

Applying the Building Code During Design

A Step-By-Step Process




AIA Learning Units

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Learning Objectives

- Improve understanding of the building code
- Learn essential information on code language, format, and definitions
- Learn how code compliance is applied at all phases of design, from schematic design to construction documents
- Learn standard step-by-step process for code analysis, applicable to any project.

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Code Application Process

Applying the building code during design is very similar to travel planning:



- There are many ways to get from Point A to Point B

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Code Application Process

Applying the building code during design is slightly different than applying the building code during jurisdictional plan review.

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Code Application Process

Plan Review: Determines compliance of completed design.

- Based on drawings and information provided.
- The result is either pass (get permit) or fail (corrections).

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Code Application Process

Design Process: Selects best solution to a design problem – “Code Compliance Strategy.”

- Minimal information available.
- There are many options that affect design and code application: materials, cost, room layout, etc.

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Finding Information

- The key to using the code is knowing where the information is located.
 - Be familiar with the chapter arrangement
 - Be familiar with the contents of each chapter
- Don't try to memorize.
 - Can lead to errors
 - May be affected by exceptions or special requirements

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Things To Look Out For

- The words “and” and “or”
- The words “shall” and “should”
- The words “shall be permitted”
- The words “shall be allowed”
- Read the exceptions
- Read the footnotes

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Know Your Definitions

- What you may think is the correct definition, may be completely different than how the code defines it.
 - Approved:
 - IBC: Acceptable to the building official.
 - Dictionary: To confirm officially; ratify.
- Definitions are found in Chapter 2.
- Some terms are referenced to other sections for definitions.

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Step-by-Step Process

- **Schematic Design** – 12 steps
 - Some steps can be started in programming if part of architect's services
- **Design Development** – 8 steps
- **Construction Documents** – 7 steps

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A Step-by-Step Process

SCHEMATIC DESIGN

Schematic Design

Step 1: Determine the applicable building code and obtain any local amendments.



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Schematic Design

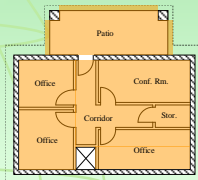
Step 2: Obtain essential building data:

- Building Area:
 - By floor
 - Overall building
- Building Height:
 - In stories
 - In feet
- Sprinklered: Yes or no?
- Construction Materials

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Building Area

The area included within surrounding exterior walls (or exterior walls and fire walls) exclusive of vent shafts and courts. Areas of the building not provided with surrounding walls shall be included in the building area if such areas are included within the horizontal projection of the roof or floor above.



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Building & Story Height

BUILDING HEIGHT: The vertical distance from grade plane to the average height of the highest roof surface.

STORY HEIGHT: The vertical distance from the top of two successive finished floor surfaces; and, for the topmost story, from the top of the floor finish to the top of the ceiling joists or, where there is not a ceiling, to the top of the roof rafters.

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Schematic Design

Step 3: Determine building's occupancy group or groups.



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Schematic Design

Step 4: Determine construction type based on anticipated construction materials.



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Schematic Design

Step 5: Determine how mixed uses and occupancies will be handled.

- Incidental Uses
- Accessory Occupancies
- Nonseparated Occupancies
- Separated Occupancies

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Incidental Uses

- Incidental to main occupancy.
- Separated and protected in accordance with Table 508.2.
- Classified in accordance with main occupancy.

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Incidental Use Areas Table 508.2*

Rooms or Areas	Separation**
Furnace room where any piece of equipment is over 400,000 Btu per hour input.	1 hour or provide automatic fire-extinguishing system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower	1 hour or provide automatic fire-extinguishing system
Laboratories and vocational shops, not classified as Group H, located in Group E and I-2 occupancies	1 hour or provide automatic fire-extinguishing system
Laundry rooms over 100 square feet	1 hour or provide automatic fire-extinguishing system
Storage rooms over 100 square feet	1 hour or provide automatic fire-extinguishing system
Parking garage (Section 406.2)	2 hours; or 1 hour and provide automatic fire-extinguishing system

* This is a partial table

** Separation is in the form of a fire barrier

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Accessory Occupancies

- Classified by the applicable occupancy.
- Fire barrier not required for uses occupying not more than 10% of the area of any floor, nor more than tabulated values for height or area for such use.
- Example: A & B occupancies
 - 2-hour (NS) or 1-hour (S) separation per Table 508.3.3
 - Group A area < 10% of floor area, therefore no separation required.

