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WOOD PRODUCTS COUNCIL



Taking the Guesswork out of Mixed-Use Building Analysis

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> Course Description

While mixed-use buildings—which combine multiple occupancy types and/or functions in a single structure—are common, determining how to apply their unique mix of code requirements can be a daunting task. To simplify code analysis associated with these buildings, this presentation covers logical, code-compliant steps for a number of topics, including determining allowable building size, separation needs, detailing requirements, and the application of special provisions. With an emphasis on the use of wood framing in Construction Types III, IV and V, examples, calculations, and details will be presented to demonstrate how to navigate the various code requirements associated with mixed-use buildings while maximizing building size and meeting fire and life safety needs.



➤ Learning Objectives

1. Review the basic fire and life safety requirements associated with mixed-use, wood-frame structures.
2. Become familiar with the differences between Construction Types III, IV and V as defined by the International Building Code.
3. Highlight options for determining allowable building size of mixed-use facilities, including separated and non-separated occupancies, incidental uses and podiums.
4. Demonstrate how to achieve separation of occupancies with fire barriers, fire walls and horizontal assemblies.



FIRE AND LIFE SAFETY

IBC



THE BUILDING CODE:

- **CONTROLS BUILDING SIZE**
- **REGULATES TYPE OF MATERIALS USED**
- **STIPULATES FIRE RESISTANCE**

FIRE AND LIFE SAFETY

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BUILDING CODE

In early years of building code development, main purpose was to provide a reasonable level of **protection to property** from fire.

Concept was that if property was adequately protected from fire, occupants would also be protected.

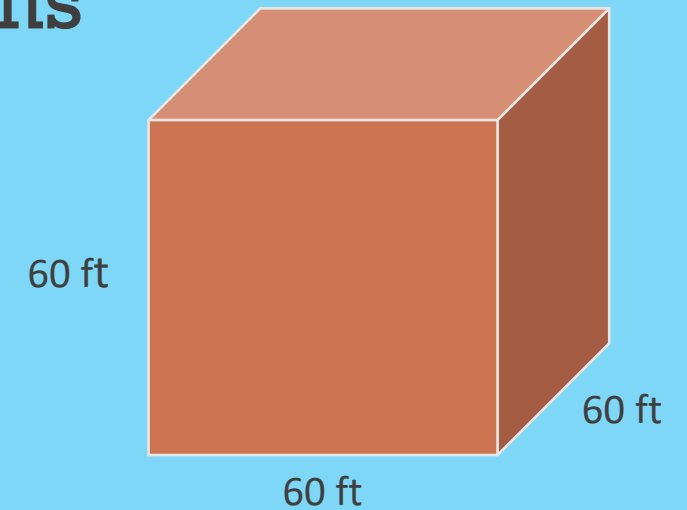
HISTORICAL LIMITATIONS

Many of the current building size limits are based on historical fire department access limitations

1050. What is practically the highest maximum to which water can be thrown with effect by a steam engine?—That is a question which very seldom arises with us, but it can be thrown to 80 or 90 feet, although not with good effect.

1051. What is the extreme height to which fire escapes and ladders can be reasonably carried for the protection of life and the saving of life?—About 50 feet.

1120. What limit, according to you, would be a fair and safe limit to impose?—I should say that the limit applied in Liverpool is about the best for this country; 60 to 65 feet.



With a well organized and properly equipped fire brigade it is found that sixty feet is the greatest height at which a building can be quickly protected, and that the cube of 60, or 216,000 cubic feet, is the largest cubical capacity which can be protected with reasonable hope of success after a fire has once come to a head.

SOURCES:

E.M. SHAW, FIRE SURVEYS 1872: E. WILSON

GREAT BRITAIN. PARLIAMENT. HOUSE OF COMMONS, REPORTS
FROM COMMITTEES. 1874.

FIRE AND LIFE SAFETY

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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

FIRE AND LIFE SAFETY

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From this outlook on property fire safety, concept of equivalent risk evolved in the code.

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}	3	2	1	0	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions	See Table 602								
Exterior									
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 ^h	1 ^{b, c}	1 ^{b, c}	0 ^c	1 ^{b, c}	0	HT	1 ^{b, c}	0

BUILDING CODE

Equivalent risk associates an acceptable level of risk against the damages of fire respective to a particular occupancy group by limiting building size according to construction type

FIRE AND LIFE SAFETY

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As a result of extensive research and advancements in fire technology, today's building codes are **more comprehensive and complex**



BUILDING CODE

While the principle of equivalent risk remains an important component in the codes for protecting the building, perspectives have changed and life safety is now the paramount fire issue.

BUT...

**THE CODE STILL ALLOWS FLEXIBILITY IN BUILDING DESIGN, CONFIGURATION,
CONSTRUCTION TYPE, MATERIALS AND OTHER CHOICES**



BUILDING OPTIONS

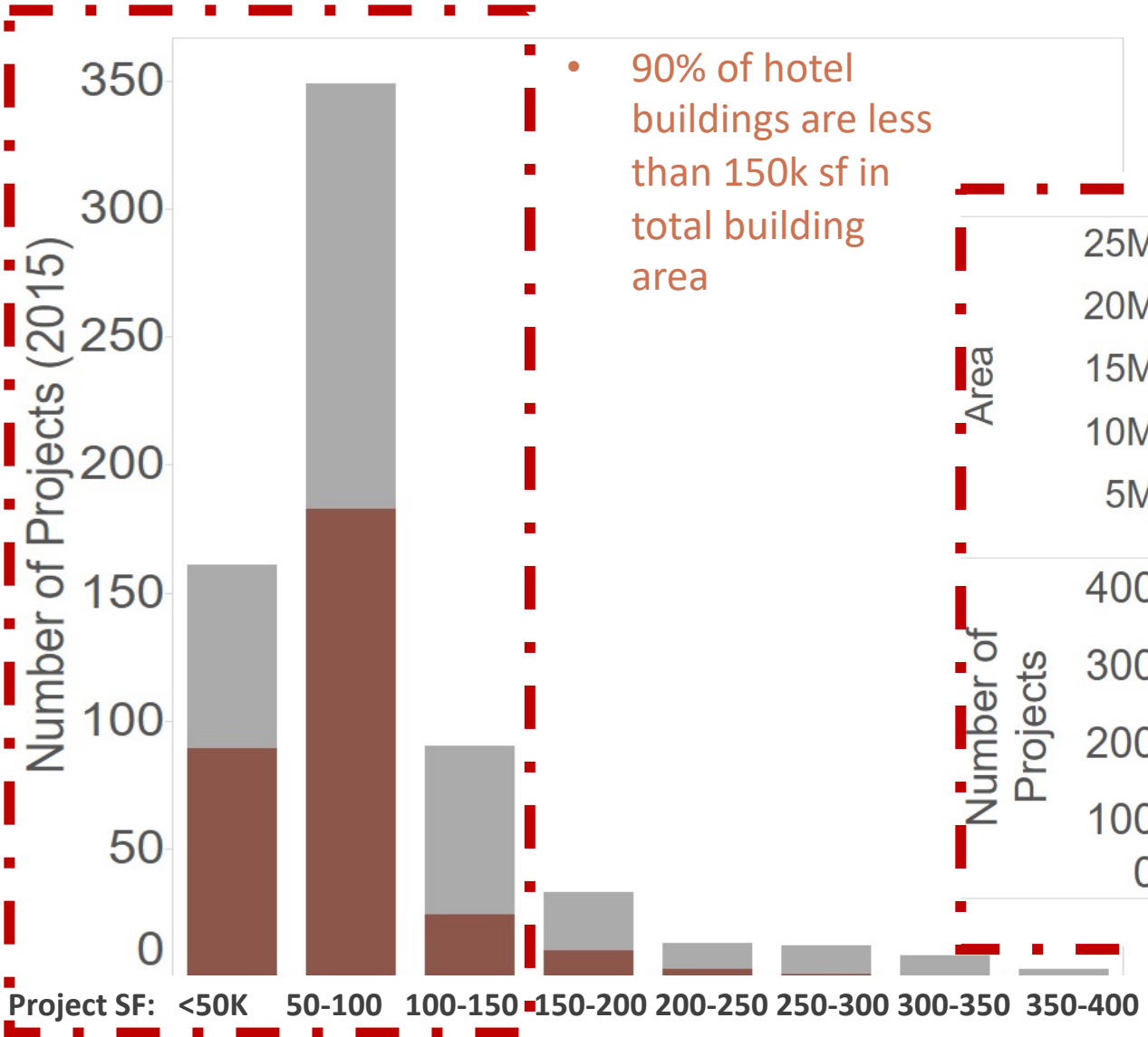
National market data indicates that many commercial occupancies including hotels, multi-family, office, retail and

restaurants can be framed with wood, including in mixed-use applications, when considering building size

