for Architects*, is intended to help guide designers through this circuitous labyrinth more quickly and with confidence. Viewed through an architect's lens during the early evolution of a design, the mapping presents an approachable path through the IBC's 35 chapters – with some 325 sections – which affect the formation of a design and consequently the building construction. With a map of the key codes, a design can absorb the regulations early, with less difficulty, and can mature with assurance that it has accounted for the codes it's required to be in compliance with.

Determining the applicable building codes in a timely manner contributes to the successful progression of a design and its eventual construction and cost. Rooting a design in building code allows the designer's creativity to flourish within the set limitations defined in the IBC and minimizes the risk of going in a direction that may lead to a dead end. Likewise, the designer's awareness of the I-Codes, and for our primary focus the IBC, makes a design more resilient to adjustments the codes will require during its development. This reduces lost time spent in the design process, and ensures the design is in alignment with its fundamental responsibility: to protect the Public Health, Safety, and General Welfare.

"Codes act as boundaries for design options that can be considered. Therefore, full awareness of all codes is a crucial foundational element to solid design decisions for any client." -Botti-Salitsky, Programming and Research

Throughout the design process, *accounting* for the codes and standards which will influence design decisions is central to the success of a good design. Knowing which edition/s and section/s are applicable to a specific project, and in what order of priority to engage the codes, affects the early ideas, concepts, and decisions that follow. It's necessary to integrate building codes and standards into design thinking strategies as early as possible in order for the creative process to flow efficiently and in a fluid manner. Codes should not be considered as an overlay onto the design, but as an underpinning of the design: they are underlying building blocks which designers are tasked to *assemble, layer, and interlock*.

With this approach, codes are thought of as design elements similar to other principles and elements in our design lexicon. By including these as a pivotal part of our design thinking strategies, we can produce an integrated design more quickly, with reduced costs in both the design process and the subsequent construction. Accordingly, knowledge of building codes can be thought of as a sustainable principle for a designer: when codes are incorporated at the start of the design process, the designer can focus their artistic talents into aligning code requirements with their other valued design principles synergistically, reducing wasted creative energy and physical resources.

I liken building codes to gravity, heat, wind, rain, snow, lightning, and earthquakes - inherent forces design must solve for, with a holistic solution.

Before we move forward into the IBC, let's set the background of building codes, as well as the organization responsible for the model codes and standards we implement today.

Building Code History

Building codes have continuously developed through civilization's history toward better protecting humanity from life- and health-threatening conditions that have impacted our built environment.

"Over the centuries, building codes have evolved from regulations stemming from tragic experiences to standards designed to prevent them." -The Insurance Institute for Business & Home Safety (IBHS).

The Code of King Hammurabi in Babylon, circa 1750-1800-B.C., is considered to be the world's first building code, although it was in effect a criminal statute that included capital punishment for deficient workmanship that resulted in a death. Today building professionals are not put to death for errors and omissions, but bear immense financial liability. Hammurabi's code recognized the need for construction safety laws to protect the general public in the built environment and ensure that a minimal construction standard be maintained.

The Book of Deuteronomy 22:8 describes the requirement of guardrails on house roofs. "When you build a new house, you must place a guard-rail around your roof. Do not allow a dangerous situation to remain in your house, since someone can fall from an unclosed roof." The height of the guardrail was prescribed to be at least 10 handbreadths (30"). There is further commentary that this applied to stairs as well.

The following are some notable events that impacted the basis of ICC model codes we utilize today.

<u>Fire Codes</u>

The Great Fires of Boston (1631), London (1666), Chicago (1871), Baltimore (1904), and Cleveland Clinic (1929) displayed the necessity to develop building codes that would prevent such fires from occurring again. After the London Fire, the Metropolitan Buildings Office was created and developed regulations on wall thickness, room height, and the placement and design of chimneys, fireplaces, and drains. After the Baltimore Fire, the city published the Handbook of Baltimore City Building Laws.

In recent history, the MGM Grand Fire in 1980 and the Station Nightclub Fire in 2003 led to stringent code provisions for fire sprinklers and crowd management in buildings.

<u>Seismic Codes</u>

The first local government to adopt a seismic-safety building code was the city of Santa Barbara, California in 1926. The city council passed a law requiring structures to be designed to resist the horizontal forces inflicted by earthquakes and wind, and further requiring such structures to be designed by accredited architects and thoroughly inspected during construction. In 1927, the first seismic code appeared in the appendix of the Uniform Building Code (UBC).

In 1971, the San Fernando Valley Earthquake rocked Los Angeles. In 1975, California established the Seismic Safety Commission to advise the governor on developing strategies to reduce earthquake risk on structures. The red flags raised during the 70's kept engineers busy at work analyzing seismic effects on

different construction types and learning how to make construction more resistant to increased levels of movement. California's 1989 Loma Prieta and 1994 Northridge Earthquakes further demonstrated the need for more stringent seismic codes.

Wind Codes

In the 1950's wind code provisions were incorporated, focusing on main wind force resistance systems on the framed construction. Not until after Hurricane Hugo (1989) and Hurricane Andrew (1992) did the code include the building envelope and roof connections.

Energy Codes

Due to the 1970's oil embargo, serious concerns arose over energy security and natural resource conservation. In 1974, California was the first state to impose energy usage regulations in their building code. The 1975 Energy Policy and Conservation Act directed the National Institute of Standards and Technology to develop test procedures for measuring the energy efficiency of appliances. The Energy Policy Act of 1992 required all states to review and consider adopting the National Model Energy Standard. The Energy Policy Act of 2005 further specified more stringent model energy codes. Buildings constructed under the 2012 Energy Code reduce energy usage by more than a third compared with the 2006 code. At the 2013 annual meeting, the U.S. Conference of Mayors adopted a resolution stating "…the 2015 IECC will strongly influence efficiency performance in millions of U.S. homes expected to be built in the U.S. over their 70-80 year lives."

Our past challenges led to finding innovative solutions to improve zoning regulations and building codes to prevent similar events from happening again. Humanity's collective experience, and the necessity to improve building standards, have impacted the type of buildings we build, where they can be built, their height, floor area, room size, circulation, sanitation, access to light and ventilation, fire separations, accessibility, construction materials and methods, and other health and safety concerns.

The COVID-19 pandemic has cast a spotlight on a whole new range of issues, which will further affect what, where and how we build in the future.

International Code Council (ICC)

Who writes the codes?

The beginning of what is considered U.S. modern codes can be traced back to the 1897 publication of the National Fire Protection Association (NFPA)'s National Electrical Code (NEC). In 1915 the Building Officials and Code Administrators (BOCA) was established and created the first national code. However, it wasn't actually published as a compilation until 1950.

Historically, model codes were prepared by code bodies such as the Building Officials and Code Administrators International, Inc. (BOCA), the National Building Code (NBC), Southern Building Code Congress International (SBCCI), the Southern Building Code (SBC), the International Conference of Building Officials (ICBO), and the Uniform Building Code (UBC). These various model building codes were adopted regionally by local authorities. However, the existence of multiple code bodies throughout the United States was problematic for the building industry as a whole.

Because of the disparity in the various code books, the International Code Council (ICC) was established in 1994: a non-profit organization for the purpose of developing a single set of comprehensive and coordinated national model construction codes. The founders of the ICC were from BOCA, ICBO, and

SBCCI, three organizations referenced above with separate sets of model codes already being used in different regions of the United States.

The first set of I-Codes were published in 2000, and included the International Residential Code (IRC) and the International Building Code (IBC). The I-Codes have since been adopted by states and municipalities throughout the country, and used in other countries as their code standard.

Model codes are the central regulatory basis for administration of code enforcement programs in cities, counties, and states throughout the U.S. The I-Codes consist of a comprehensive set of 15 integrated, topical, geographically specific model codes. The IBC is 1 of 15.

<u>ICC Code Set</u>

IBC	International Building Code
ICCPC	International Code Council Performance Code for Buildings and Facilities
IECC	International Energy Conservation Code
IEBC	International Existing Building Code
IFC	International Fire Code
IFGC	International Fuel Gas Code
IgCC	International Green Construction Code
IMC	International Mechanical Code
IPC	International Plumbing Code
IPMC	International Property Maintenance Code
IPSDC	International Private Sewage Disposal code
IRC	International Residential Code for One- and Two-Family Dwellings
ISPSC	International Swimming Pool and Spa Code
IWUIC	International Wildland-Urban Interface Code
IZC	International Zoning Code

Today, the ICC is an association with over 60,000 members. While anyone can become a member, the membership consists of mostly fire officials, code enforcement officials, builders, architects, designers, engineers, manufacturers, labor, and industry representatives.

The ICC adheres to an open and transparent codes and standards development process; it's a place where knowledge rules (building science research, engineering principles, experience of leading technical experts), and where all affected people get together to reach consensus on how to make better buildings. All committee meetings are open to the public.

Codes are approved by consensus opinion: they represent the views of all relevant parties and are developed in a rigorous participatory democratic process. Any interested party can participate and propose changes to the code standards, or make public comments in the model code update process. A code change proponent has the opportunity to rebut opponents and vice versa. Committee members are required to consider and balance all interests, views, objections, and the cost impact of all code changes; they then vote to approve the code, make modifications to it, or vote against it. A simple majority from the committee member voting decides the action of the proposed code change. Evidence of committee vote, with reason, must be documented. Final decisions are made in an open hearing by public safety officials. Anyone can appeal an action or inaction of the code committee; however, the ICC renders its appeal decision based on whether due process was served.

The ICC's mission is to make safer, healthier and more resilient environments with each iteration of the model codes. The 3-year cycle of code modifications helps accelerate innovation in products and systems to improve our quality of life. This process keeps our building technologies advancing, doing more with less wasted resources. It compels continuous improvement in construction workforce skills and requires design professionals to be the most up-to-date on advancements.

Based on the latest evidence-based information approved at the time of issuance, the I-Codes provide the minimum level safeguards and standards for construction. The standards are approved by the American National Standards Institute (ANSI). The I-Codes are the primary source that architects, engineers, designers, builders, code officials, and suppliers can all reference. These are the rulebooks for what is permitted.

As we have seen, there have been different building codes with different standards applied in different regions throughout the U.S. This caused inconsistencies and discrepancies for builders, architects, engineers, insurance companies, manufacturers, and the public. To a much lesser extent this is still occurring. Our federalist system of government reserves property law for state and local authorities. This gives each jurisdiction the right to adopt its own set of model codes. Some states adopt the most recent edition and errata when published; other states may choose not to update, depending on their governing legislature's choice.

The governing rulebooks that apply in a specific locale depend on which code edition the state and local jurisdiction have adopted. With this said, check with the local authority having jurisdiction (AHJ) that governs your project to verify which IBC edition is enforced, and what additional state and municipal codes have been adopted. This is extremely important so you're confident you're working with the applicable rulebooks that regulate your project.

The most recent IBC edition was issued in 2018, with the 2021 edition available later this year.

Below are a few examples of various IBC editions states are enforcing. (Some of these states may have adopted a more recent edition since the publication of this course.)

California: 2018 IBC
Mississippi: 2018 IBC
Ohio: 2018 IBC
New York: 2015 IBC
Washington: 2015 IBC
Kansas: 2015 IBC
Texas: 2015 IBC
Idaho: 2015 IBC
Florida: 2015 IBC
Louisiana: 2015 IBC
Indiana: 2012 IBC

The adoption and enforcement of the most recent edition of model codes and standards results in our built environment being more resilient to destructive forces, reduces natural resource consumption, and helps improve both quality of life and building life-cycle cost. In addition, across the building industry, there is the perception that out-of-date building codes hurt the international competitiveness of construction industry suppliers. The more outdated the local building code becomes, the less incentive

local builders and manufacturers have to innovate, and the more inefficient and behind times the building industry and its domestic suppliers become. This has ramifications of both lower-quality buildings and lost economic opportunity. In contrast, some Eurocodes have been on the cutting edge of innovation, propelling the European manufacturers ahead of the U.S. manufacturers in the global building industry market.