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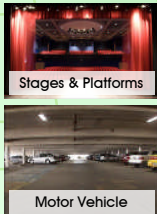
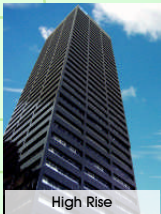
Nonseparated vs. Separated Occupancies

- Nonseparated Uses (§508.3.2): Most restrictive of all area, height, fire sprinkler, and construction types shall apply to the entire building.
- Separated Uses (§508.3.3):
 - Each space classified and separated by a fire barrier in accordance with Table 508.3.3.
 - Sum of the ratios of actual floor area to allowable floor area for each use shall not exceed 1.

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Schematic Design

Step 6: Determine if any special use and occupancy requirements apply.



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Special Use & Occupancies Chapter 4

- Chapter covers the following:
 - Covered mall buildings
 - High-rise buildings
 - Atriums
 - Underground buildings
 - Motor-vehicle-related occupancies
 - Private garages and carports
 - Open & enclosed parking garages
 - Motor fuel-dispensing facilities
 - Repair garages
 - Groups I-2 and I-3
 - Motion picture projection rooms

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Special Use & Occupancies Chapter 4

- Chapter covers the following:
 - Stages and platforms
 - Special amusement buildings
 - Aircraft-related occupancies
 - Combustible storage
 - Hazardous materials
 - Group H
 - Application of flammable finishes
 - Drying rooms
 - Organic coatings
 - Group I-1, R-1, R-2, and R-3 separations

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High-Rise Buildings Section 403

- Applies to buildings having occupied floors located more than 75 feet above the lowest level of fire department access.
- Exceptions: Section does not apply to:
 - Open parking garages
 - Buildings with an occupancy in Group A-5

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High-Rise Buildings Section 403

If greater than 75 feet, then it's a high-rise

Lowest fire department access

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Atriums Section 404

- Don't start with this section; start with exceptions to Section 707.2 for shaft enclosures.
- Vertical openings meeting the requirements of this section need not be enclosed as shafts.
- Enclosure: 1-hour fire barrier or horizontal assembly.
 - Exception 1: Glass wall with sprinklers.
 - Exception 2: Glass block having a ¾-hour rating.
 - Exception 3: Up to 3 floors are not required to have the separation.

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Schematic Design

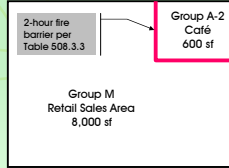
Step 7: Determine allowable area and height.

- Dependent on separation of occupancies.
- Tabulated areas and heights from Table 503.
- Application of increases.

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Separated Occupancies

- Example:
 - A Group M retail with a Group A-2 café.
 - Construction Type: VB
 - Table 503:
 - M: 9,000 sf / 1 story
 - A-2: 6,000 sf / 1 story
 - Sprinkler, Fire Area is:
 - M: >12,000 sf
 - A-2 >5,000 sf
 - Area:

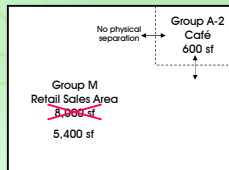


$$\sum \left[\frac{A_{\text{act}}^1}{A_{\text{allow}}^1} + \frac{A_{\text{act}}^2}{A_{\text{allow}}^2} + \dots + \frac{A_{\text{act}}^n}{A_{\text{allow}}^n} \right] \leq 1 \therefore \frac{8,000 \text{ sf}}{9,000 \text{ sf}} + \frac{600 \text{ sf}}{6,000 \text{ sf}} = 0.89 + 0.1 = 0.99 \leq 1 \therefore \text{OK}$$

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Nonseparated Occupancies

- Example:
 - A Group M retail with a Group A-2 café.
 - Construction Type: VB
 - Table 503:
 - M: 9,000 sf / 1 story
 - A-2: 6,000 sf / 1 story
 - Sprinkler, Fire Area is:
 - M: >12,000 sf
 - A-2 >5,000 sf
 - Group A-2 will govern for area and sprinkler requirements.



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Code Compliance Options

What do you do if the design exceeds the allowable area, allowable height, or both?

- Change to a higher construction type.
- Break up building into smaller "buildings" using fire walls.
- Maximize increases:
 - Add sprinklers if not already provided.
 - Increase fire separation distance to increase frontage
- Determine if building is applicable as an "unlimited area building" per Section 507.