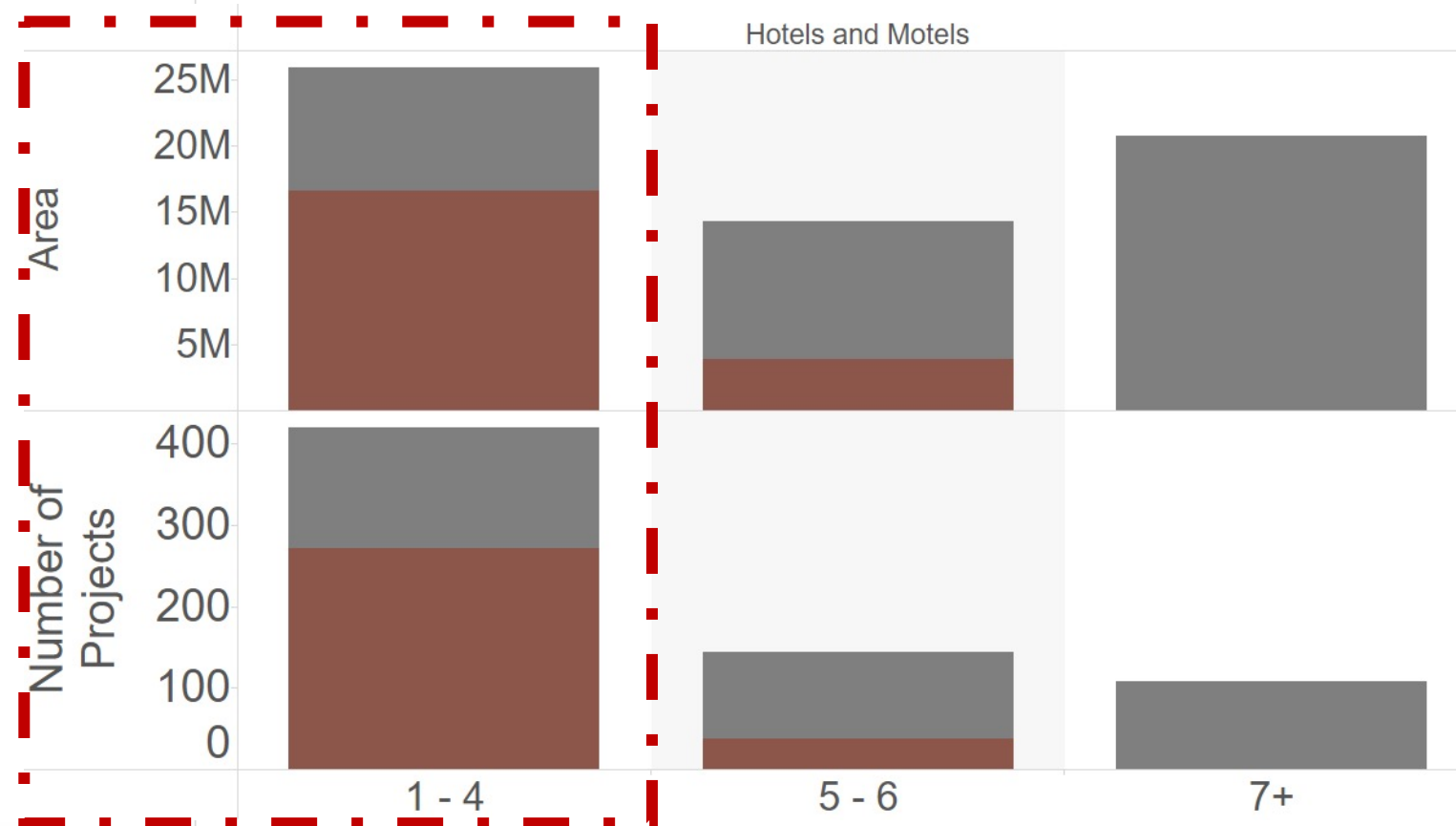


MARKET DATA ANALYSIS

SOURCE: 2015 DODGE MARKET DATA

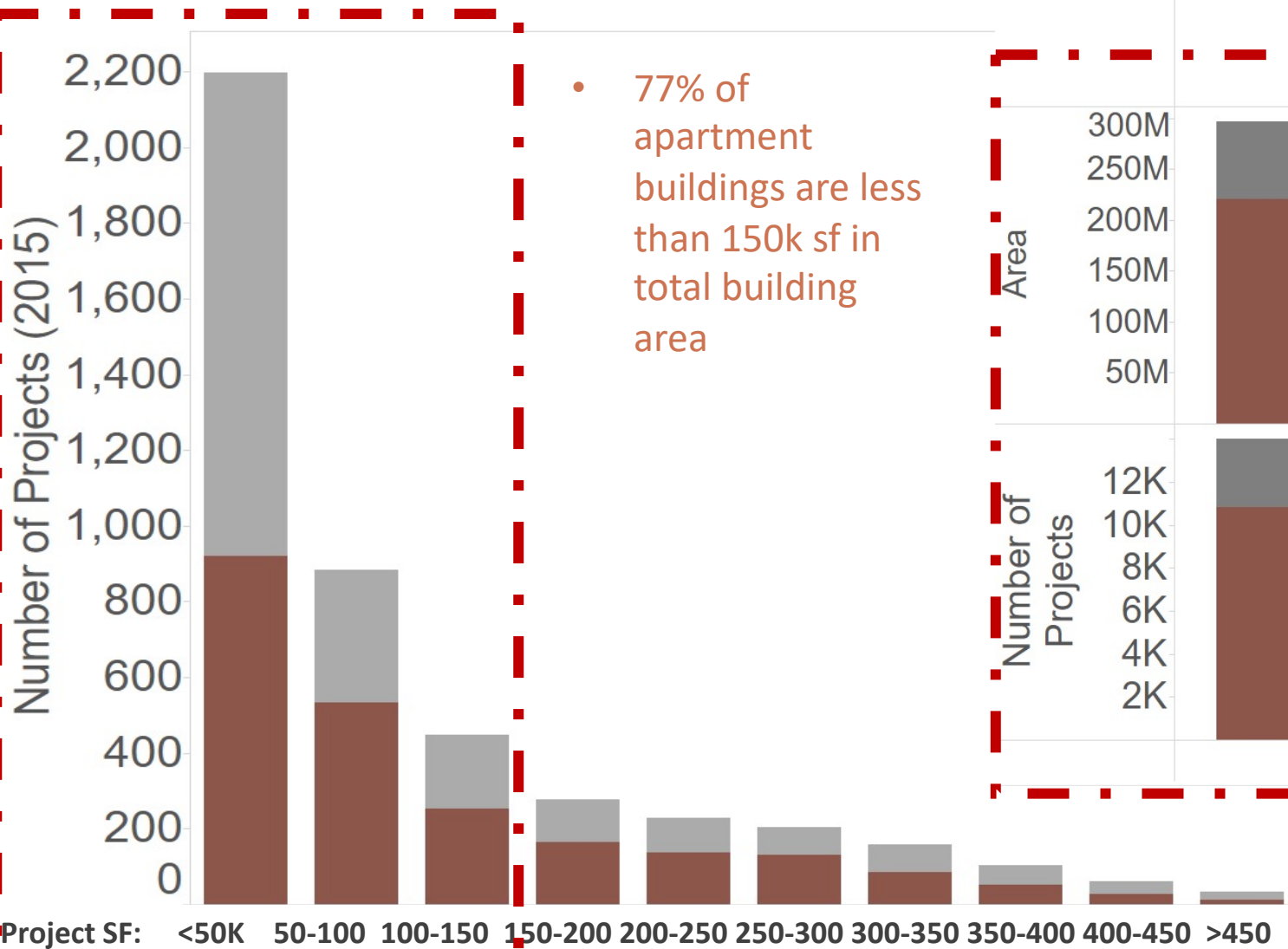


HOTELS AND MOTELS: AVERAGE BUILDING SIZE

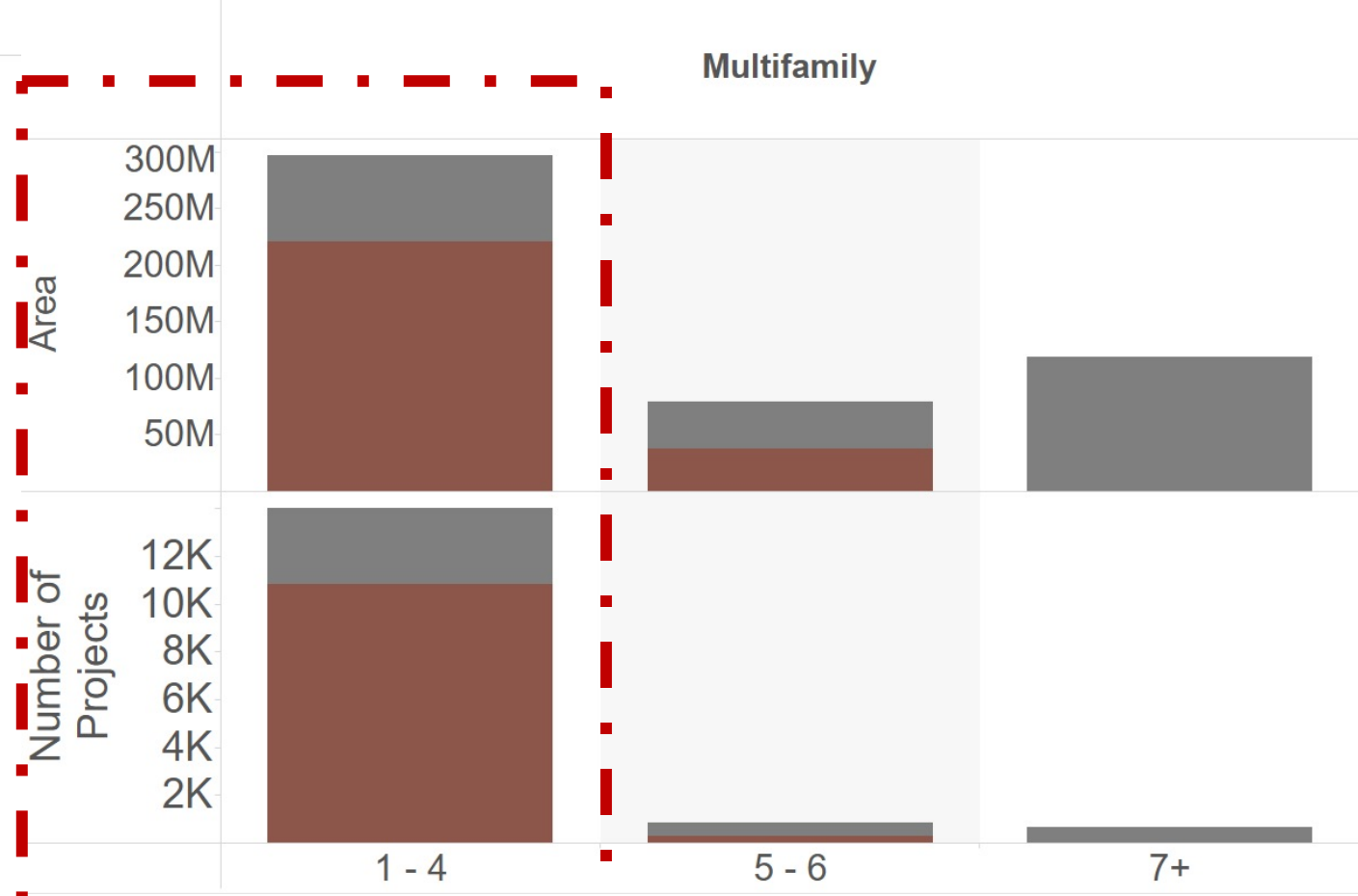


MARKET DATA ANALYSIS

SOURCE: 2015 DODGE MARKET DATA



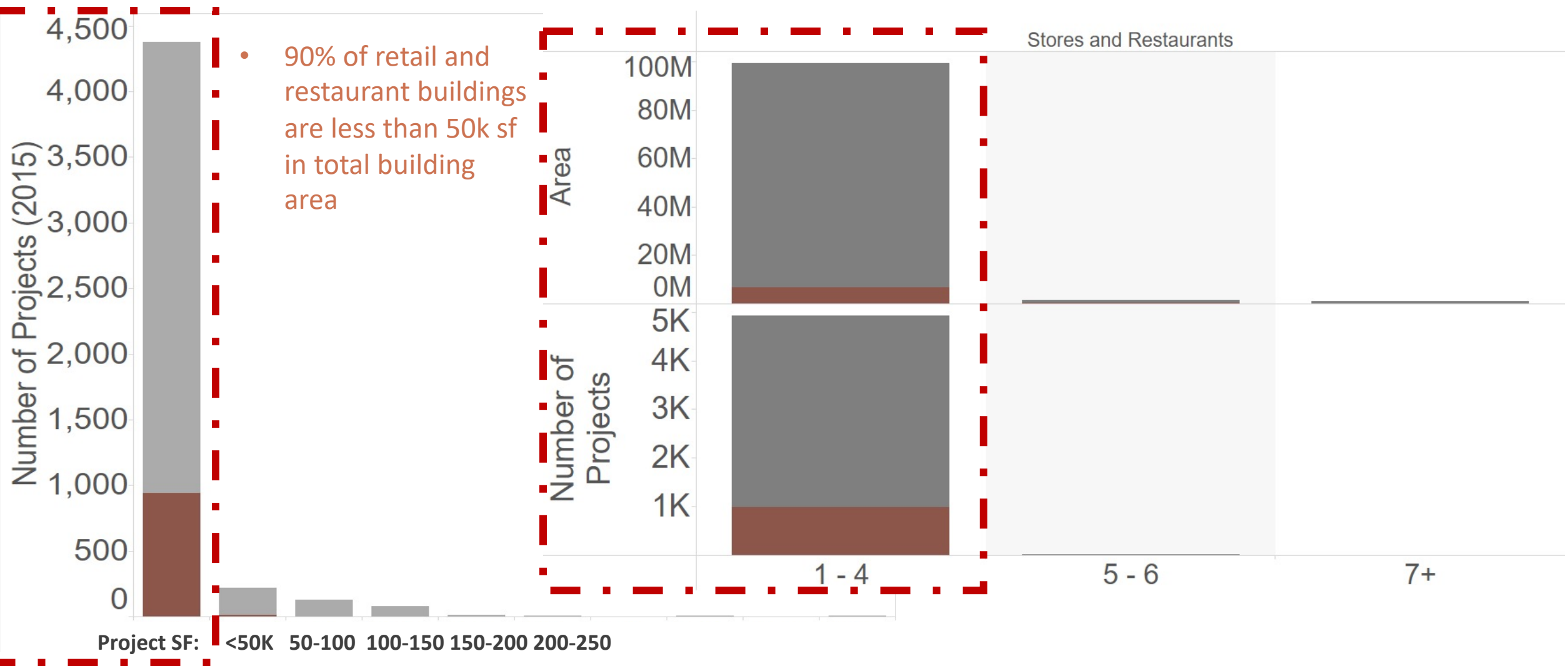
APARTMENTS: AVERAGE BUILDING SIZE



MARKET DATA ANALYSIS

RETAIL & RESTAURANTS: AVERAGE BUILDING SIZE

SOURCE: 2015 DODGE MARKET DATA



MARKET DATA ANALYSIS

WHAT DOES ALL OF THIS MEAN?

WOOD IS BEING UNDERUTILIZED IN MANY COMMERCIAL OCCUPANCY BUILDINGS

		OF THOSE BLDGS: % WOOD
HOTELS	90% < 150 K SF	49% ARE WOOD
APARTMENTS	77% < 150K SF	48% ARE WOOD
RETAIL/RESTAURANT	90% < 50K SF	22% ARE WOOD
OFFICES	76% < 50K SF	25% ARE WOOD

THESE CAN BE FRAMED WITH WOOD, TYPE V CONSTRUCTION, WHY IS IT IMPORTANT TO RECOGNIZE THAT?

BUILDING OPTIONS

IN LOW- TO MID-RISE BUILDING TYPES, MANY DESIGNERS ACCUSTOMED TO STEEL & CONCRETE DEFAULT TO TYPE II CONSTRUCTION

However, nearly identical building size can be achieved with wood framing in Type IIIA or IIIB

WHY IS THE CONSTRUCTION TYPE SELECTION SO IMPORTANT?



ICC BUILDING VALUATION DATA, M OCCUPANCY BUILDINGS, FEBRUARY 2017