This is not to say that all model codes are unquestionable. For example, a specific code might interfere with a satisfactory design solution which does not meet the model code definition, but maintains the intent and purpose of the code. In these cases, there's an administrative process which allows a registered design professional to submit an Alternate Materials and Methods of Construction (AMMC) application to the AHJ. Each AMMC is reviewed on case-by-case basis. The AHJ reviews the supporting technical documents, may require a test by an approved testing agency as proof of equivalency, and can approve or disapprove. The process is an investment of time and money, but from time to time might best serve a project's interest.

Now we know why and how the model codes are established, and who establishes them.

REVIEW QUESTIONS

1. The first set of I-Codes were published in what year?

a. 1992
b. 1994
c. 2000
d. 2018

2. The IBC is 1 of how many ICC code books?

a. 9
b. 14
c. 20
d. 15

3. What is the acronym AHJ?

a. Accessible Housing Journal
b. Advocate Health Justice
c. Authority Having Jurisdiction
d. Alternative Healing Jargon

IBC Code Mapping

Please note: The ICC has granted permission to include the referenced IBC tables in this code mapping course. Some tables have been shortened in their length (excluding some supplementary information and conditional footnotes) in order for them to fit within the depth of the code investigation we'll accomplish in this course. For referenced sections and tables in their entirety, refer to the 2018 IBC.

As we've seen, the I-Codes are model codes. Local authorities adopt codes using the model codes as the basis for their requirements. They may choose to adopt as is, or make changes as they deem appropriate. Your local jurisdiction may also be using an older edition of the I-Codes.

The I-Codes provide the *minimum safeguards*. Based on your application, an I-Code minimum standard may not be considered sufficient. The local AHJ may reject the minimum standard – in their opinion – and require a more stringent standard. *Always check with your local AHJ regarding their minimum standards.*

The following Code Mapping is based on the 2018 IBC, which contains 35 Chapters and 14 Appendices.

Chapter 1: Scope and Administration
Chapter 2: Definitions
Chapter 3: Use and Occupancy Classification
Chapter 4: Special Detailed Requirements Based on Use and Occupancy
Chapter 5: General Building Heights and Areas
Chapter 6: Types of Construction
Chapter 7: Fire and Smoke Protection Features
Chapter 8: Interior Finishes
Chapter 9: Fire Protection Systems
Chapter 10: Means of Egress
Chapter 11: Accessibility
Chapter 12: Interior Environment
Chapter 13: Energy Efficiency
Chapter 14: Exterior Walls
Chapter 15: Roof Assemblies and Rooftop Structures
Chapter 16: Structural Design
Chapter 17: Special Inspections and Tests
Chapter 18: Soils and Foundations
Chapter 19: Concrete
Chapter 20: Aluminum
Chapter 21: Masonry
Chapter 22: Steel
Chapter 23: Wood
Chapter 24: Glass and Glazing
Chapter 25: Gypsum Board, Gypsum Panel Products and Plaster
Chapter 26: Plastic
Chapter 27: Electrical
Chapter 28: Mechanical Systems
Chapter 29: Plumbing Systems
Chapter 30: Elevators and Conveying Systems
Chapter 31: Special Construction

Chapter 32: Encroachments into the Public Right-of-way
Chapter 33: Safeguards During Construction
Chapter 34: Reserved
Chapter 35: Referenced Standards
Appendix A: Employee Qualifications
Appendix B: Board of Appeals
Appendix C: Group U-Agricultural Buildings
Appendix D: Fire Districts
Appendix E: Supplementary Accessibility Requirements
Appendix F: Rodentproofing
Appendix G: Flood-resistant Construction
Appendix H: Signs
Appendix I: Patio Covers
Appendix J: Grading
Appendix K: Administrative Provisions
Appendix L: Earthquake Recording Instrumentation
Appendix M: Tsunami-Generated Flood Hazard
Appendix N: Replicable Buildings

We'll be focusing on the ***bold italicized chapters*** above: these chapters are key in the design process. We'll apply a building component module method as a framework to investigate these chapters synchronistic with the development of a design. Through this method, knowing *what to account for, where to look and when to look* are brought together to make the IBC easier to access and apply.

For me, the following mantra is helpful:

Account for Regulations
Accommodate within Concept
Assemble in Schematic
Integrate into Design

Adjacent to each code section is a corresponding (letter) associated with the phase when it's timely to analyze and/or apply the code comprehensively. Please keep in mind: *the less going backwards the more efficient we are.*

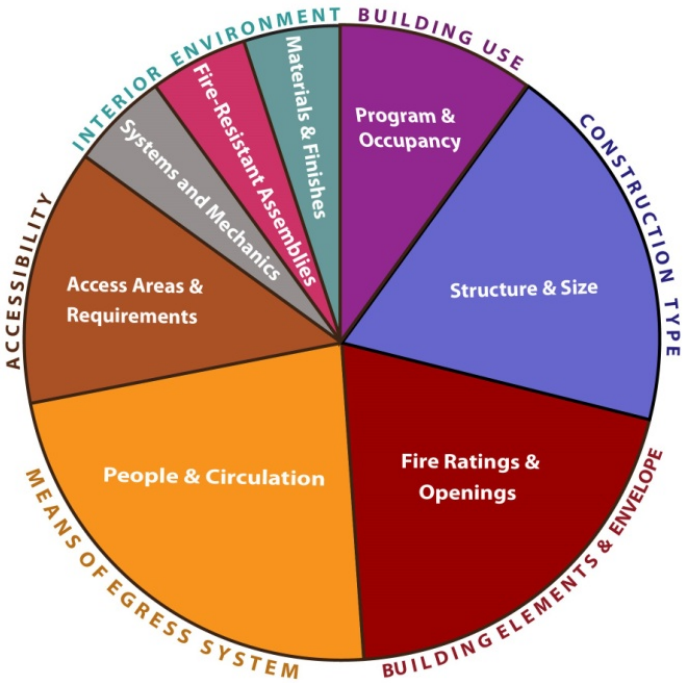
(C) ***(S)*** ***(DD)*** ***(CD)***
Concept - Schematic - Design Development - Construction Documents

Code Analysis Progression
The following framework is what I utilize to access the IBC when designing a building. The mapping is organized into eight modules starting from 'Building Use' to 'Interior Surface'. Each module contains code building blocks that affect how the previous and following module building blocks are linked and applied.

Within each module are the essential mainstream codes of the module topic in order of priority to investigate. The modules contain associated chapters and sections from the IBC and a few other sources

which interrelate with the component. These cross-referenced chapters and sections may need to be considered concurrently as the design entails.

The module framework links IBC terminology to common AEC vocabulary to help identify how the codes relate to and affect a design. The modules are organized from the broadest question of building use into specific building systems and elements which impact the formation of a building.



1. Building Use: *Program & Occupancy*
2. Construction Type: *Structure & Size*
3. Building Elements & Envelope: *Fire Rating & Openings*
4. Means of Egress System: *People & Circulation*
5. Accessibility: *Access Areas & Requirements*
6. Interior Environment: *Systems & Mechanics*
7. Interior Elements: *Fire-Resistant Assemblies*
8. Interior Surface: *Materials & Finishes*

This sequence of inquiry works for me in locating and accounting for a project's building codes. The order may shift depending on the scope of work and what fits best in your design process. You can adjust, subtract and/or add as you see fit. Each project's specific requirements determine the module's percentage of investigation.

At this stage in the design process, we've analyzed the client/s objectives, budget, site, municipal planning ordinances and all other governing agencies' requirements which regulate the project. Our pre-design due diligence has set some of our initial parameters for the direction of the design. With this collection of information in hand, we can now undertake a focused *building code analysis* which will affect design decisions. Through this analysis process we can ensure the design is in compliance with the applicable codes.

As we begin our investigation, it's important to note: the following discussions of codes deal “only” with the subject matter of each. It's imperative for the designer to scrutinize each section, and all subsections and tables, in their entirety before determining how a code applies or does not apply to a specific design.

Module 1 - Building Use: *Program & Occupancy*

What are we Tasked to Design?
For our purposes, we'll be looking into the IBC as if we're tasked to design a new building. Your layers of investigation and findings of the IBC are dependent on your specific project requirements.

- see **International Existing Building Code** (IEBC) if this codebook is applicable to your project
- see **International Residential Code** (IRC) if this codebook is applicable to your project

Let's proceed into assembling the building code building blocks.

What's the Building's Use?
The building Program is the catalyst.

Examples:
Office, mercantile, housing, school, hotel, restaurant, health club, theater, factory, etc.

***(C/S)* Chapter 3: Use and Occupancy Classification**
Within this chapter we locate ten Use Classifications. Each of the classifications has definitions of the type of use/s included, with further sub-categories based on the different type of uses within a classification and the concentration levels of occupants associated with a use type. Code requirements become more restrictive with the increase of the Use Life Safety Hazard.

Identify the appropriate Group and Use that matches your program.

USE CLASSIFICATION STRUCTURE

Group	*Use*
Group A:	Assembly
Group B:	Business
Group E:	Educational
Group F:	Factory
Group H:	High Hazard
Group I:	Institutional
Group M:	Mercantile
Group R:	Residential
Group S:	Storage
Group U:	Utility and Miscellaneous

Example:
Assembly Group A has five sub-groups associated with the Group**:** *A-1, A-2, A-3, A-4* and *A-5***.** Each subgroup has its own list of use types. This is because within certain classifications there are different levels of restrictions based on life safety and the relative hazard level of a particular use.

Group A-1 includes Motion Picture Theaters, Symphony and Concert Halls, Television and Radio Studios admitting an audience, and Theaters.

Group A-2 includes uses intended for food and/or drink consumption including, but not limited to Banquet Halls, Night Clubs, Restaurants, Taverns, and Bars.

We can see that these different types of Assemblies have varying degrees of life safety hazard based on the function of space, density of occupants, and other contributing factors.

However, in **Section 303.1.1**: a building or tenant space used for assembly purposes with an occupant load (see **Table 1004.1.1** for occupant: sq. ft. factor) of less than 50 persons shall be classified as a Business Group B occupancy. The rationale for this is the restriction on the amount of people within a space and therefore the level of life safety hazard.

Always dig deeper into additional surrounding sections which may be linked and affect your particular condition.

If a Use is not specifically provided for in Chapter 3, such Use shall be classified in the group that the occupancy most nearly resembles. If you don't find the Use you're looking for in Chapter 3 proceed to Chapter 4 for Additional Use Classifications.

***(C/S)* Chapter 4: Special Detailed Requirements Based On Use and Occupancy**
Here you'll find uses ranging from Covered Mall and Open Mall Buildings, High-Rise Buildings, Atriums, Underground Buildings, Motor-Vehicle-Related Occupancies (such as private garages and carports, parking garages, open parking garages) Motion Picture Projection Rooms, Stages and Platforms, Special Amusement buildings, Aircraft-Related Occupancies, Combustible Storage, Hazardous Materials, Drying Rooms, Live/Work Units, Ambulatory Health Care Facilities.

***(C/S)* For multiple occupancies in a building see Section 508: Mix Use and Occupancy**
Section 508.2.3 determines what is considered an Accessory Occupancy. Accessory Occupancies shall not occupy more than 10 percent of the building area of the story in which they are located and shall not exceed the tabular values for nonsprinklered building in Table 506.2.