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Schematic Design

Step 8: Calculate occupant load.

- Based on preliminary floor areas.
- Readdress and refine as design develops.
- Used to determine:
 - Number of exits
 - Exit width
 - Fixture counts

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Schematic Design

Step 9: Establish points of exit.

- Number of exits based on occupant load.
- At least two exits separated by 1/2 the overall diagonal of the area served (1/3 the diagonal if sprinklered).
- Minimum 2 exits per floor.
 - Buildings may have 1 exit if Section 1019.2 is applicable

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Schematic Design

Separation of Exits

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Schematic Design

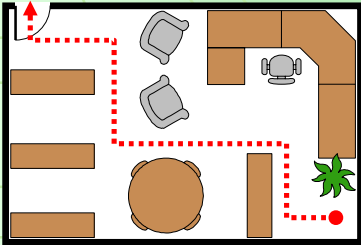
Step 10: Check egress pathways for the following:

- Travel distances
- Common path of egress travel
- Dead-end corridors
- Accessible routes and egress

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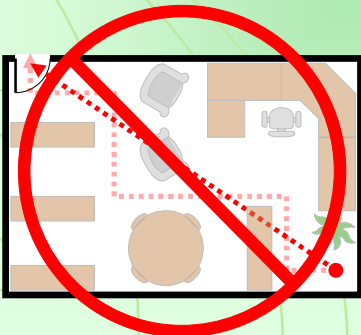
Travel Distance

Most remote point to the entrance of an exit along the natural unobstructed path.

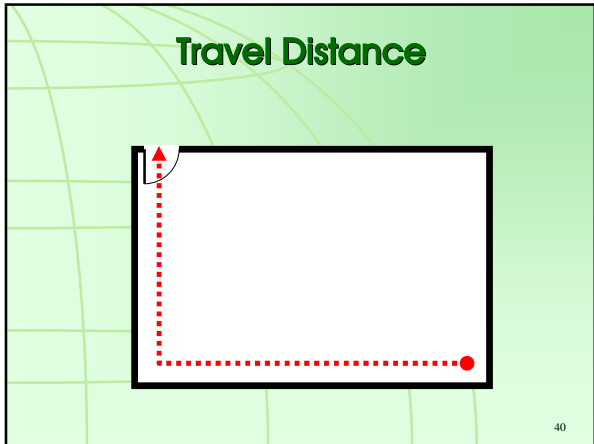


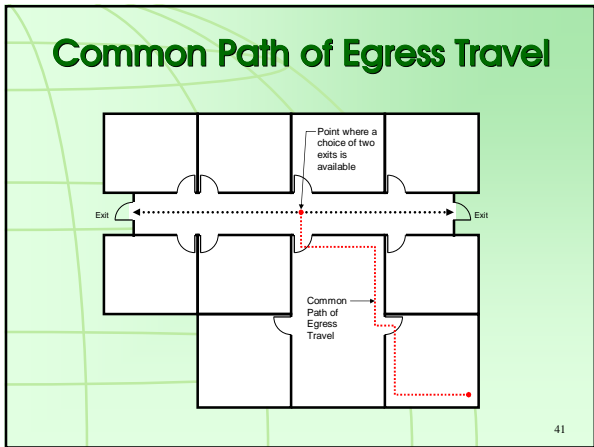
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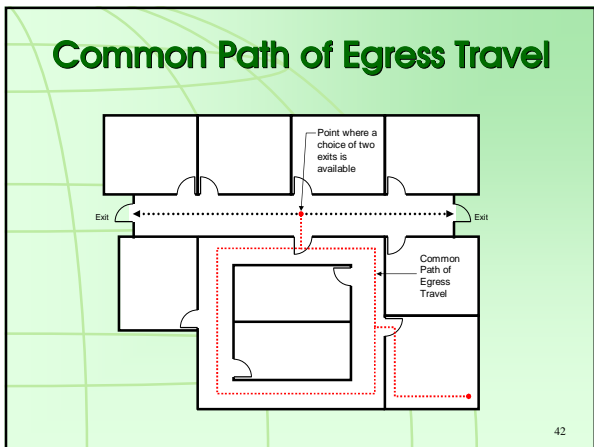
Travel Distance



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Schematic Design

Step 11: Determine fixture counts.

- Based on occupant load calculated in Step 8.
- Broken down by occupancy.