Cost per SF

\$134

\$128

\$123

\$117



IA



IB



IIA



IIB

Construction Type

\$107

\$104

\$93

\$89



IIIA



IIIB



VA



VB

ICC BUILDING VALUATION DATA, R-1 OCCUPANCY BUILDINGS, FEBRUARY 2017

Cost per SF

\$186



IA

\$179



IB

\$174



IIA

\$167



IIB

Construction Type

\$154



IIIA

\$150



IIIB

\$138



VA

\$134



VB

BUILDING OPTIONS

MANY BUILDINGS UTILIZE A HIGHER CONSTRUCTION TYPE THAN NECESSARY DUE TO TRADITIONAL PRACTICE. THIS CAN HAVE AN IMPACT ON FIRE RATINGS, MATERIALS AND ULTIMATELY COST.



WHAT IS A MIXED-USE BUILDING?



PHOTO CREDIT: NICHOLAS WREY COURTESY OF APPLIED ARCHITECTURE INC.

Mixed-use development is a type of urban development that blends residential, commercial, cultural, institutional, or industrial uses, where those functions are physically and functionally integrated, and that provides pedestrian connections.

SOURCE: THRALL

OR, SIMPLISTICALLY:



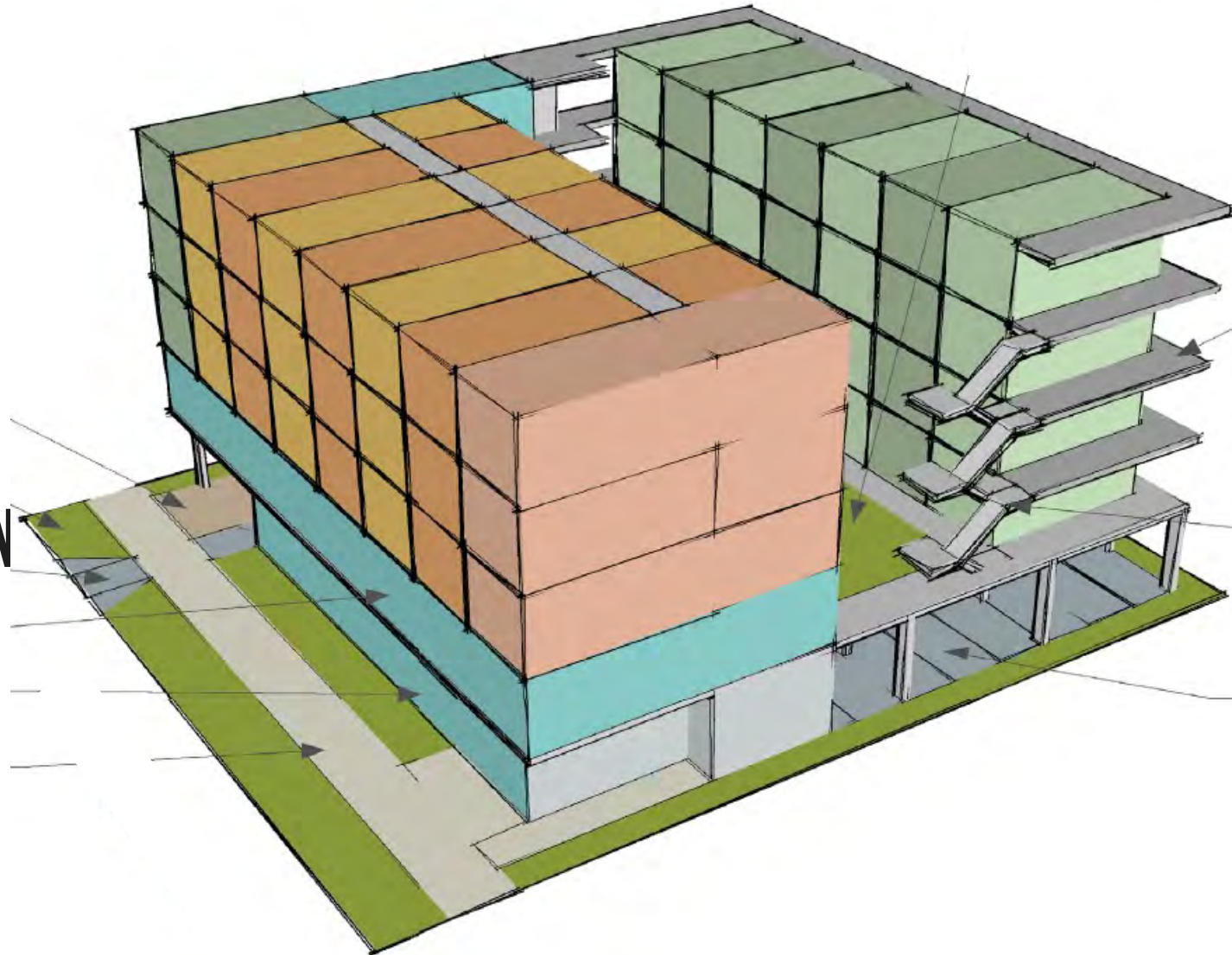
BUILDING WITH MORE THAN ONE OCCUPANCY GROUP OR INTENDED FUNCTION





BUILDING OPTIONS

**THERE ARE MULTIPLE WAYS TO
CLASSIFY A BUILDING. CHALLENGE
TRADITION AND CONSIDER ALL
OPTIONS IN AN EFFORT TO ACHIEVE
THE MOST COST-EFFECTIVE SOLUTION**