If your Accessory Occupancy is greater than 10 percent of the building area of the story then whichever occupancy is more restrictive will determine the Use Classification used in determining Construction Type.

Example:
A two-story building containing 70% Group B Use and 30% Group E Use would be classified as a Group E Occupancy.

Is there a Required Fire Separation between Occupancies?

***(C/S)* Table 508.4: Required Separation of Occupancies**

Here we find the table that specifies the required fire separation between different Occupancies. Depending on the Adjacent Occupancy, the level of fire separation can range from no rated separation requirement, to a 1, 2, 3 or 4 hour fire separation, to the adjacencies not being permitted at all.

TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)[f]

OCCUPANCY	A, E		I-1[a], I-3, I-4		I-2		R[a]		F-2, S-2[b], U		B[e], F-1, M, S-1		H-1		H-2		H-3, H-4		H-5	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A, E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP	3	4	2	3	2	NP
I-1[a], I-3, I-4	—	—	N	N	2	NP	1	NP	1	2	1	2	NP	NP	3	NP	2	NP	2	NP
I-2	—	—	—	—	N	N	2	NP	2	NP	2	NP	NP	NP	3	NP	2	NP	2	NP
R[a]	—	—	—	—	—	—	N	N	1[c]	2[c]	1	2	NP	NP	3	NP	2	NP	2	NP
F-2, S-2[b], U	—	—	—	—	—	—	—	—	N	N	1	2	NP	NP	3	4	2	3	2	NP
B[e], F-1, M, S-1	—	—	—	—	—	—	—	—	—	—	N	N	NP	NP	2	3	1	2	1	NP
H-1	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	NP	NP	NP	NP	NP	NP
H-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	1	NP	1	NP
H-3, H-4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1[d]	NP	1	NP
H-5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP

S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.
NS = Buildings not equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.
N = No separation requirement.
NP = Not Permitted.
a. See Section 420.
b. The required separation from areas used only for private or pleasure vehicles shall be reduced by 1 hour but not to less than 1 hour.
c. See Section 406.3.2.
d. Separation is not required between occupancies of the same classification.
e. See Section 422.2 for ambulatory care facilities.
f. Occupancy separations that serve to define fire area limits established in Chapter 9 for requiring fire protection systems shall also comply with Section 707.3.10 and Table 707.3.10 in accordance with Section 901.7.

Example:
'B' occupancy adjacent to 'M' adjacent to Group S-1 with or without sprinkler system = *No Separation Requirement*

However, as we dig deeper into the code we locate ***(S)* Section 508.2.4: Separation of Occupancies**
Exceptions: R-1, R-2 and R-3 dwelling units and sleeping units shall be separated from other dwelling or sleeping units and from other occupancies contiguous to them in accordance with requirements of ***(DD)* Section 420: Groups I-1, R-1, R-2, R-3 and R-4**.

This is an example of reading through multiple code sections related to your question, which then leads to the code/s that your design is required to satisfy. Each code section is in bold helping the designer to scan through quickly to locate the applicable sections which will apply to your design.

It is critical to determine the correct Use Classification, as this is the underpinning of all other applicable codes to follow. In Module 4 we'll link the Use Classification with each Function of Space within the building to determine the Occupant Load, which then affects the Means of Egress system.

Now that we know which Group Classification a project is considered within, you can determine the appropriate Type of Construction which will set the Maximum Allowable Building Height, Stories, and Floor Area per Story.

Module 2 - Construction Type: *Structure & Size*

What Construction Type is Required for the Project?

Based on the Program and associated Occupancy Group/s we can now determine the Construction Type that best fits the project's objectives. The following is a framework to build your analysis of what construction type/s will be required for the occupancy group and the size of building you're designing. There are multiple factors and tables to consider when making this pivotal decision. Besides the tables, other factors such as labor forces, material resources, structural spans and member sizes play key roles in the construction type selection.

***(C/S)* Construction Type** (see Section 602)
There are five construction types ranging from least restrictive to most restrictive of materials utilized in the building construction.

Type V is the least restrictive of materials utilized. Type V construction is that type of construction in which the structural elements, exterior walls and interior walls are of any material permitted by the code. However, when we refer to Type V, we're mostly referring *to wood construction*. Since nominal lumber is the most combustible, Type V Construction is the most restrictive in the building height, stories and floor area.

Type IV is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of large-section sawn lumber (HT), structural composite lumber (SCL), glued laminated timber (GLT), and cross-laminated timber (CLT) without concealed spaces.

Note: In the upcoming 2021 IBC, 14 tall mass timber code changes create three new types of construction, setting fire safety requirements and allowable heights, areas, and number of stories for tall mass timber buildings up to 18 stories tall. The three new mass timber building types are:

- *Type IV-A – Wood buildings up to 18 stories tall*
- *Type IV-B – Wood buildings up to 12 stories tall*
- *Type IV-C – Wood buildings up to 9 stories tall*

Type III is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by the code.

Types I & II are those types of construction in which building elements listed in Table 601 are of noncombustible materials, except as permitted in Section 603 (Combustible Material in Type I and II Construction) and elsewhere in the code.

With each construction type, either the letter *'A'* or *'B'* is associated: *'A'* - protected (fire rated) building elements vs. *'B'* - unprotected (nonrated) building elements.

Whether the building elements are *'A' protected* or *'B' unprotected* and *'S' equipped* or *'NS' not equipped* with automatic sprinkler systems, and what type of system if equipped, will determine the building maximum size.

Example:
Construction Type Misdiagnosis

A property owner who was converting an existing three-story brick warehouse into an R-2 occupancy building contacted me to review the architect of record's construction drawings because of cost overruns that the general contractor presented. Reviewing the drawings, I observed the architect had specified a Type lll construction because the existing building was constructed of exterior load bearing masonry walls. The cost overruns were due to the additional fire prevention requirements for a Type lll Construction.

Based on the tables and sections we'll review next, the building qualified as a Type VB 'S' building, eliminating the additional cost due to the increased fire protection requirements. Type V could be constructed of masonry, concrete and/or steel and still be considered a Type V construction. The architect's misdiagnosis of the construction type had significant cost implications which could have been avoided.

***(C/S)* Chapter 5: General Building Heights and Areas -** *Size*
The following Tables limit the Building Size depending on Occupancy Group and Construction Type. Let's look at each Table using a Group B Occupancy Classification within a Type VA -'NS' Construction Type.

(C/S) Table 504.3: Allowable Building Height in Feet above Grade Plane

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE[a]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A, B, E, F, M, S, U	NS[b]	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
H-1, H-2, H-3, H-5	NS[c, d]	UL	160	65	55	65	55	65	50	40
	S									
H-4	NS[c, d]	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
I-1 Condition 1, I-3	NS[d, e]	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
I-1 Condition 2, I-2	NS[d, e, f]	UL	160	65	55	65	55	65	50	40
	S	UL	180	85						
I-4	NS[d, g]	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
R[h]	NS[d]	UL	160	65	55	65	55	65	50	40
	S13D	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	85	70	60

UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing building height in accordance with the *International Existing Building Code*.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the *International Fire Code*.
g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

Example:

Group B Occupancy Classification within a Type VA 'NS' Construction Type = 50' Ht.

- Equipped with automatic sprinkler system = 70' Ht.

It's crucial to read through the associated footnotes of each table. Contained within the footnotes are additional information and requirements that may apply. Always cross-reference.

***(C/S)* Table 504.4: Allowable Number of Stories above Grade Plane**

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE[a, b]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	2	1
	S	UL	6	4	3	4	3	4	3	2
A-2	NS	UL	11	3	2	3	2	3	2	1
	S	UL	12	4	3	4	3	4	3	2
A-3	NS	UL	11	3	2	3	2	3	2	1
	S	UL	12	4	3	4	3	4	3	2
A-4	NS	UL	11	3	2	3	2	3	2	1
	S	UL	12	4	3	4	3	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	3	2
	S	UL	12	6	4	6	4	6	4	3
E	NS	UL	5	3	2	3	2	3	1	1
	S	UL	6	4	3	4	3	4	2	2
F-1	NS	UL	11	4	2	3	2	4	2	1
	S	UL	12	5	3	4	3	5	3	2
F-2	NS	UL	11	5	3	4	3	5	3	2
	S	UL	12	6	4	5	4	6	4	3
	NS[c, d]									

(Note: table has been trimmed for space and clarity)

R-1[h]	S13R	4	4						4	3
	S	UL	12	5	5	5	5	5	4	3
R-2[h]	NS[d]	UL	11	4	4	4	4	4	3	2
	S13R	4	4	4					4	3
	S	UL	12	5	5	5	5	5	4	3
R-3[h]	NS[d]	UL	11	4	4	4	4	4	3	3
	S13D	4	4						3	3
	S13R	4	4						4	4
	S	UL	12	5	5	5	5	5	4	4
	NS[d]	UL	11	4	4	4	4	4	3	2
	S13D	4	4						3	2

(Note: table has been trimmed for space and clarity)

	S	UL	12	5	3	4	3	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	2
	S	UL	12	6	4	5	4	5	5	3
U	NS	UL	5	4	2	3	2	4	2	1
	S	UL	6	5	3	4	3	5	3	2

(Note: same footnotes as Table 504.3 with the inclusion of NP = Not Permitted)

Example:
Group B Occupancy Classification within a Type VA 'NS' Construction Type = 3 Stories

- Equipped with automatic sprinkler systems = 4 Stories

(C/S) Table 506.2: Allowable Area Factor

TABLE 506.2
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET[a, b]

OCCUPANCYCLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1									
	SM									
B	NS	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	76,500	55,500	28,500
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	33,500	14,000	8,500
	S1	UL	UL	100,000	62,000	76,000	48,000	134,000	56,000	34,000
	SM	UL	UL	75,000	46,500	57,000	36,000	100,500	42,000	25,500

NS =Buildings not equipped throughout with an automatic sprinkler system.
S1 =Buildings a maximum one story equipped throughout with an automatic sprinkler system installed per Section 903.3.1.1.
SM =Buildings a maximum two or more stories equipped throughout with an automatic sprinkler system installed per Section 903.3.1.1.
S =Buildings equipped throughout with an automatic sprinkler system installed per Section 903.3.1.1.
S13R =Buildings equipped throughout with an automatic sprinkler system installed per Section 903.3.1.2.
S13D =Buildings equipped throughout with an automatic sprinkler system installed per Section 903.3.1.3.

Example:
Group B Occupancy Classification within a Type VA 'NS' Construction Type = 18,000 sf.

- Equipped with 'SM' automatic sprinkler systems = 54,000 sf.

Below is a brief overview of the three types of fire sprinkler systems: NFPA 13, NFPA 13R & NFPA 13D. In Module 6 *Interior Environment: Systems & Mechanics* we'll investigate **Chapter 9 Fire Protection** and Life Safety Systems.

	NFPA 13	NFPA 13R	NFPA 13D
Objective	Life Safety + Property Protection (NFPA 13 2002-2019 1.2.1)	Life Safety Only (NFPA 13R 2002-2019 1.2)	Life Safety Only (NFPA 13D 2002-2019 1.2.1)
Considered "Fully-Sprinklered" for Code Purposes	Yes (IBC ref. section 903.1.1)	No	No
Building Height Increases Permitted	Yes (IBC Table 504)	Only for R-Occupancy (IBC Table 504)	No
Permitted in One & Two-Family, or Group R-3 & R-4 Condition 1 and townhome R-Occupancies	Yes (IBC 903.1.1)	Yes (IBC 903.1.2)	Yes (IBC 903.3.1.3)
Permitted in R-Occupancies up to 4 stories	Yes (IBC 903.1.1)	Yes (IBC 903.1.2)	No
Permitted in Mixed Use / Non-Residential Occupancies	Yes (IBC Table 508.4, 508.3.1)	No (IBC 903.1.2)	No

Example:
Group B - Type VA - 'S' Construction permits a max. 70' Ht. - 4 story - 54,000 sq. ft. per story building. There are additional codes that allow further increase of floor area per story.