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Fixture Count

- A-1: 1,200 occupants = 600 M / 600 F
- B: 76 occupants = 38 M / 38 F
- M: 100 occupants = 50 M / 50 F

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Fixture Count

- A-1: 1,200 occupants = 600 M / 600 F
- Male W/C = $600 \div 125 = 4.8$
- Female W/C = $600 \div 65 = 9.2$
- Male Lavs = $600 \div 200 = 3$
- Female Lavs = $600 \div 200 = 3$

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Fixture Count

• B: 76 occupants = 38 M / 38 F

Male W/C = 1 for first 25; $13 \div 50 = 0.26$

Total = $1 + 0.26 = 1.26$

Female W/C = 1 for first 25; $13 \div 50 = 0.26$

Total = $1 + 0.26 = 1.26$

Male Lavs = $38 \div 40 = 0.95$

Female Lavs = $38 \div 40 = 0.95$

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Fixture Count

• M: 100 occupants = 50 M / 50 F

Male W/C = $50 \div 500 = 0.10$

Female W/C = $50 \div 500 = 0.10$

Male Lavs = $50 \div 750 = 0.07$

Female Lavs = $50 \div 750 = 0.07$

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Fixture Count

• Male W/C = $4.8 + 1.26 + 0.10 = 6.16$

Provide 7 water closets Substitute 3 W/Cs for urinals

• Female W/C = $9.2 + 1.26 + 0.10 = 10.56$

Provide 11 water closets

• Male Lavs = $3 + 0.95 + 0.07 = 4.02$

Provide 5 lavatories

• Female Lavs = $3 + 0.95 + 0.07 = 4.02$

Provide 5 lavatories

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Schematic Design

Step 12: Identify fire department access roads.

- IFC Section 503.
- Shall extend to within 150 ft. of all portions of the exterior walls of the first story.
- Minimum 20 ft. wide.
- Minimum 13'-6" vertical clearance.

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A Step-by-Step Process

DESIGN DEVELOPMENT

Design Development

Step 13: Confirm Steps 2 through 12.



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Design Development

Step 14: Identify locations of fire-resistive assemblies and openings in accordance with Chapter 7.

- Fire walls
- Fire barriers
- Fire partitions
- Smoke barriers
- Horizontal assemblies

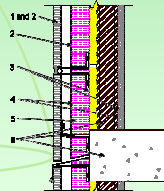


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Design Development

Step 15: Develop exterior wall assemblies complying with Chapters 7 and 14.

- Fire-rated exterior walls
- Opening protection
- Water-resistive barrier
- Wall coverings

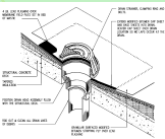


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Design Development

Step 16: Develop roof assemblies complying with Chapter 15.

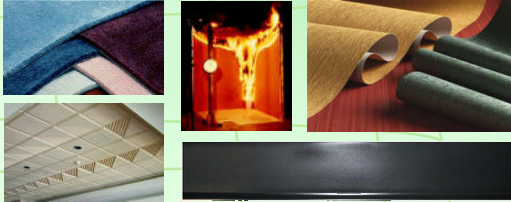
- Roof slope
- Drainage
- Roofing materials
- Fire classification
- Thermal barrier for foam insulation if not test with roof covering



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Design Development

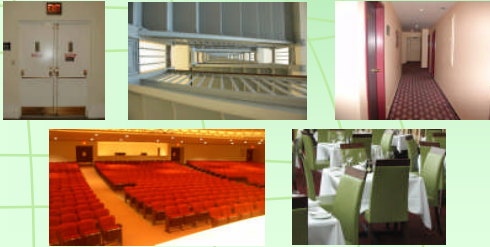
Step 17: Select finishes complying with Chapter 8.



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Design Development

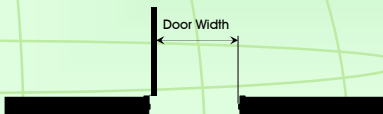
Step 18: Check egress widths.