BUILDING OPTIONS

START WITH THE LOWEST COMMON DENOMINATOR OPTION & WORK UP. DON'T ASSUME THAT A CERTAIN CONSTRUCTION TYPE, OCCUPANCY SEPARATION, ETC. WILL BE REQUIRED SIMPLY BASED ON USE OF CERTAIN MATERIALS OR PRESENCE OF CERTAIN OCCUPANCIES



IMAGE CREDIT: NEO STUDIO

MIXED OCCUPANCY BUILDINGS

IBC 508

EXAMPLE: URBAN INFILL PROJECT:

3 story building

Below grade: 12,000 sf parking

1st floor: 9,500 sf parking
1,200 sf insurance agency
1,300 sf print shop

2nd floor: 2,400 sf martial arts studio
9,600 sf apartments

3rd floor: 12,000 sf apartments

NFPA 13 sprinkler system throughout building
enclosed parking garage

grade to mean roof height = 38 ft



MIXED OCCUPANCY BUILDINGS

IBC 508



PER IBC 503 & 506, BASEMENT DOES NOT NEED TO BE INCLUDED
IN AREA AND STORY CALCULATIONS

	PARKING (S-2)	INSURANCE AGENCY (B)	PRINT SHOP (B)	MARTIAL ARTS STUDIO (B)	APARTMENTS (R-2)
3 RD FLOOR	-	-	-	-	12,000 SF
2 ND FLOOR	-	-	-	2,400 SF	9,600 SF
1 ST FLOOR	9,500 SF	1,200 SF	1,300 SF	-	-
BASEMENT	12,000 SF	-	-	-	-

MIXED OCCUPANCY BUILDINGS

IBC 508

TRY TYPE VB CONSTRUCTION:

	S-2	B	R-2	ACTUAL BUILDING
ALLOW. # STORIES	3	3	3	3
ALLOW. HEIGHT	60 FT	60 FT	60 FT	38 FT
ALLOW. AREA/FLOOR	40,500 SF	27,000 SF	21,000 SF	12,000 SF
ALLOW. TOTAL AREA	121,500 SF	81,000 SF	63,000 SF	36,000 SF

MOST RESTRICTIVE OCCUPANCY GROUP, R-2 WORKS FOR TOTAL BUILDING.

USE NON-SEPARATED, TYPE VB CONSTRUCTION



MIXED OCCUPANCY BUILDINGS

IBC 508

THIS 3 STORY, TYPE VB MIXED-USE BUILDING CAN BE FULLY FRAMED WITH WOOD AND CAN HAVE NON-SEPARATED OCCUPANCIES

- No podium is necessary
- No fire resistance rated separation between occupancies is necessary (unless required by other code provisions)
- Even if other materials are used in parts of the building, can still be type VB construction



MIXED OCCUPANCY BUILDINGS

IBC 508

WHAT ARE THE SPECIAL PROVISIONS AND/OR OTHER SPECIAL DESIGN ALLOWANCES WE CAN USE?



MIXED OCCUPANCY BUILDINGS

IBC 508

- **INCIDENTAL USES (509)**
- **ACCESSORY OCCUPANCIES (508.2)**
- **UNIQUE OCCUPANCY COMBINATIONS (303)**
- **ROOF TOP OCCUPANCIES (CHPT. 5)**
- **SPECIAL PROVISIONS (510)**
- **NON-SEPARATED OCCUPANCIES (508.3)**
- **SEPARATED OCCUPANCIES (508.4)**
- **SEPARATE BUILDINGS — FIREWALLS (503.1 & 706)**
- **COVERED AND OPEN MALLS (402)**



CREDIT: BOYE ARCHITECTURE

**OUTSIDE SCOPE OF
PRESENTATION**

INCIDENTAL USES

IBC 509

- **ANCILLARY FUNCTION ASSOCIATED WITH AN OCCUPANCY**
- **POSE GREATER RISK THAN THE OCCUPANCY**
- **EXAMPLES:**
 - **LAUNDRY ROOM OVER 100 SF**
 - **REFRIGERANT MACHINERY ROOM**
 - **INCINERATOR ROOM**
 - **FURNACE ROOM**
 - **BOILER ROOM**
 - **VOCATIONAL SHOP IN A SCHOOL**

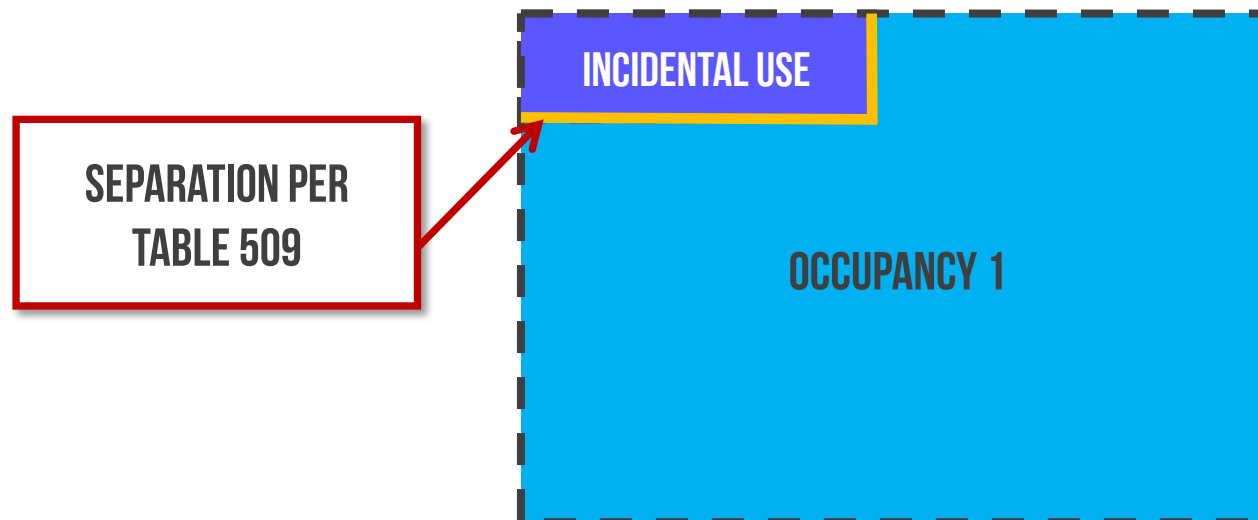


INCIDENTAL USES

IBC 509

LIMITATIONS:

- Each incidental use not more than 10% of area of story
- Have fire resistance rated separation (fire barrier or horizontal assembly), smoke separation and/or sprinkler systems per Table 509 and Section 509.4
 - Many permit use of sprinklers in lieu of rated separation
- NOT classified as a different occupancy.
- Allowable Building Area and Height per main Occupancy

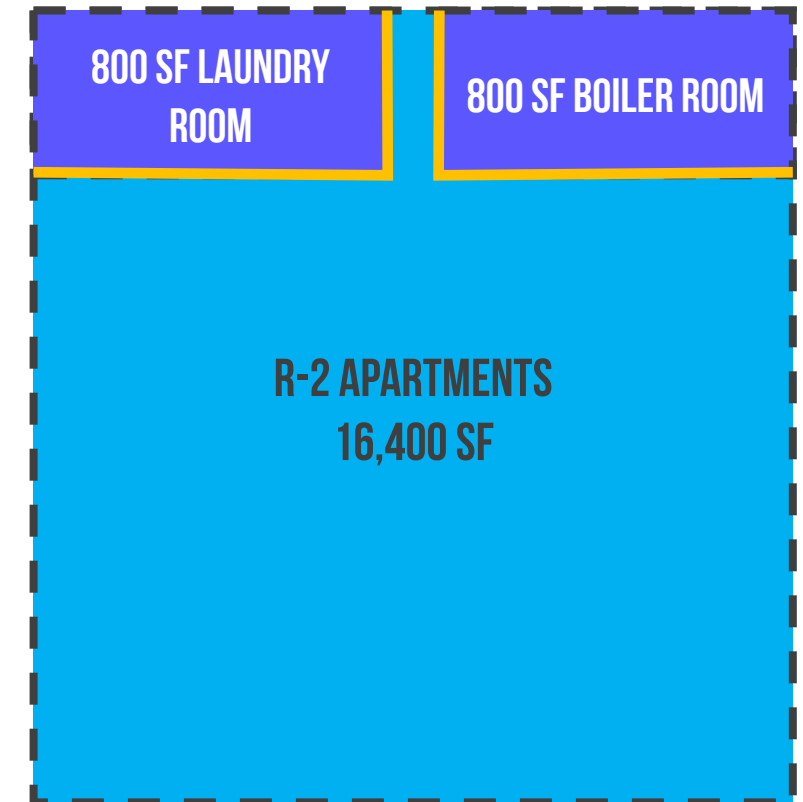


INCIDENTAL USES

IBC 509

INCIDENTAL USES EXAMPLE:

- NFPA 13 sprinklered, 4 story, type VA building
- Upper 3 floors: 18,000 sf apartments (r-2)
- 1st floor: 16,400 sf apartments plus 800 sf laundry room & 800 sf boiler room
- Total building area = 72,000 sf
- Table 503: allowable building area w/sprinkler increase = 108,000 sf; no floor greater than 36,000 sf: ok
- Allowable incidental use area = $18,000 \times 0.10 = 1,800 \text{ sf} > 800 \text{ sf}$: ok can classify laundry room & boiler room as r-2
- Table 509: walls and floor separating laundry room & boiler room from r-2: no hourly rating required since bldg is sprinklered but smoke resistance is required in conjunction with sprinklers per Section 509.4.2



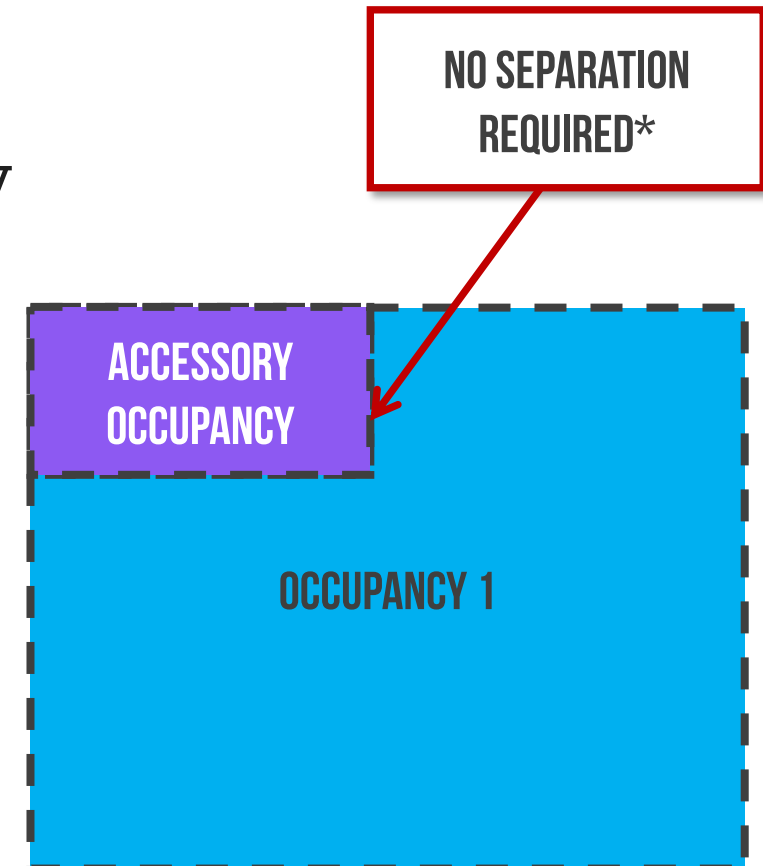
ACCESSORY OCCUPANCIES

IBC 508.2

- Ancillary to the main occupancy
- Aggregate accessory area not greater than:
 - 10% of the main Occupancy on same floor
 - Table 503 non-increased Allowable Area limit of accessory occupancy
- No separation between occupancies required*
- Allowable building area and height per main occupancy

*Hazardous occupancies require separation

*Residential separations per Section 420 still apply

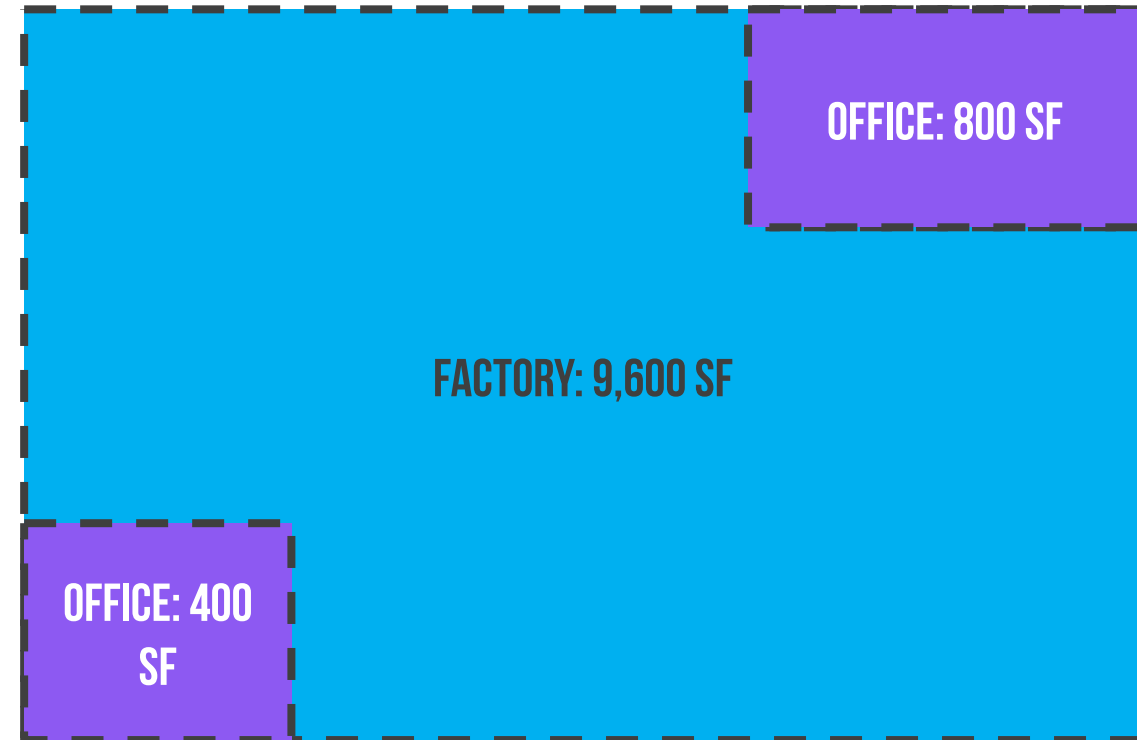


ACCESSORY OCCUPANCIES

IBC 508.2

ACCESSORY OCCUPANCIES EXAMPLE:

- Unsprinklered, 1 story, type VA building
- Factory (f-1) 9,600 sf
- Two office (b) spaces: 400 sf and 800 sf
- Table 503: allowable area = 14,000 sf
- Total floor area = 10,800 sf < 14,000 sf ok
- Aggregate Accessory use areas = 1,200 sf
- Max. allowable aggregate accessory use area = $10,800 \times 0.10 = 1,080$ sf
- Does not work as accessory occupancies
- Solution: reduce office area, increase factory area or use mixed-use occupancies



SMALL ASSEMBLY SPACES

IBC 303.1.1 & 303.1.2

SMALL ASSEMBLY SPACES:

- A building or tenant space used for assembly purposes with an occupant load of less than 50 persons shall be classified as a Group B occupancy.

Example: small cafe

SMALL ASSEMBLY SPACES ACCESSORY TO OTHER OCCUPANCIES:

- Occupant load less than 50 persons or less than 750 sf in area - can be classified as a Group B occupancy or as part of main occupancy

Examples:

- Conference room in office building
- Fitness center in hotel



ASSEMBLY SPACES IN EDUCATIONAL FACILITIES

IBC 303.1.3

EDUCATIONAL FACILITIES:

- A room or space used for assembly purposes that is associated with a Group E occupancy is not considered a separate occupancy.

Examples: gymnasium used for school sports; cafeteria used for school meals



EDUCATIONAL SPACES IN PLACES OF WORSHIP

IBC 303.1.4

PLACES OF RELIGIOUS WORSHIP:

- Accessory religious educational rooms and religious auditoriums with occupant loads of less than 100 per room or space are not considered separate occupancies.

Example: classrooms

ST. MARTHA CATHOLIC CHURCH — PORTER, TX

DESIGN TEAM : TURNER DURAN ARCHITECTS, PINNACLE STRUCTURAL ENGINEERS

PHOTO CREDIT: G. LYON PHOTOGRAPHY, INC.



MULTIPLE FUNCTIONS

IBC 302.1

BUILDINGS USED FOR MULTIPLE FUNCTIONS:

- A room or space that is intended to be occupied at different times for different purposes shall comply with all of the requirements that are applicable to each of the purposes for which the room or space will be occupied.

Example: church hall also used as a daycare center and for wedding receptions



ROOFTOP DECKS

IBC 503.1

Many mixed-use buildings, especially apartment buildings, are implementing occupiable roof top decks, either for individual use or as a gathering space

No current code sections clearly discuss this except for basic exit provisions but several design routes have been used:

Typically these spaces do not have a roof and therefore aren't classified as stories per the definition of a story (IBC 202)



OCCUPIED ROOFS CODE DEVELOPMENT

2012 IBC section 1021 contains exit provisions for occupied roofs

2015 IBC clarified egress requirements for occupied roofs (IBC 1006.3)

2018 IBC further recognizes occupied roofs. 2018 IBC provisions:

302.1: Occupied roof classified as occupancy it most closely resembles

503.1.4: Permitted to be used as an occupied roof if the occupancy of the roof is an occupancy that is permitted by code for the story immediately below the roof. Area of the occupied roofs is not required to be included in the building area. Further exceptions for sprinklered buildings exist

SPECIAL PROVISIONS

IBC 510.2

HORIZONTAL BUILDING SEPARATION

OFTEN CALLED PODIUM PROVISION:

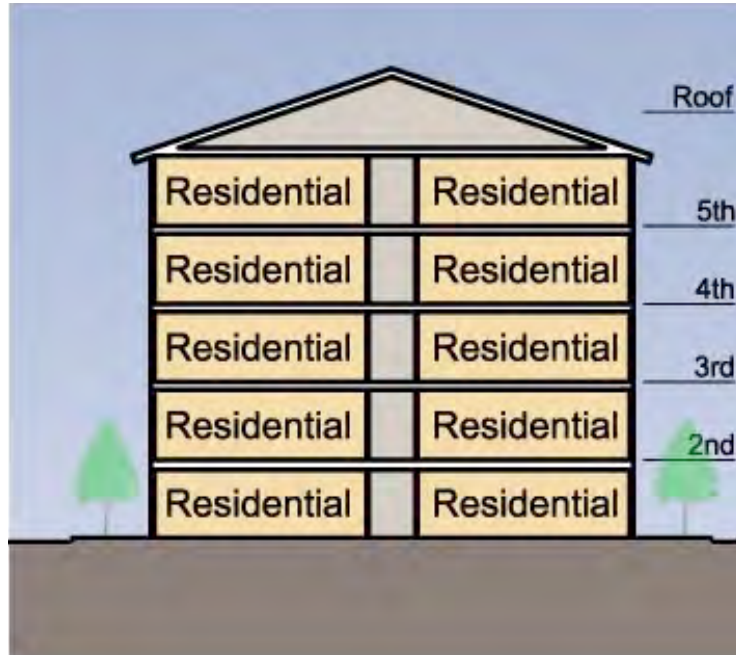
- Considered separate buildings above and below for purposes of area calculations if:
- Overall height in feet is still limited to min of either building
- 3hr rated horizontal assembly
- Building below is Type 1A with sprinklers
- Occupancy restrictions above and below



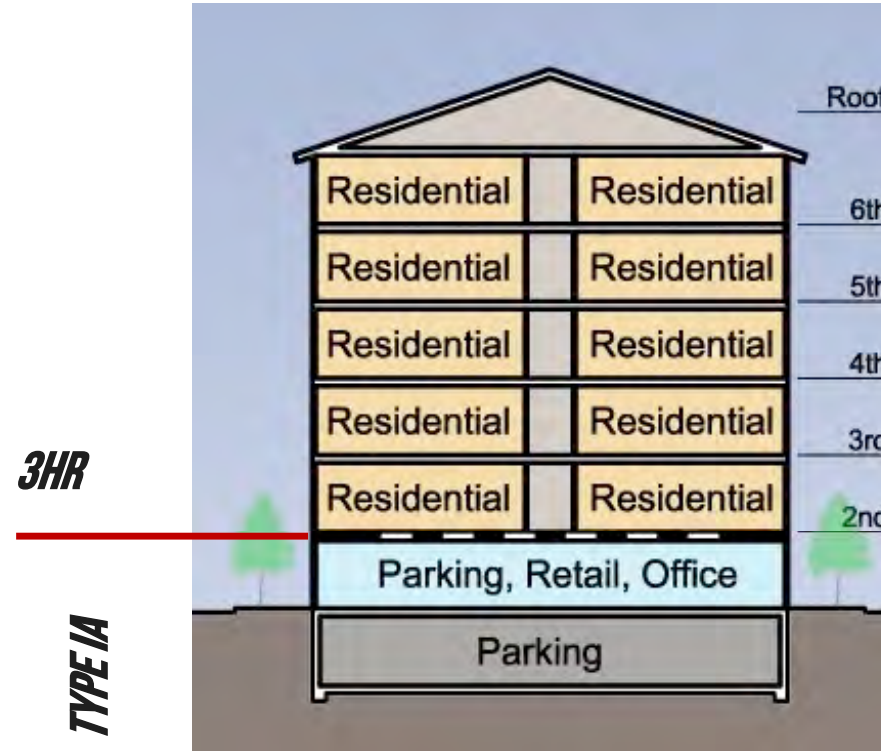
SPECIAL PROVISIONS

IBC 510.2

HORIZONTAL BUILDING SEPARATION



5 STORY TYPE III BUILDING



**5 STORY TYPE III BUILDING
ON TOP OF A TYPE IA PODIUM**

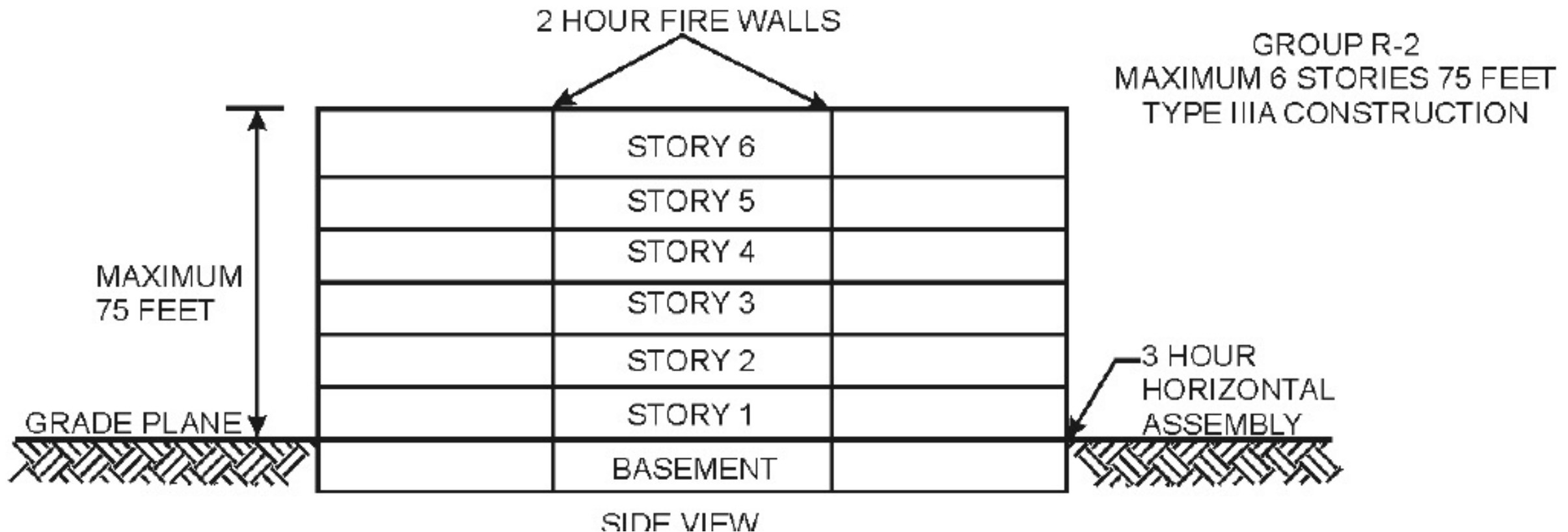
INCREASES ALLOWABLE STORIES... NOT ALLOWABLE BUILDING HEIGHT

SPECIAL PROVISIONS

IBC 510.5

GROUP R-1 & R-2, TYPE IIIA BUILDINGS

- Height limitation increased to 6 stories & 75 ft
- First floor assembly above the basement has a fire-resistance rating of not less than 3 hours
- Floor area is subdivided by 2-hour fire-resistance-rated fire walls into areas of not more than 3,000 square feet



WHAT ABOUT MIXED OCCUPANCIES?