The Code permits the increase for Building Height, Stories & Floor Area due to the installation of automatic sprinkler systems with the following three Sections allowing for additional floor area per story.

***(C/S)* Section 506: Building Area**
This section contains requirements with equations to determine if additional floor area can be added to maximize building square feet. *Equations 5-1, 5-2, 5-3*

***(C/S)* Section 506.3.2: Minimum Frontage Distance**
Every building shall adjoin or have access to a public way with a min. 20 feet distance from building to receive an area factor increase. *Equations 5-4, 5-5*

***(C/S)* Section 507: Unlimited Area Buildings**
If applicable**.** Limited to 1- 2 stories.

The following sections permit a building to be separated into multiple distinct buildings for the purpose of determining area limitations, stories and construction type.

***(C/S)* Section 510.2: Horizontal Building Separation Allowance**
***(C/S)* Section 503.1.2: Buildings on Same Lot**
***(C/S)* Section 705.3: Buildings on the Same Lot**

This does not mean that increasing building size through an automatic sprinkler system is the only option. It might be more cost-effective to change type of construction and/or install a fire barrier to compartmentalize floor area.

Example:
The client wants to build a one-story retail building with 14,000 sq. ft. of floor area. At first glance we could either select a Type VA (NS) or Type VB (S1). Another option might be to separate the building in half with a fire wall, reducing each floor area to 7000 sq. ft. which would allow for a Type B (NS) building. We'll investigate fire walls in Module 7 *Interior Elements: Fire-Resistant Assemblies*.

Depending on the program, budget, and client, the construction type selected needs to fit the overall project objectives. A *cost analysis* is prepared to determine if sprinklers, fire walls or a more restrictive type of construction is the most effective solution to accommodate the project program. As we can see from Section 506, there may be other variables to consider in determining the specified type of construction.

After determining Type of Construction, this chapter and sections are useful in the development of the exterior envelope and interior space.

***(C/S)* Chapter 32: Encroachments into the Public Right-of-way**
Limits exterior projections over property lines adjacent the Public Right-Of-Way.

***(C/S)* Table 705.2: Minimum Distance of Projections**
Cornices, eave overhangs, exterior balconies, and similar projections extending beyond the exterior wall shall not extend any closer to the line used to determine the fire separation distance.

TABLE 705.2
MINIMUM DISTANCE OF PROJECTION

FIRE SEPARATION DISTANCE-FSD (feet)	MINIMUM DISTANCE FROM LINE USED TO DETERMINE FSD
0 to less than 2	Projections not permitted
2 to less than 3	24 inches
3 to less than 5	24 inches plus 8 inches for every foot of FSD beyond 3 feet or fraction thereof
5 or greater	40 inches

***(C/S)* Section 505: Mezzanines and Equipment Platforms**
For floor area allowed. This section is useful in space planning inside the building envelope.

***(S/DD)* Section 1207: Interior Space Dimensions**

Selecting your Construction Type or options sets up the next piece of the puzzle to fit.

Which Building Elements are Required to be Fire Rated with Associated Element Hour Rating?

***(C/S)* Table 601: Fire-Resistance Rating Requirements for Building Elements (hours)**
Defines the building elements' minimum fire hour rating based on Type of Construction with 'A' protected or 'B' unprotected.

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b]	1[b]	0	1[b]	0	HT	1[b]	0
Bearing walls Exterior[e, f] Interior	 3 3[a]	 2 2[a]	 1 1	 0 0	 2 1	 2 0	 2 1/HT	 1 1	 0 0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

For SI: 1 foot = 304.8 mm.
a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed where a 1-hour or less fire-resistance rating is required.
d. Not less than the fire-resistance rating required by other sections of this code.
e. Not less than the fire-resistance rating based on fire separation distance (see Table 602).
f. Not less than the fire-resistance rating as referenced in Section 704.10.

Example:
Type VA Building Elements = 1 Hour Rated

This table is important, because it may affect your previous decision of determining to protect or unprotect the selected construction type 'A' or 'B'.

***(C/S)* Table 602: Fire-Resistance Rating Requirements for Exterior Walls Based on Fire Separation Distance**

This table defines the minimum distance of exterior walls from property line or imaginary property line on the same site, Type of Construction, Occupancy Group with Fire Hour Rating.

- see **Section 705.2: Projections** and **Table 705.2: Minimum Distance of Projection**

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R[i], S-2, U[h]
X < 5[b]	All	3	2	1
5 ≤ X < 10	IA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB	2	1	1[c]
	IIB, VB	1	0	0
	Others	1	1	1[c]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.3.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.
i. For a Group R-3 building of Type II-B or Type V-B construction, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

Example:

Type VA Exterior Walls = 1 Hour Rated

***(C/S/DD*) Chapter 14: Exterior Walls**

This chapter sets the criteria for *material performance, weather protection, fire resistance, and durability* for exterior wall coverings, exterior wall openings, windows, doors, and architectural trim. This chapter along with **Tables 601 & 602** affects the design of the building's envelope.

***(S/DD)* Section 1402: Performance Requirements**
***(S/DD)* Section 1403: Materials**
***(S/DD)* Section 1403: Installation**

Further along, in Module 4 *Means of Egress System: People & Circulation* and Module 7 *Interior Elements: Fire-Resistant Assemblies,* we'll investigate other fire-rated conditions to account for.

***(C/S)* Table 705.8: Maximum Area of Exterior Wall Openings Based on Fire Separation Distance and Degree of Opening Protection**

This table is critical for establishing percentage of Openings Area of building envelope per wall/ floor plane. The percentage is determined by separation distance between the exterior wall/s' distance from property line and/or an imaginary line between buildings on the same lot (refer to **Sections 503.1.2** & **705.3)**.

- see **Section 705.8: Openings**

TABLE 705.8
MAXIMUM AREA OF EXTERIOR WALL OPENINGS BASED ON FIRE SEPARATION DISTANCE AND DEGREE OF OPENING PROTECTION

FIRE SEPARATION DISTANCE (feet)	DEGREE OF OPENING PROTECTION	ALLOWABLE AREA[a]
0 to less than 3[b, c, k]	Unprotected, Nonsprinklered (UP, NS)	Not Permitted[k]
	Unprotected, Sprinklered (UP, S)[i]	Not Permitted[k]
	Protected (P)	Not Permitted[k]
3 to less than 5[d, e]	Unprotected, Nonsprinklered (UP, NS)	Not Permitted
	Unprotected, Sprinklered (UP, S)[i]	15%
	Protected (P)	15%
5 to less than 10[e, f, j]	Unprotected, Nonsprinklered (UP, NS)	10%[h]
	Unprotected, Sprinklered (UP, S)[i]	25%
	Protected (P)	25%
10 to less than 15[e, f, g, j]	Unprotected, Nonsprinklered (UP, NS)	15%[h]
	Unprotected, Sprinklered (UP, S)[i]	45%
	Protected (P)	45%
15 to less than 20[f, g, j]	Unprotected, Nonsprinklered (UP, NS)	25%
	Unprotected, Sprinklered (UP, S)[i]	75%
	Protected (P)	75%
20 to less than 25[f, g, j]	Unprotected, Nonsprinklered (UP, NS)	45%
	Unprotected, Sprinklered (UP, S)[i]	No Limit
	Protected (P)	No Limit
25 to less than 30[f, g, j]	Unprotected, Nonsprinklered (UP, NS)	70%
	Unprotected, Sprinklered (UP, S)[i]	No Limit
	Protected (P)	No Limit
30 or greater	Unprotected, Nonsprinklered (UP, NS)	No Limit
	Unprotected, Sprinklered (UP, S)[i]	No Limit
	Protected (P)	No Limit

UP, NS = Unprotected openings in buildings not equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
UP, S = Unprotected openings in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
P = Openings protected with an opening protective assembly in accordance with Section 705.8.2.
a. Values indicated are the percentage of the area of the exterior wall, per story.

***(C/S/DD)* Section 406.5.2: Open Parking Garages Openings**

This section establishes the minimum area for natural ventilation.

***(S/DD)* Chapter 15: Roof Assemblies and Rooftop Structures -** governs the design, materials, construction and quality of roof assemblies and rooftop structures

***(S/DD)* Section 705.11: Parapets**

Once the above codes have been analyzed, now's a suitable time to look through the following sections:

***(C/S/DD)* Section 1202.5: Natural Ventilation**

***(C/S/DD)* Section 1204.2: Natural Light**

***(C/S/DD)* Section 1030: Emergency Escape & Rescue**
***(C/S/DD)* Section 716: Opening Protectives**

The additional sections below, which are mapped in Module 6 *Interior Environment: Systems & Mechanics*, are useful to be aware of when considering the building envelope, if applicable.

***(C/S/DD)* Chapter 13: Energy Efficiency**
***(S/DD)* Section 1204: Lighting**
***(S/DD)* Section 720: Thermal and Sound Insulating Materials**
***(S/DD/CD)* COMcheck Software**

Jointly, these sections will affect the building's envelope. Further along we'll reinvestigate these sections as they apply to building systems, as well as *(DD)* Chapter 7: Fire and Smoke Protection Features and Chapter 9: Fire Protection Systems, when we address the Interior Environment.

REVIEW QUESTIONS

4. Group H defines what use?

a. Healthcare
b. Hospitality
c. High Hazard
d. Housing

5. What Construction Type allows for building elements to be constructed from any material permitted?

a. Type I
b. Type III
c. Type IV
d. Type V

6. Which automatic sprinkler system is permitted for R-Occupancies up to 4 stories?

a. NFPA 13
b. NFPA 13R
c. NFPA 13D
d. NFPA 13 & NFPA 13R

Module 4 - Means of Egress System: *People & Circulation*

At this point in the design process, you've established the appropriate Use Classification with Type of Construction that best fits the project parameters.

Next, calculate Number of Occupants and determine Means of Egress Requirements.

***(C/S)* Chapter 10: Means of Egress -** *People*
Chapter 10 determines the *egress system* for all occupancies. We'll begin with calculating the maximum number of occupants per function of space/s in order to establish the Means of Egress Requirements.

How Many Occupants?

***(C/S)* Table 1004.5: Maximum Floor Area Allowances per Occupant**
If the function of your space is not specifically listed, such function shall be classified as that which it most nearly resembles.

The table on the next page refers to minimum floor area in sq. ft. per occupant – Occupant Load Factor. The floor area is determined to be either *gross floor area* or *net floor area* depending on the *function of space*. The reason for this is how the occupants use, and are distributed, within the space/s.

Floor Area, Gross: The floor area within the inside perimeter of the exterior walls of the building, exclusive of vent shafts and courts, without deduction for corridors, stairways, closets, the thickness of interior walls, columns or other features.

Floor Area, Net: The actual occupied area not including unoccupied accessory areas such as corridors, stairways, toilet rooms, mechanical room and closets.