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Door Width

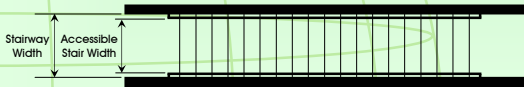
- 0.15 inch per occupant w/ sprinkler
- 0.2 inch per occupant w/o sprinkler
- 32-in. min. door width =
 - 213 occupants w/ sprinkler
 - 160 occupants w/o sprinkler
- A 36-in. door is actually about 34 inches



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Stair Width

- 0.2 inch per occupant w/ sprinkler
- 0.3 inch per occupant w/o sprinkler
- 44-in. min. stair width =
 - 220 occupants w/ sprinkler
 - 146 occupants w/ sprinkler
- 48-in. min. clear for accessible stair width

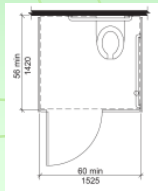
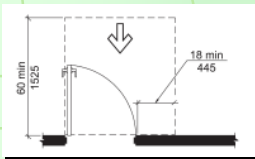


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Design Development

Step 19: Check accessibility requirements.

- Clearances.
- Toilet compartment dimensions.



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Design Development

Step 20: Integrate special requirements.


- Floor and wall sound transmission for residential occupancies.
- Stage and platform requirements.
- Assembly seating requirements.
- Energy efficiency requirements.

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A Step-by-Step Process
CONSTRUCTION DOCUMENTS

Construction Documents

Step 21: Confirm Steps 2 through 20.



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Construction Documents

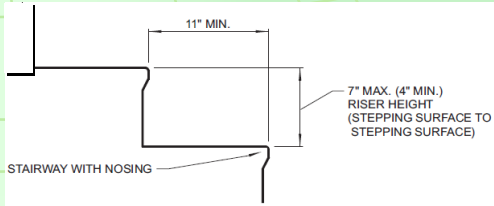
Step 22: Integrate egress details.

- Door swings.
 - OL >49: Swing in direction of travel.
- Riser and tread dimensions.
- Handrail and guard heights.

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Riser & Tread Dimensions

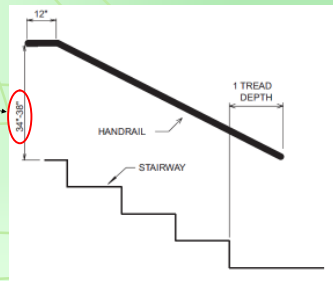
- Tolerance: $\frac{3}{8}$ between smallest and largest.



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Handrail Heights

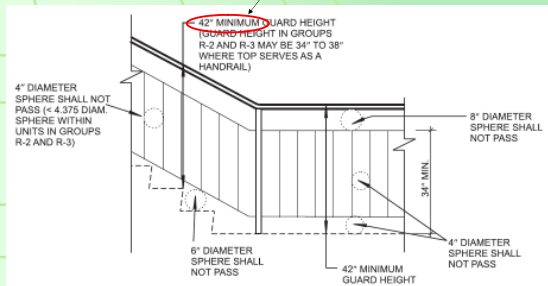
Recommend using 36" to give a +/- 2" tolerance



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Guard Heights

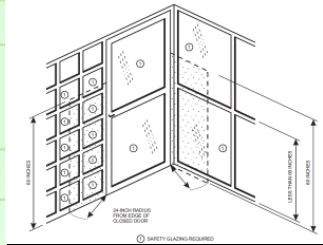
Recommend 42 1/2" to adjust for floor finishes



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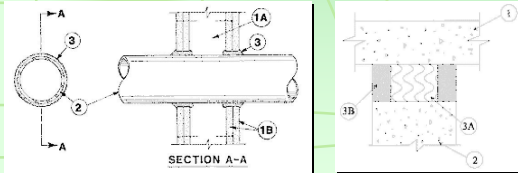
Construction Documents

Step 23: Identify locations of safety glazing.



Construction Documents

Step 24: Detail firestopping and fire-resistant joints.



Construction Documents

Step 25: Locate portable fire extinguishers and cabinets IAW IFC Section 906.



Fire Extinguisher Locations

- Use “Ordinary” hazard unless “Light” or “Extra” hazard is confirmed.
- Minimum is a 2-A rating.
- Area Per Unit “A”: 1,500 sq. ft.
- Max. Area Per Extinguisher: 11,250 sq. ft.
- Max. Travel Distance: 75 feet
- Locations:
 - Along normal path of travel.
 - Unobstructed and unobscured

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Construction Documents

Step 27: Detail construction specific to building materials.

- Concrete
- Masonry
- Steel
- Wood

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This concludes
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Questions?

Contact Information



Ronald L. Geren, AIA, CSI, CCS, CCCA, SCIP
e: ron@specsandcodes.com
p: (602) 569-9645

www.specsandcodes.com

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