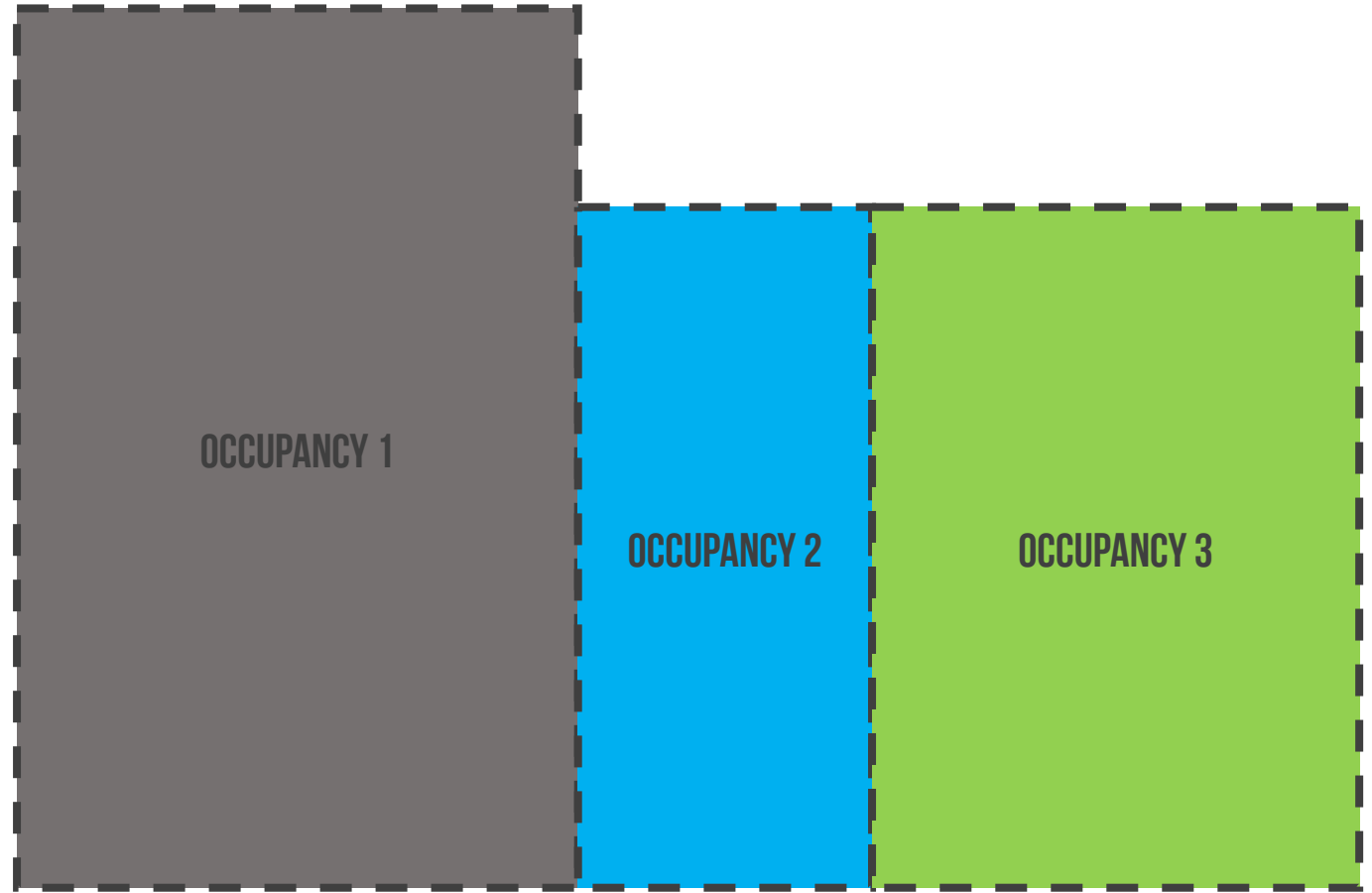
NON-SEPARATED OCCUPANCIES





MIXED OCCUPANCY BUILDINGS

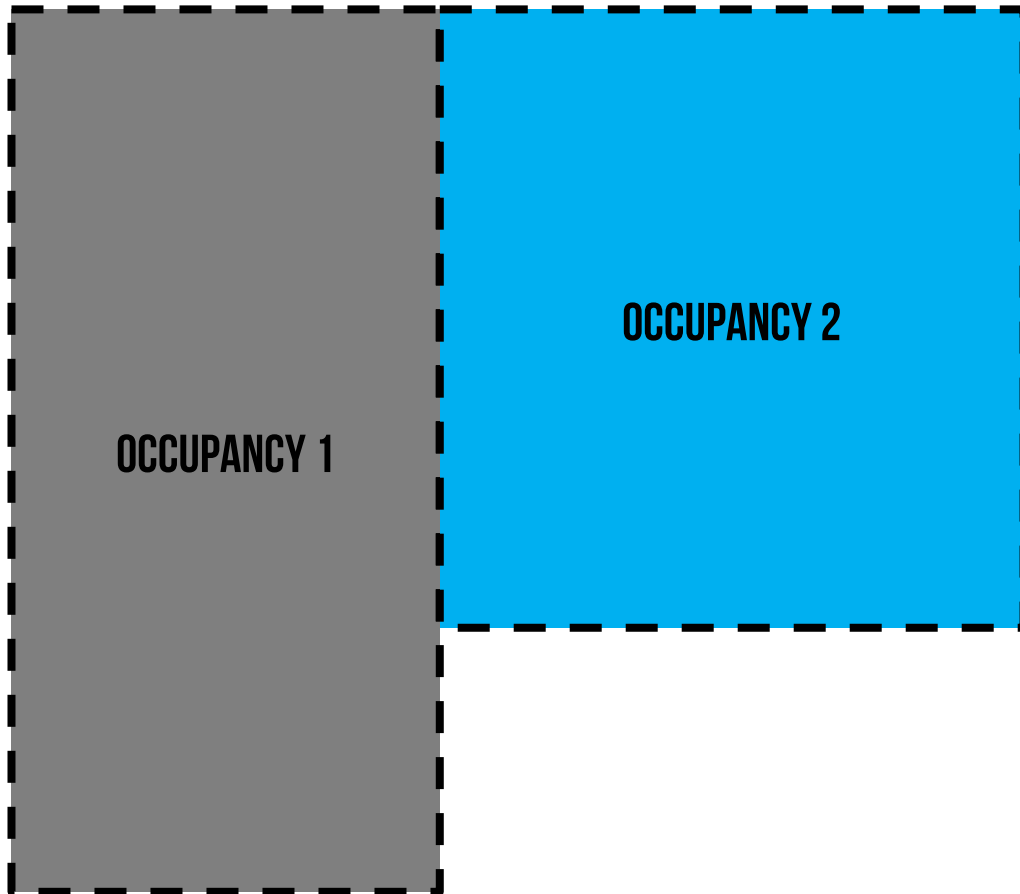
IBC 508



ALLOWABLE BUILDING SIZE

IBC 508

NON-SEPARATED OCCUPANCIES



Most restrictive requirements of all occupancies apply for:

- Fire Protection Systems (Chapter 9)
- Allowable Height and Area

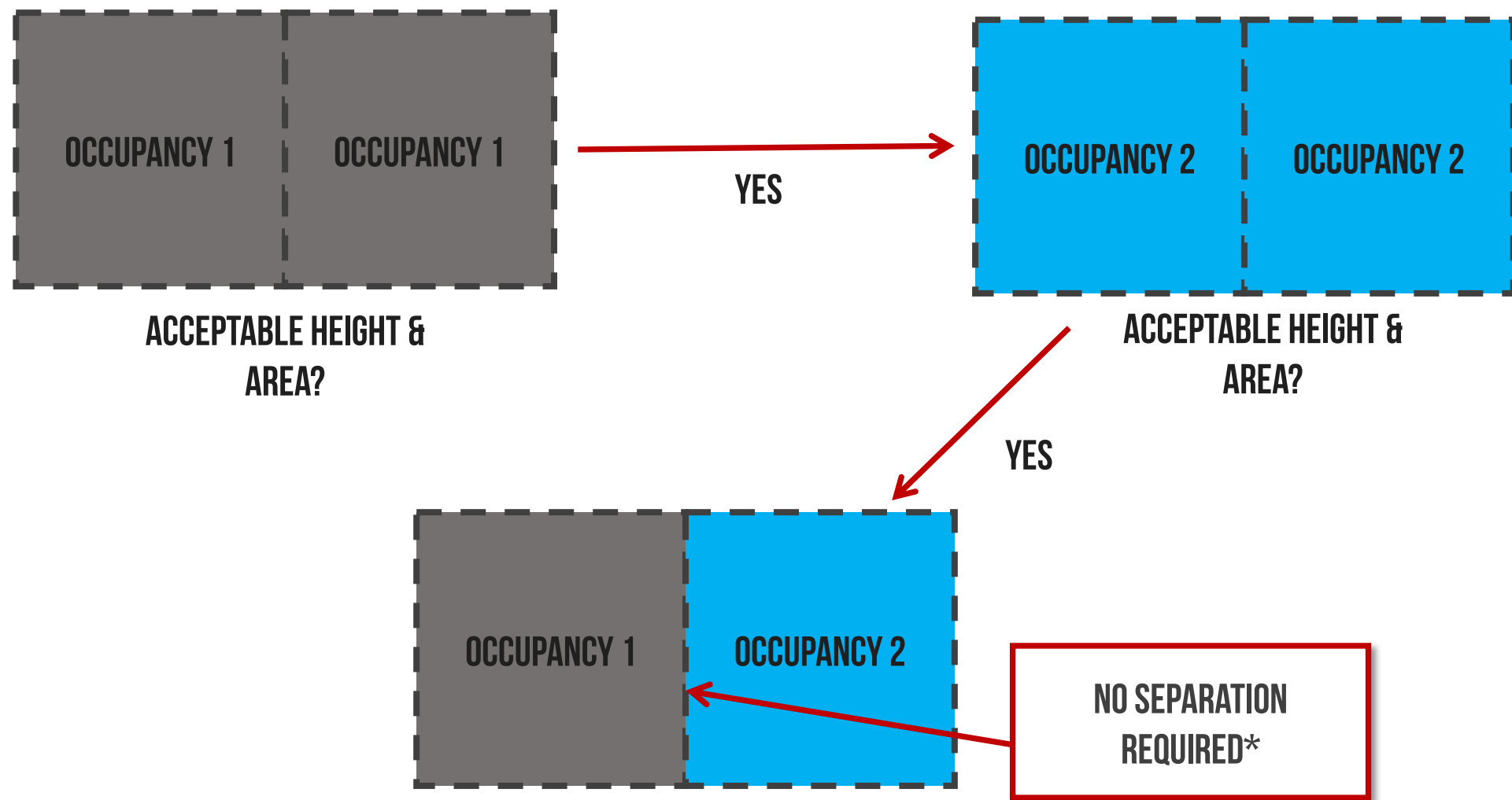
Other requirements for each portion based upon occupancy of that portion (i.e. egress, others)

No fire separation between occupancies required*

*Hazardous occupancies require separation.