TABLE 1004.5
MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

FUNCTION OF SPACE	OCCUPANT LOAD FACTOR[a]
Accessory storage areas, mechanical equipment room	300 gross
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal Baggage claim Baggage handling Concourse Waiting areas	 20 gross 300 gross 100 gross 15 gross
Assembly Gaming floors (keno, slots, etc.) Exhibit gallery and museum	 11 gross 30 net
Assembly with fixed seats	See Section 1004.6
Assembly without fixed seats Concentrated (chairs only—not fixed) Standing space Unconcentrated (tables and chairs)	 7 net 5 net 15 net
Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas Concentrated business use areas	150 gross See Section 1004.8
Courtrooms—other than fixed seating areas	40 net

Example:
A2 (Assembly) Restaurant with tables & chairs (Unconcentrated) that has a floor area of:
Kitchen: 500/200 gross sq. ft = 3 occupants
+ Dining Area: 685 net sq. ft /15 sq. ft = 46 Occupants
= 49 Total Occupants = Group B Occupancy

- refer back to **Section 303.1.1**

Repeat similar equations for each type of Function of Space, if necessary.

Example:
Program includes Residential + Mercantile + Parking Garage, etc.

The Occupant Load Calculation/s affects the Means of Egress Requirements.

Chapter 10: Means of Egress - *Circulation*
This chapter also provides the general criteria for the design, arrangement, and construction for the Means of Egress Components. Its purpose is to provide safe passage for the occupants to move through, relocate within, or evacuate the building and portions thereof, in a timely, unobstructed way. Means of Egress Components include:

Exit Access: The portion of a means of egress that leads to the entrance of an exit. It includes any room area or space occupied by a person and any doorway, aisle, corridor, stair, or ramp traveled on the way to the exit.

Exit: The portion of a means of egress that is protected and fully enclosed, and is in between the exit access and the exit discharge or public way. In some special cases, it can include certain corridors or passageways. The components of an exit have higher fire ratings than the exit access portion.

Area of Refuge: A space or area providing protection from fire and/or smoke where persons who are unable to use the stairway (or elevator) can remain temporarily to await assistance during an emergency evacuation.

Exit Discharge: The portion of a means of egress between the termination of an exit and the public way. It can be inside the building such as a lobby, or outside a building such as an egress court, courtyard, patio, or other safe passageway.

Public Way: The area outside a building between the exit discharge and a public street. This can include an alley and sidewalk.

We previously established our Use Classification, Occupant Load and Construction Type. With this information we can begin to assemble the required Means of Egress System.

How Many Exits are Required per Story?

***(C/S)* Table 1006.3.2: Minimum Number of Exits or Access to Exits Per Story**
Occupant load per story determines the minimum number of exits or access to exits per story. A typical range is 2-4 exits.

- see **Section 1006: Number of Exits and Exit Access Doorways**

TABLE 1006.3.2
MINIMUM NUMBER OF EXITS OR ACCESS TO EXITS PER STORY

OCCUPANT LOAD PER STORY	MINIMUM NUMBER OF EXITS OR ACCESS TO EXITS FROM STORY
1-500	2
501-1,000	3
More than 1,000	4

However, there are exceptions: *Where exceptions are provided, read the language carefully. Some exceptions are required to meet all listed criteria while other exceptions are autonomous conditions.*

***(C/S)* Table 1006.3.3(1): Stories with One Exit or Access to One Exit for R-2 Occupancies**
***(C/S)* Table 1006.3.3(2): Stories with One Exit or Access to One Exit for Other Occupancies**
This table allows one exit for a two story building where the occupant load is less than specified per story.

TABLE 1006.3.3(2)
STORIES WITH ONE EXIT OR ACCESS TO ONE EXIT FOR OTHER OCCUPANCIES

STORY	OCCUPANCY	MAXIMUM OCCUPANT LOAD PER STORY	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)
First story above or below grade plane	A, B[b], E F[b], M, U	49	75
	H-2, H-3	3	25
	H-4, H-5, I, R-1, R-2[a, c]	10	75
	S[b, d]	29	75
Second story above grade plane	B, F, M, S[d]	29	75
Third story above grade plane and higher	NP	NA	NA

Example:
Group M: 48 occupants first story
+ Group B: 28 occupants second story with Type VB
= Two-story building with one exit and a maximum 75' common path of egress travel distance

Note: depending on the Type of Group B Use (dentist office) an elevator may be required.

- see **Section 1104.4: Multistory buildings and facilities, exception 1.2** and **Section 1003.7: Elevators, escalators and moving walks** and **Section 1009.4.**

Here's an example of where Means of Egress and Accessibility overlap. We'll look at accessibility requirements a little further on.

***(C/S)* Section 1007.1.1: Two Exits or Exit Access Doorways**
The *distance apart* shall not be less than 1/2 of the length of the max. overall diagonal dimension of the building or area served measured in a straight line between them. Building equipped with an automatic sprinkler system is increased to 1/3 of the length of the max. overall diagonal.

***(C/S)* Section 1020.4: Dead Ends**
Where more than one exit or exit access doorway is required the exit access shall not be located further than 20' from the end of the corridor without sprinklers and 50' with sprinklers.

***(C/S)* Table 1017.2: Exit Access Travel Distance**

Travel distance within *exit access portion* of the means of egress system. Exit access travel distance is measured from the most remote point of each room, area, or space along the natural and unobstructed path of horizontal and vertical egress travel to the entrance to exit.

TABLE 1017.2
EXIT ACCESS TRAVEL DISTANCE[a]

OCCUPANCY	WITHOUT SPRINKLER SYSTEM (feet)	WITH SPRINKLER SYSTEM (feet)
A, E, F-1, M, R, S-1	200[c]	250[b]
I-1	Not Permitted	250[b]
B	200	300[c]
F-2, S-2, U	300	400[c]
H-1	Not Permitted	75[d]
H-2	Not Permitted	100[d]
H-3	Not Permitted	150[d]
H-4	Not Permitted	175[d]
H-5	Not Permitted	200[c]
I-2, I-3	Not Permitted	200[c]
I-4	150	200[c]

For SI: 1 foot = 304.8 mm.

a. See the following sections for modifications to exit access travel distance requirements:
   Section 402.8: For the distance limitation in malls.
   Section 404.9: For the distance limitation through an atrium space.
   Section 407.4: For the distance limitation in Group I-2.
   Sections 408.6.1 and 408.8.1: For the distance limitations in Group I-3.
   Section 411.3: For the distance limitation in special amusement buildings.
   Section 412.6: For the distance limitations in aircraft manufacturing facilities.
   Section 1006.2.2.2: For the distance limitation in refrigeration machinery rooms.
   Section 1006.2.2.3: For the distance limitation in refrigerated rooms and spaces.
   Section 1006.3.3: For buildings with one exit.
   Section 1017.2.2: For increased distance limitation in Groups F-1 and S-1.
   Section 1029.7: For increased limitation in assembly seating.
   Section 3103.4: For temporary structures.
   Section 3104.9: For pedestrian walkways.
b. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where automatic sprinkler systems are permitted in accordance with Section 903.3.1.2.
c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
d. Group H occupancies equipped throughout with an automatic sprinkler system in accordance with Section 903.2.5.1.
e. Group R-3 and R-4 buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.3. See Section 903.2.8 for occupancies where automatic sprinkler systems are permitted in accordance with Section 903.3.1.3.

Example:

'B' Occupancy without Sprinkler System = common path of egress travel distance is 200'

***(C/S)* Table 1006.2.1: Spaces with One Exit or Exit Access Doorway**

This table allows rooms, areas, and spaces to have one exit or doorway when equal to or less than Occupant Load of Space.

TABLE 1006.2.1
SPACES WITH ONE EXIT OR EXIT ACCESS DOORWAY

OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)		
		Without Sprinkler System (feet)		With Sprinkler System (feet)
		Occupant Load		
		OL ≤ 30	OL > 30	
A[c], E, M	49	75	75	75[a]
B	49	100	75	100[a]
F	49	75	75	100[a]
H-1, H-2, H-3	3	NP	NP	25[b]
H-4, H-5	10	NP	NP	75[b]
I-1, I-2[d], I-4	10	NP	NP	75[a]
I-3	10	NP	NP	100[a]
R-1	10	NP	NP	75[a]
R-2	20	NP	NP	125[a]
R-3[e]	20	NP	NP	125[a, g]
R-4[e]	20	NP	NP	125[a, g]
S[f]	29	100	75	100[a]
U	49	100	75	75[a]

Example:

'B' Occupancy without Sprinkler System with 35 Occupants = the maximum common path of egress travel distance is 75'

Table 1017.2 *and* ***Table 1006.2.1*** *are critical to differentiate between each other and integrate into the means of egress system accordingly.*

What Egress Components are Required?

***(C/S)* Table 1020.2: Minimum Corridor Width**
Based on the Occupant Load per room, area, space, or story, the minimum width is determined by calculating the Occupant Load multiplied by either a factor of 0.3 inch for stairways or 0.2 for other egress components but shall not be less than Table 1020.2.

- see **Section 1005.1 Means of Egress Sizing**

TABLE 1020.2
MINIMUM CORRIDOR WIDTH

OCCUPANCY	MINIMUM WIDTH (inches)
Any facility not listed in this table	44
Access to and utilization of mechanical, plumbing or electrical systems or equipment	24
With an occupant load of less than 50	36
Within a *dwelling unit*	36
In Group E with a *corridor* having an occupant load of 100 or more	72
In *corridors* and areas serving stretcher traffic in *ambulatory care facilities*	72
Group I-2 in areas where required for bed movement	96

Example:
'B' Occupancy without Sprinkler System with 35 Occupants = 36 in. Corridor Width

***(C/S/DD)* Section 1020.1: Corridor Construction -** Exceptions to fire- resistance-rated construction
***(S/DD)* Section 1024: Exit Passageway -** Fire- resistance-rated construction
***(S/DD)* Section 1026: Horizontal Exits -** Fire- resistance-rated construction

***(S/DD)* Table 1020.1: Corridor Fire-Resistance-Rating**

TABLE 1020.1
CORRIDOR FIRE-RESISTANCE RATING

OCCUPANCY	OCCUPANT LOAD SERVED BY CORRIDOR	REQUIRED FIRE-RESISTANCE RATING (hours)	
		Without sprinkler system	With sprinkler system[c]
H-1, H-2, H-3	All	Not Permitted	1
H-4, H-5	Greater than 30	Not Permitted	1
A, B, E, F, M, S, U	Greater than 30	1	0
R	Greater than 10	Not Permitted	0.5[c]/1[d]
I-2[a]	All	Not Permitted	0
I-1, I-3	All	Not Permitted	1[b]
I-4	All	1	0

Example:
'B' Occupancy without Sprinkler System with 35 Occupants = 1 Hour Rated Corridor

***(S)* Section 1018: Aisles - m**inimum width requirements
***(C/S)* Section 1023: Interior Exit Stairways and Ramps -** shall be enclosed and terminate at an exit discharge or a public way
***(C/S)* Section 1019: Exit Access Stairways and Ramps - e**xceptions to enclosure
***(C/S)* Section 1028: Exit Discharge - e**xits shall discharge directly to the exterior of the building and provide a direct and unobstructed access to a public way

At this point it's critical to review **Section 1009: Accessible Means of Egress.**

***(C/S)* Section 1009: Accessible Means of Egress**
Accessible spaces shall be provided with not less than one accessible means of egress. Where more than one means of egress is required, not less than two accessible means of egress shall be provided.

The following sections will assist in determining your vertical circulation system.

Does the Project Require an Elevator?

***(C/S)* Section 1009.2.1: Elevators required**
***(C/S)* Section 1104.4: Multistory Buildings and Facilities**
***(DD)* Section 1009.4: Elevators**
***(S/DD)* DOJ 2010 ADA Standards Section 407: Elevators**
***(S)* Section 1009.5: Platform Lifts**
***(S/DD)* Chapter 30: Elevators and Conveying Systems**
***(C/S)* Section 1009.4.2: Area of Refuge** - the elevator shall be accessed from an area of refuge

- see Exceptions

***(C/S)* Section 1009.3.3: Area of Refuge** - stairways shall incorporate an area of refuge within an enlarged floor-level landing or shall be accessed from an area of refuge complying with **Section 1009.6**.

- see Exceptions

***(C/S)* Section 1009.3: Stairways**
***(C/S)* Section 1009.3.2: Stairway Width -** stairways shall have a clear width of 48 inches minimum between handrails

- see Exceptions

***(C/S/DD)* Section 1011: Stairways** - requirements
***(C/S/DD)* DOJ 2010 ADA Standards Section 504: Stairways**

***(C/S/DD)* Section 1012: Ramps** - requirements
***(C/S/DD)* DOJ 2010 ADA Standards Section 405: Ramps**
***(S/DD)* Section 1014: Handrails** - requirements
***(S/DD)* Section 1015: Guards** - requirements

The following sections define a mixture of components which also affect the means of egress system.

***(C/S)* Section 1016.2: Egress through Intervening Spaces**
***(S/DD)* Section 1010: Doors, Gates and Turnstiles**
***(C/S/DD)* DOJ 2010 ADA Standards Section 404: Doors, Doorway, and Gates**
***(S/DD)* Section 1003.2: Ceiling Height**
***(S/DD)* Section 1003.3.1: Headroom**
***(DD)* Section 1111: Signage**

Module 5 - Accessibility: *Access Areas & Requirements*

At this point in our code analysis it's critical to review **Chapter 11: Accessibility**. As you see from above, accessibility requirements have started to influence the design.

Chapter 11: Accessibility - outside & inside of building

- see **Appendix E: Supplementary Accessibility Requirements**

What are the Accessibility Requirements?

Where required, sites, buildings, structures, facilities, elements, and spaces, temporary or permanent, shall be accessible to individuals with disabilities. Accessibility criteria for existing buildings are addressed in the **International Existing Building Code (IEBC)**. **The International Residential Code (IRC)** references this chapter for its accessibility provisions.

- see **DO J 2010 ADA Standards for Accessible Design**

The **California Disabled Accessibility Guidebook (CalDAG)** is a comprehensive, detailed interpretive manual that is useful in clearly understanding accessibility requirements. It contains more than 250 diagrams, which illustrate the requirements.

Chapter 11 is extremely important to study closely and incorporate into your design early. Knowing these requirements and exceptions is vital to programming and space planning.

We'll start at the site property line and move our way inward.

***(C/S)* Section 1104: Accessible Route**
At least one accessible route within the site shall be provided from public transportation stops, accessible parking, accessible passenger loading zones, and public streets and sidewalks to the accessible building entrance served, in addition to mezzanine, accessible elements, and spaces that are on the same site.

DOJ 2010 ADA Standards: Section 402.2
Accessible routes shall have a walking surface with a running slope *not steeper than 1:20 (5%)*, doorways, ramps, curb ramps excluding the flared sides, elevators, and platform lifts. If the running slope exceeds 5%, it must comply with accessibility requirements for ramps. Check with AHJ for minimum route width.

DOJ 2010 ADA Standards: Advisory 206.3 - Location
The accessible route must be in the same area as the general circulation path. This means that circulation paths, such as vehicular ways designed for pedestrian traffic, walks, and unpaved paths that are designed to be routinely used by pedestrians, must be accessible or have an accessible route nearby. Additionally vertical interior circulation must be in the same area as stairs and escalators, not isolated in the back of the facility.

***(C/S)* Section 1104.4: Multistory Buildings and Facilities**
At least one accessible route shall connect each accessible story, mezzanine, and occupied roofs.

- see Exceptions

DOJ 2010 ADA Standards Section 206.2.3: Exception 1
In private multistory buildings or facilities that that *are less than 3 stories high or less than 3,000 sq. ft. per story* an accessible route is not required to connect stories provided the building or facility is not a shopping center, shopping mall, professional office of a health care provider, a terminal, depot or other station used for specified public transportation, an airport passenger terminal. There are other exceptions that apply to residential facilities as well.

***(C/S)* Section 1105: Accessible Entrances**
At least 60% of all public entrances shall be accessible and meet **DOJ 2010 ADA Standards Section 404.**

***(C/S)* Section 1106: Parking and Passenger Loading Facilities** - where parking is provided, accessible parking spaces shall be provided in compliance with **Table 1106**, except as required by **Sections 1106.2** through **1106.4**

- see **DOJ 2010 ADA Standards Section 502** and **503.**

***(C/S)* Section 1106.5: Van Spaces** - for every six or fraction of six accessible spaces, at least one shall be van-accessible parking space
***(C/S)* Section 1106: Location** - accessible parking spaces shall be located on the shortest accessible route of travel from adjacent parking to an accessible building entrance

***(C/S/DD)* Section 1107: Dwelling Units and Sleeping Units** - if applicable
***(C/S)* Table 1107.6.1.1: Accessible Dwelling Units and Sleeping Areas**
***(C/S)* Section 1107.3: Accessible Spaces**

Type A (accessible) Units or Type B (adaptable) Units shall be accessible. Accessible spaces shall include toilet and bathing rooms, kitchen, living and dining areas and any exterior spaces, including patios, terraces and balconies.

- see **DOJ 2010 ADA Standards Section 809** and **ANSI A117.1 Chapter 10: Dwelling Units and Sleeping Units** for specific requirements

***(C/S/DD)* Section 1108: Special Occupancies -** if applicable
***(C/S)* Section 1108.2.9: Dining and Drinking Areas & DOJ 2010 ADA Standards Chapter 10 -** if applicable
***(C/S/DD)* Section 1109: Other Features and Facilities**
This section contains features such as toilet & bathing facilities, water closet compartments, drinking fountains, saunas & steam rooms, seating at tables, counters and work surfaces, dressing, fitting & locker rooms, check-out aisles, point of sale counter, and food service lines.
***(C/S)* Section 1110: Recreational Facilities** - if applicable

Module 6 - Interior Environment: *Systems & Mechanics*

We've looked at the building's frame, envelope, and public circulation systems; now let's look into the interior environment's requirements. Note: LEED criteria is not included.

The Plumbing, Mechanical, Electrical & Fire Protection Systems have a significant impact on the design and notably on construction costs, particularly mechanical systems and fire rated penetrations.

What Systems are Required?

***(C/S)* Table 2902.1: Minimum Number of Required Plumbing Fixtures**
To determine the occupant load of each sex, the total occupant load shall be divided in half.

***(S/DD)* DOJ 2010 ADA Standards Section 213: Toilet Facilities & Bathing Facilities** and **Chapter 6: Plumbing Elements and Facilities**
Specific requirements**.** Where multiple single user toilet, urinals and lavatories units are provided at a single location, at least 5%, but no fewer than one of each type shall comply with Chapter 6.

***(C/S/DD)* Chapter 28: Mechanical Systems**
References **IMC, IFGC, IPMC,** and **IFC**. What type of system is suitable and how will it fit into the design.
***(S/DD)* Section 1202: Ventilation**
***(S/DD)* Section 1206: Sound Transmission**
***(S/DD)* Table 509: Incidental Uses** - mechanical rooms

***(S/DD)* Section 908: Smoke Control Systems**
HVAC: ventilation, exhaust, ducts, plenum, access. Consult with mechanical engineer.
***(S/DD)* Section 709: Smoke Barriers**
***(S/DD)* Section 710: Smoke Partitions**
***(S/DD)* Section 717: Duct and Air Transfer Openings**

***(S/DD)* Chapter 27: Electrical**

References **NFPA 70, IFC,** and **IPMC**. What are the power/ electrical requirements and how will these fit into the design.

- see **Section 1008: Means of Egress Illumination** - Lighting Fixtures, Switching, Outlets

(S/DD) **DOJ 2010 ADA Height Standards** - consult with electrical engineer

- see **IECC**

(S/DD) **Chapter 13: Energy Efficiency** - references **IECC**: Thermal Envelope, Plumbing, Mechanical, Electrical Systems
(S/DD) **Section 1204: Lighting**
(S/DD) **Section 720: Thermal and Sound Insulating Materials**
(S/DD/CD) **COMcheck Software**

Occupancy and Construction Type will determine what Fire Protection Components are required.

(S/DD) **Chapter 9: Fire Protection Systems**
(S/DD) **Section 901.2: Fire Protection Systems -** references **IFC**
(S/DD) **Section 903: Automatic Sprinkler System**
(S/DD) **Table 903.2.11.6: Additional Required Suppression Systems**
(S/DD) **Section 904: Alternate Automatic Fire-Extinguishing Systems**
(S/DD) **Section 903.3.1.1: NFPA 13 Sprinkler System**
(S/DD) **Section 903.3.1.2: NFPA 13R Sprinkler System**
(S/DD) **Section 903.3.1.3: NFPA 13D Sprinkler System**
(S/DD) **Section 905: Standpipe System**
(S/DD) **Section 902: Fire Pump and Riser Room Size**
(S/DD) **Section 913: Fire Pumps**
(S/DD) **Section 912: Fire Department Connections**
(S/DD) **Section 914: Emergency Responder Safety Features**
(S/DD) **Section 906: Portable Fire Extinguishers**

(S/DD) **Section 907: Fire Alarm and Detection Systems**
(S/DD) **Section 915: Carbon Monoxide Detection**
(S/DD) **Section 916: Gas Detection Systems**

Module 7 - Interior Elements: *Fire-Resistant Assemblies*

Review Occupancy Separation.

What Interior Components Require Fire-Resistant Assemblies?

Chapter 7: Fire and Smoke Protection Features provides detailed requirements for fire-resistance-rated construction, including structural members, walls, partitions and horizontal assemblies.

(S/DD) **Section 713: Shaft Enclosure:**
Shaft enclosures shall have a fire-resistance-rating of not less than 2 hours where connecting four stories or more, and not less than 1 hour where connecting less than four stories.

***(C/S/DD)* Section 706.1.1: Party Walls**
Any wall located on an imaginary or real lot line between adjacent buildings, which is used or adapted for joint service between the two buildings, shall be constructed as a fire wall. Fire walls shall be designed and constructed to allow collapse of the structure on either side without the collapse of the other structure.

***(C/S/DD)* Table 706.4: Fire Wall Fire-Resistance Ratings**

TABLE 706.4
FIRE WALL FIRE-RESISTANCE RATINGS

GROUP	FIRE-RESISTANCE RATING (hours)
A, B, E, H-4, I, R-1, R-2, U	3[a]
F-1, H-3[b], H-5, M, S-1	3
H-1, H-2	4[b]
F-2, S-2, R-3, R-4	2

a. In Type II or V construction, walls shall be permitted to have a 2-hour fire-resistance rating.
b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.7 and 415.8.

***(C/S/DD)* Section 707.3.10: Fire Areas**
Fire barriers, fire walls or horizontal assemblies, or combination, separating a single occupancy into different fire areas shall have a fire-resistance rating of not less than that indicated in Table 707.3.10

***(C/S/DD* Table 707.3.10: Fire-Resistance Rating Requirements for Fire-Barriers, Fire Walls or Horizontal Assemblies Between Fire Areas**

TABLE 707.3.10
FIRE-RESISTANCE RATING REQUIREMENTS FOR FIRE BARRIERS, FIRE WALLS OR HORIZONTAL ASSEMBLIES BETWEEN FIRE AREAS

OCCUPANCY GROUP	FIRE-RESISTANCE RATING (hours)
H-1, H-2	4
F-1, H-3, S-1	3
A, B, E, F-2, H-4, H-5, I, M, R, S-2	2
U	1

***(C/S/DD)* Section 708: Fire Partitions** - walls separating specific types of spaces
***(C/S/DD)* Section 712: Vertical Openings**
***(S/DD)* Section 711: Floor and Roof Assemblies**
***(S/DD)* Section 718: Concealed Spaces**
***(DD/CD)* Section 714: Penetrations**
***(DD/CD)* Section 715: Fire-Resistant Joint Systems**
***(DD)* Section 716: Opening Protectives**
***(DD)* Table 716.1(2:) Opening Fire Protection Assemblies, Ratings and Markings**

Below are tables and references that are useful in developing Fire Assembly Details.

***(DD)* Table 721.1(1): Minimum Protection of Structural Parts Based on Time Periods for Various Noncombustible Insulating Materials**
***(DD)* Table 721.1(2): Rated Fire-Resistance Periods for Various Walls & Partitions**
***(DD)* Table 721.1(3): Minimum Protection for Floor and Roof Systems**
***(DD/CD)* UL Listed Fire Resistance Directory** - assembly details
***(DD/CD)* Gypsum Association Fire Resistance & Sound Control Design Manual** - assembly details

Module 8 - Interior Surface: *Materials & Finishes*

Based on the Occupancy and Construction Type, the following table and sections are applicable in specifying the Interior Finishes.

(*S/DD)* Table 803.13: Interior Wall and Ceiling Finish Requirements by Occupancy

TABLE 803.13
INTERIOR WALL AND CEILING FINISH REQUIREMENTS BY OCCUPANCY[k]

GROUP	SPRINKLERED[l]			NONSPRINKLERED		
	Interior exit stairways and ramps and exit passageways[a, b]	Corridors and enclosure for exit access stairways and ramps	Rooms and enclosed spaces[c]	Interior exit stairways and ramps and exit passageways[a, b]	Corridors and enclosure for exit access stairways and ramps	Rooms and enclosed spaces[c]
A-1 & A-2	B	B	C	A	A[d]	B[e]
A-3[f], A-4, A-5	B	B	C	A	A[d]	C
B, E, M, R-1	B	C[m]	C	A	B	C
R-4	B	C	C	A	B	B
F	C	C	C	B	C	C
H	B	B	C[g]	A	A	B
I-1	B	C	C	A	B	B
I-2	B	B	B[h, i]	A	A	B
I-3	A	A[j]	C	A	A	B
I-4	B	B	B[h, i]	A	A	B
R-2	C	C	C	B	B	C
R-3	C	C	C	C	C	C
S	C	C	C	B	B	C
U	No restrictions			No restrictions		

a. Class C interior finish materials shall be permitted for wainscotting or paneling of not more than 1,000 square feet of applied surface area in the grade lobby where applied directly to a noncombustible base or over furring strips applied to a noncombustible base and fireblocked as required by Section 803.15.1.
b. In other than Group I-3 occupancies in buildings less than three stories above grade plane, Class B interior finish for nonsprinklered buildings and Class C interior finish for sprinklered buildings shall be permitted in interior exit stairways and ramps.
c. Requirements for rooms and enclosed spaces shall be based on spaces enclosed by partitions. Where a fire-resistance rating is required for structural elements, the enclosing partitions shall extend from the floor to the ceiling. Partitions that do not comply with this shall be considered to be enclosing spaces and the rooms or spaces on both sides shall be considered to be one room or space. In determining the applicable requirements for rooms and enclosed spaces, the specific occupancy thereof shall be the governing factor regardless of the group classification of the building or structure.
d. Lobby areas in Group A-1, A-2 and A-3 occupancies shall be not less than Class B materials.
e. Class C interior finish materials shall be permitted in places of assembly with an occupant load of 300 persons or less.
f. For places of religious worship, wood used for ornamental purposes, trusses, paneling or chancel furnishing shall be permitted.
g. Class B material is required where the building exceeds two stories.
h. Class C interior finish materials shall be permitted in administrative spaces.
i. Class C interior finish materials shall be permitted in rooms with a capacity of four persons or less.
j. Class B materials shall be permitted as wainscotting extending not more than 48 inches above the finished floor in corridors and exit access stairways and ramps.
k. Finish materials as provided for in other sections of this code.
l. Applies when protected by an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.
m. Corridors in ambulatory care facilities shall be provided with Class A or B materials.

Class A = Flame spread index 0-25; smoke developed index 0-450
Class B = Flame spread index 26-75; smoke developed index 0-450
Class C = Flame spread index 76-200; smoke developed index 0-450

The following sections will assist in determining the interior materials and finish requirements.

***(DD/CD)* Section 803.1.2: Interior Wall and Ceiling Finish Materials**
***(DD/CD)* Section 806: Decorative Materials and Trim**
***(S/DD)* Section 805: Combustible Materials in Types I & II Construction**
***(S/DD)* Section 804: Interior Floor Finish**
***(DD/CD)* Section 1003.4: Slip-Resistant Surface**
***(DD/CD)* Section 1209: Toilet and Bathroom Requirements**
***(DD)* Section 2406: Safety Glazing: Hazardous Locations**

Conclusion

At this point of our code review we've covered significant portions of the IBC, all of which have formational impacts on the development of a design. The designer needs to be assured at each phase of the design process that the required building codes have been accounted for and integrated as a particular phase necessitates. These 125 sections, subsections and tables should be of assistance in this investigation. No doubt, I've excluded sections that might apply to your specific project. *This mapping is not exhaustive; it's a framework for you to add to, subtract from, or shift as you see fit to be useful in your work.* For further inquiry, use the IBC Table of Contents and Index as a reference. Contact your AHJ for clarification as needed.

Code Mapping in Action
I was the architect of record for a multifamily project where we were tasked to design a new R-2 Type VB building on a site containing an existing R-2 Type VB building with residents living within it. Because of the site's physical constraints, the new building had to be located 1" away from the existing structure for the new program to fit into the site. This new condition required a fire wall between the buildings. The existing building was to remain as is with the addition of a new exterior entrance canopy.

I communicated with the Fire Marshal and Building Official intermittingly during the schematic phase to review the scope of the project, to ensure we were accounting for all the state and municipal Life Safety and Fire Prevention Requirements. At that time in the design process, we were in agreement of the required fire separation rating without installing a new automatic sprinkler system into the existing building.

With this understanding we proceeded to design the new building accordingly, incorporating the applicable state and municipal building and fire codes. Specifically, we had specified a NFPA 13D System for the new structure only. During the building permit review process the Fire Marshal changed his position and requested a NFPA 13R System for both buildings. As architect, I agreed that sprinklering the existing building would improve the fire prevention level for the project; however, in this specific circumstance, the additional requirement had numerous impacts on the feasibility of the project.

Here's where submitting an Alternate Materials and Method of Construction to the AHJ was necessary. The AMMC was our only means to make the official case that the additional sprinkler system was not required. We documented the applicable codes that permitted a new building to be located adjacent to an existing independent building without the existing adjacent building required to be sprinklered. The chief Building Official, plan examiner and Fire Marshal reviewed the AMMC and then approved the project without the additional sprinkler requirement. The AHJ approved the design as submitted with minor modifications which did not impact the feasibility of the project.

This was where code mapping, plus code analysis worksheets with code summary drawings, were beneficial to the project success.

For code mapping to be fully effective, I recommend developing your own *code analysis worksheets* to document your code considerations. From these worksheets you can develop *code summary drawings* that clearly illustrate the applicable code requirements have been included in the design drawings. Many AHJ have their own checklist or require similar type of documentation to verify the required codes have been integrated satisfactorily.

Code Documentation: Double check = Triple check = Control $

I hope code mapping has strengthened your creative approach into the IBC and leads to the further success of your projects.

REVIEW QUESTIONS

7. The Occupant Load affects which?

a. Construction Type
b. Floor Area
c. Fire Rating
d. Means of Egress

8. In a building equipped with an automatic sprinkler system the maximum Dead End corridor length is increased from 20 feet to?

a. 40 feet
b. 50 feet
c. 75 feet
d. No increase permitted

9. Chapter 5 includes codes affecting which building component?

a. Types of Construction
b. General Building Heights and Areas
c. Means of Egress

d. Use and Occupancy Classification

10. Which 2 documents ensure applicable codes have been accounted for?

a. AMMC, COMcheck
b. Construction Drawings, Specifications
c. Building Permit Application, I-Codes
d. Code Analysis Worksheets, Code Summary Drawings

About the Author

Tuvia Poliskin, AIA, LEED AP BD+C, PSM, is the principal of T2 Design + Architecture, with over 30 years' experience in project types ranging from multi-family housing, food service, retail, work environments, health clubs, mix-use occupancies, and renovation of landmark buildings. Tuvia has also been an instructor at UC Berkeley and Bellevue College, where he taught courses in Principles & Elements of Design, Building Components & Systems, Building Codes, and Professional Business Practice. He is a licensed practicing architect in Washington, California, and Indiana.

Appendix

1) Code Analysis Worksheet

Example: this is 1 of 12 Worksheets.

CODE ANALYSIS WORKSHEETS

2018 IBC EDITION

SECTION 2 – BUILDING CONSTRUCTION					
List Construction Type(s) used in the design (IA, IIIB, VA, etc.):					
			Allowed	Purposed	
Building Height (per IBC Table 504.3)					
Number of Stories (per IBC Table 504.4)					
Floor Area (per IBC Table 506.2)					
Are Automatic Sprinklers used for Height Modifications? (per IBC Section 504)				YES	NO
Is there a basement?	YES	NO	**If YES, List square footage of basement and grade elevations on CS sheets.**		

BUILDING HEIGHTS AND AREAS

USE GROUP	TYPE	A or B	(A) BLDG AREA PER STORY (ACTUAL)	(B) ALLOWABLE AREA Table 506.2	(C) AREA FOR SPRINKLER INCREASE	(D) AREA FOR FRONTAGE INCREASE	(E) ALLOWABLE AREA OR UNLIMITED	(F) MAX. STORIES

1. Type equals Construction Type
2. If there are multiple construction types, or if a fire wall divides the building, provide a separate analysi for each area. Repeat as necessary.

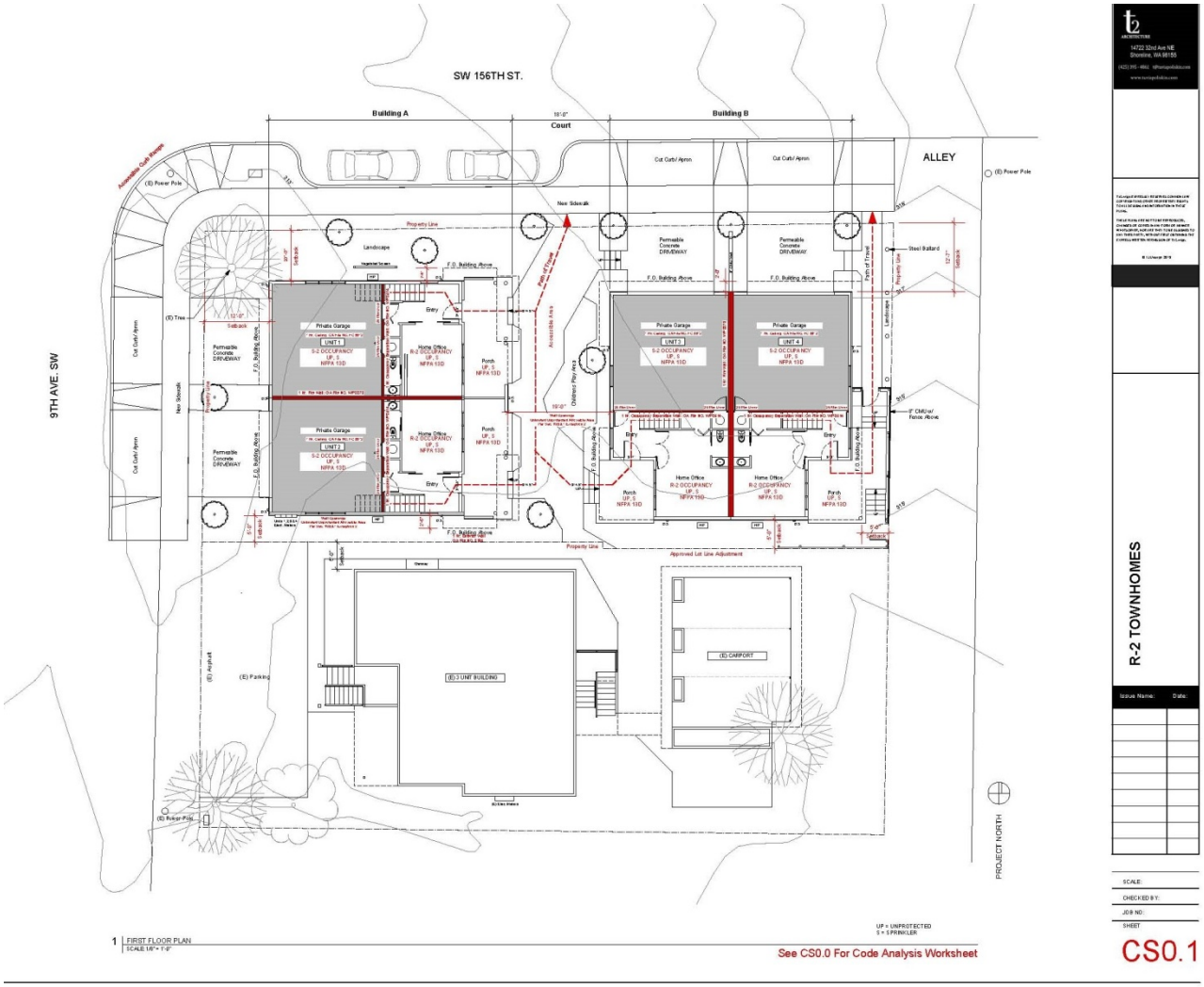
Area Limitations for Each ProposedIBC Use or Occupancy Group	Occupancy - 1	Occupancy - 2	Occupancy - 3	Occupancy - 1
IBC Use / Occupancy Group IBC Chapter 3 and 4				
Type of Construction (IBC Table 601)				
Fire sprinkler system design type (IBC 903.3) NFPA 13, 13R, 13D, None				
Allowable Building Height in feet above grade plane. (IBC Table 504.3)				
Fire sprinkler Factor (IBC Table 504.4 footnote) NS, S, S13				
Allowable Number of Stories above grade plane. (IBC Table 504.4)				
Fire sprinkler Factor (IBC Table 506.2 footnote) NS, S1, SM				
Allowable Area in Square Feet (IBC Table 506.2)				

2) Code Summary Drawing

Example: this is 1 of 5 Code Summary Drawings.

Includes the minimum depending on scope of work:

- Occupancy Group
- Occupancy Separations
- Construction Type
- Fire Rated Walls & Floor/Ceilings
- Sprinkler System
- Exterior Walls Separation Distance
- Exterior Wall Openings
- Means of Egress Path of Travel
- Accessibility



1 FIRST FLOOR PLAN
SCALE 1/8" = 1'-0"

UP = UNPROTECTED
S = SPRINKLER

See CS0.0 For Code Analysis Worksheet

Works Cited

1. 2018 International Building Code
2. 2010 Department of Justice ADA Standards
3. ANSI A117.1 (2009)
4. 2020 CalDAG
5. International Code Council
6. WoodWorks Wood Products Council
7. The Value and Impact of Building Codes 2013; Environmental and Energy Study Institute
8. A History of the California Seismic Safety Commission 2000; California Senate Office of Research
9. Whole Building Design Guide 2016; National Institute of Building Sciences

IBC Code Mapping for Architects
Review Questions Key

1. The first set of I-Codes were published in what year?

   a. 1992
   b. 1994
   c. 2000
   d. 2018

   a. 1992
   incorrect - the correct answer is 2000. The Energy Policy Act of 1992 required all states to review and consider adopting the National Model Energy Standard.

   b. 1994
   incorrect - the correct answer is 2000. The Northridge Earthquake occurred in 1994.

   c. 2000
   correct - the first set of I-Codes were published in 2000, and included the IRC and IBC.

   d. 2018
   incorrect - the correct answer is 2000. The most recent IBC Edition is 2018.

2. The IBC is 1 of how many ICC code books?

   a. 9
   b. 14
   c. 20
   d. 15

   a. 9
   incorrect - the correct answer is the International Building Code is 1 of 15 ICC Code Books.

   b. 14
   incorrect - the correct answer is the International Building Code is 1 of 15 ICC Code Books.

   c. 20
   incorrect - the correct answer is the International Building Code is 1 of 15 ICC Code Books.

   d. 15
   correct - the International Building Code is 1 of 15 ICC Code Books.

3. What is the acronym AHJ?

   a. Accessible Housing Journal

b. Advocate Health Justice
c. Authority Having Jurisdiction
d. Alternative Healing Jargon

a. Accessible Housing Journal
incorrect - the correct answer is Authority Having Jurisdiction which regulates building permits.

b. Advocate Health Justice
incorrect - the correct answer is Authority Having Jurisdiction which regulates building permits.

c. Authority Having Jurisdiction
correct - AHJ stands forAuthority Having Jurisdiction which regulates building permits.

d. Alternative Healing Jargon
incorrect - the correct answer is Authority Having Jurisdiction which regulates building permits.

4. Group H defines what use?

a. Healthcare
b. Hospitality
c. High Hazard
d. Housing

a. Healthcare
incorrect - the correct answer is High-Hazard which is defined in Chapter 3: Use and Classification.

b. Hospitality
incorrect - the correct answer is High-Hazard which is defined in Chapter 3: Use and Classification.

c. High Hazard
correct - Group H is High Hazard which is defined in Chapter 3: Use and Occupancy Classification.

d. Housing
incorrect - the correct answer is High-Hazard which is defined in Chapter 3: Use and Classification.

5. What Construction Type allows for building elements to be constructed from any material permitted?

a. Type l
b. Type III
c. Type IV
d. Type V

a. Type l
incorrect - the correct answer is Type V Construction. Type l only permits noncombustible materials, except as permitted in Section 603 (Combustible Material in Type I and II Construction) and elsewhere in the code.

b. Type III
incorrect - the correct answer is Type V Construction. Type III is a construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by the code.

c. Type IV
incorrect - the correct answer is Type V Construction. Type IV is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of large-section sawn lumber (HT), structural composite lumber (SCL), glued laminated timber (GLT) and cross- laminated timber (CLT) without concealed spaces.

d. Type V
correct - Type V Construction permits building elements to be constructed from wood, masonry, concrete and/or steel.

6. Which automatic sprinkler system is permitted for R-Occupancies up to 4 stories?

a. NFPA 13
b. NFPA 13R
c. NFPA 13D
d. NFPA 13 & NFPA 13R

a. NFPA 13
incorrect - the correct answer is NFPA 13 & NFPA 13R. Either NFPA 13 or 13R are permitted. NFPA 13 protects the property and life safety while NFPA 13R only protects life safety.

b. NFPA 13R
incorrect - the correct answer is NFPA 13 & NFPA 13R. Either NFPA 13 or 13R are permitted. NFPA 13 protects the property and life safety while NFPA 13R only protects life safety.

c. NFPA 13D
incorrect - the correct answer is NFPA 13 & NFPA 13R. NFPA 13D is only permitted in one & two-family, or Group R-3 & R-4 Condition 1 and townhome R-occupancies.

d. NFPA 13 & NFPA 13R
correct - either NFPA 13 or 13R are permitted. NFPA 13 protects the property and life safety while NFPA 13R only protects life safety.

7. The Occupant Load affects which?

a. Construction Type
b. Floor Area
c. Fire Rating
d. Means of Egress

a. Construction Type
incorrect - the correct answer is Means of Egress. Construction Type is affected by occupancy classification, with or without sprinkler system, height, stories and floor area.

b. Floor Area
incorrect - the correct answer is Means of Egress. Floor Area is affected by occupancy classification, with or without sprinkler system.

c. Fire Rating
incorrect - the correct answer is Means of Egress. Fire Rating is affected by occupancy classification and construction type.

d. Means of Egress
correct - the Occupant Load affects the number of exits, corridor fire-resistance rating, width of corridor, stairs and other egress components.

8. In a building equipped with an automatic sprinkler system the maximum Dead End corridor length is increased from 20 feet to?

a. 40 feet
b. 50 feet
c. 75 feet
d. No increase permitted

a. 40 feet
incorrect - the correct answer is 50 feet. The length could be increased to 40 feet as this length is within the 50 feet maximum, but 50 feet is a more accurate answer.

b. 50 feet
correct - where more than one exit or exit access doorway is required the exit access shall not be located further than 20' from the end of the corridor without sprinklers and 50' with sprinklers per Section 1020.4 exception 2.

c. 75 feet
incorrect - the correct answer is 50 feet. 75 feet exceeds the maximum distance; however, per Section 1020.4 exception 3, a dead-end corridor shall not be limited in length if the length of the dead-end corridor is less than 2.5 times the least width of the dead-end corridor.

d. No increase permitted

incorrect - the correct answer is 50 feet. Per Section 1020.4 exceptions 1,2 & 3 the dead-end corridor length is permitted to be increased.

9. Chapter 5 includes codes affecting which building component?

a. Types of Construction
b. General Building Heights and Areas
c. Means of Egress
d. Use and Occupancy Classification

a. Type of Construction
incorrect - the correct answer is General Building Heights and Areas. Chapter 6 provides the criteria of types of construction.

b. General Building Heights and Areas
correct - the correct answer is General Building Heights and Areas.

c. Means of Egress
incorrect - the correct answer is General Building Heights and Areas. Chapter 10 provides the criteria for the means of egress.

c. Use and Occupancy
incorrect - the correct answer is General Building Heights and Areas. Chapter 3 provides the criteria for use and occupancy.

10. Which 2 documents ensure applicable codes have been accounted for?

a. AMMC, COMcheck
b. Construction Drawings, Specifications
c. Building Permit Application, I-Codes
d. Code Analysis Worksheets, Code Summary Drawings

a. AMMC, COMcheck
incorrect - the correct answer is Code Analysis Worksheets, Code Summary Drawings. AMMC applies to a specific condition and COMcheck verifies the building's energy code compliance.

b. Construction Drawings, Specifications
incorrect - the correct answer is Code Analysis Worksheets, Code Summary Drawings. Construction Drawings and Specifications are instructions of what to build.

c. Building Permit Application, I-Codes
incorrect - the correct answer is Code Analysis Worksheets, Code Summary Drawings. Building Permit Application is for permission to build from the AHJ and I-Codes are the model codes that the AHJ uses to review the drawings and supporting documents.

d. Code Analysis Worksheets, Code Summary Drawings

correct - these documents ensure that the applicable codes have been accounted for and incorporated into the design, drawings and specifications.