NON-SEPARATED OCCUPANCIES

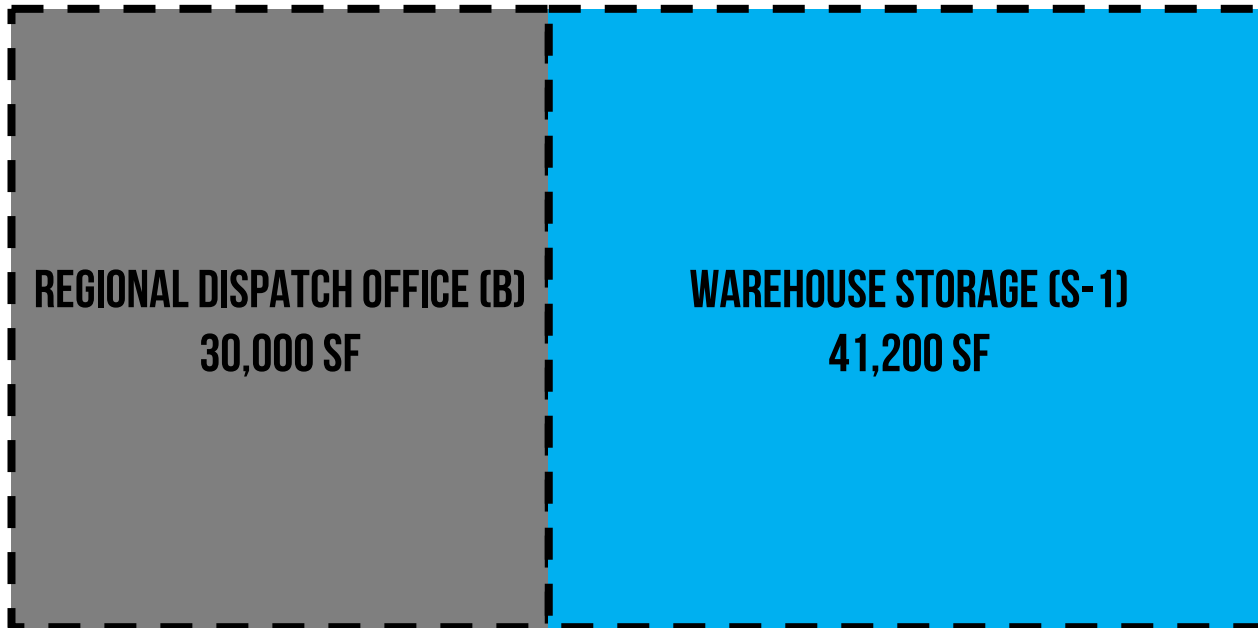
IBC 508.3



ALLOWABLE BUILDING SIZE

IBC 508

NON-SEPARATED OCCUPANCIES EXAMPLE

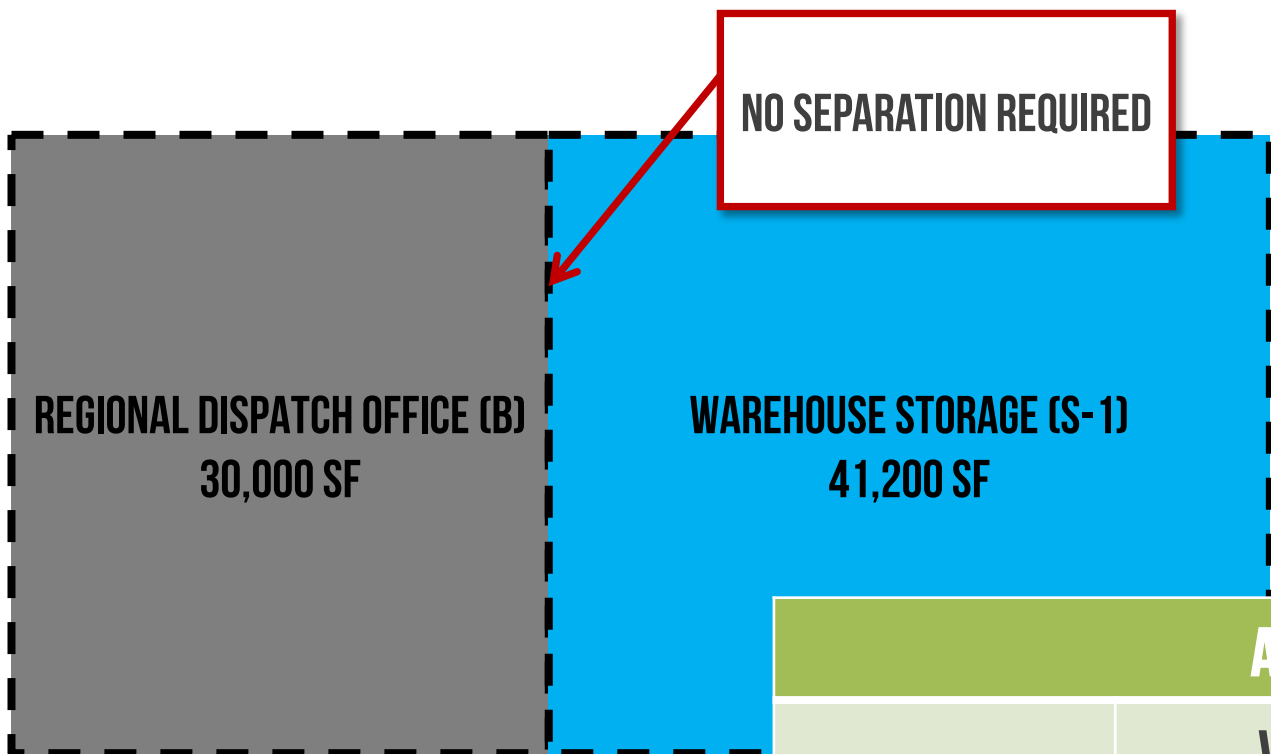


- 1 story building
- Total building area = 71,200 sf
- IBC section 903 does not require an automatic sprinkler in group B buildings but it does for S-1 buildings with fire area > 12,000 sf (903.2.9)
- NFPA 13 sprinkler required throughout building

ALLOWABLE BUILDING SIZE

IBC 508

NON-SEPARATED OCCUPANCIES EXAMPLE CONT'D



CONSTRUCTION TYPE OPTIONS

- VB: INADEQUATE FOR BOTH
- VA: OK FOR B, INADEQUATE FOR S-1
- IIIB: OK FOR B, INADEQUATE FOR S-1
- IIIA: WORKS FOR BOTH, USE TYPE IIIA

ASSUMPTIONS:
NFPA 13 SPRINKLER THROUGHOUT. NO
FRONTAGE INCREASE.

ALLOWABLE 1 STORY BUILDING AREA				
	VB	VA	IIIB	IIIA
GROUP B	36,000 SF	72,000 SF	76,000 SF	114,000 SF
GROUP S-1	36,000 SF	56,000 SF	70,000 SF	104,000 SF

ALLOWABLE BUILDING SIZE

IBC 508



**MULTI-STORY NON-SEPARATED OCCUPANCY
BUILDINGS**

ALLOWABLE BUILDING SIZE

IBC 508

MULTI-STORY NON-SEPARATED OCCUPANCIES EXAMPLE



IMAGE CREDIT: WARE MALCOMB

- **TOTAL BUILDING AREA = 61,200 SF:**
 - FLOOR 3**
 - 16,400 SF CLASSROOMS
 - 4,000 OFFICES
 - FLOOR 2**
 - 14,000 SF CLASSROOMS
 - 5,600 SF OFFICES
 - 800 SF COFFEE/ SNACK AREA
 - FLOOR 1**
 - 13,700 SF CLASSROOMS
 - 4,200 OFFICES
 - 1,700 SF ADMINISTRATION
 - 800 SF COFFEE/ SNACK AREA
- **NFPA 13 SPRINKLER REQUIRED THROUGHOUT BUILDING**

ALLOWABLE BUILDING SIZE

IBC 508

MULTI-STORY NON-SEPARATED OCCUPANCIES EXAMPLE



- OFFICES: **GROUP B OCCUPANCY**
- CLASSROOMS FOR HIGHER THAN 12TH GRADE: **GROUP B OCCUPANCY**
- ADMIN & OFFICES: **GROUP B OCCUPANCY**
- COFFEE/SNACK BAR: **GROUP A-2 OCCUPANCY**
 - **MAY BE ABLE TO USE SMALL ASSEMBLY PROVISION (IBC 303.1.1) — GROUP B**

ALLOWABLE BUILDING SIZE

IBC 508

MULTI-STORY NON-SEPARATED OCCUPANCIES EXAMPLE



OPTIONS:

- If coffee/snack areas meet provisions for small assembly spaces: classify as group b. entire building is group B and can use type VB construction: allowed 3 stories, 60 ft, 27,000 sf per floor, 81,000 sf total area
- If coffee/snack areas don't meet provisions for small assembly spaces: classify them as group A-2. use non-separated occupancies, type VA construction: group B ok per above, group A-2 allowed 3 stories, 70 ft, 34,500 sf per floor, 103,500 sf total area
- Could also use separated occupancies, type VB construction

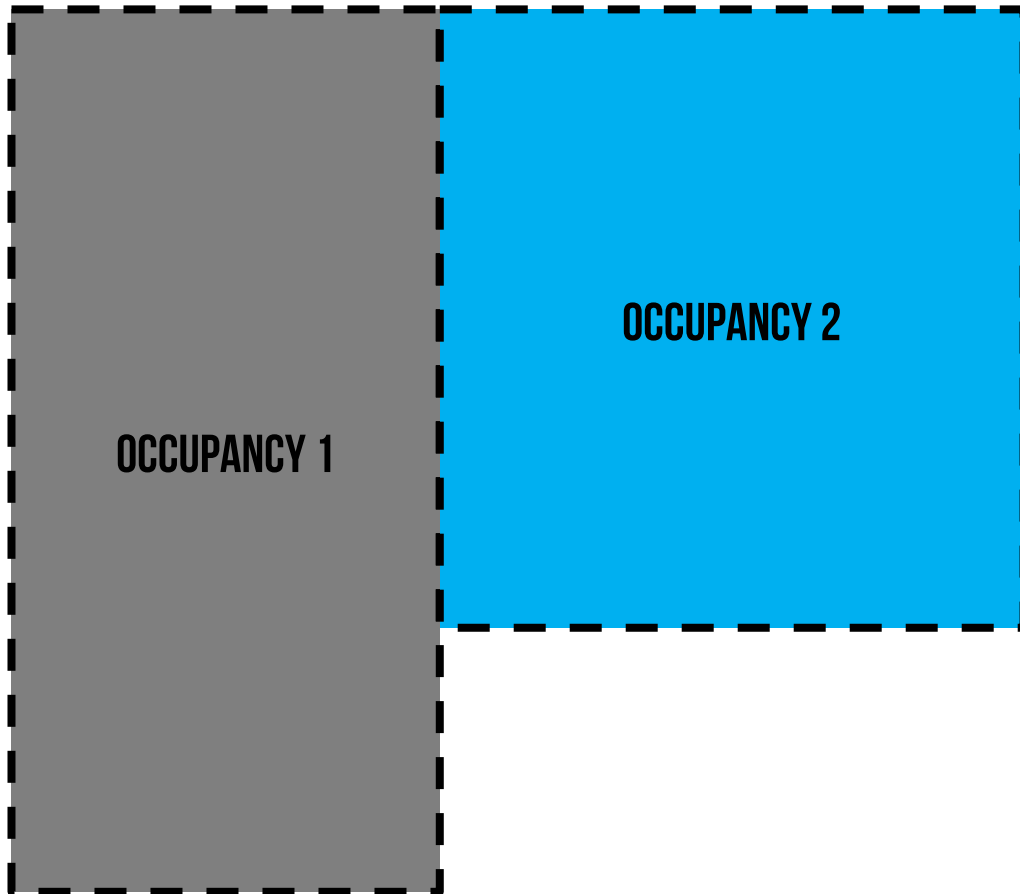
SEPARATED OCCUPANCIES



ALLOWABLE BUILDING SIZE

IBC 508

SEPARATED OCCUPANCIES



Requirements of code for each portion based upon occupancy of that portion

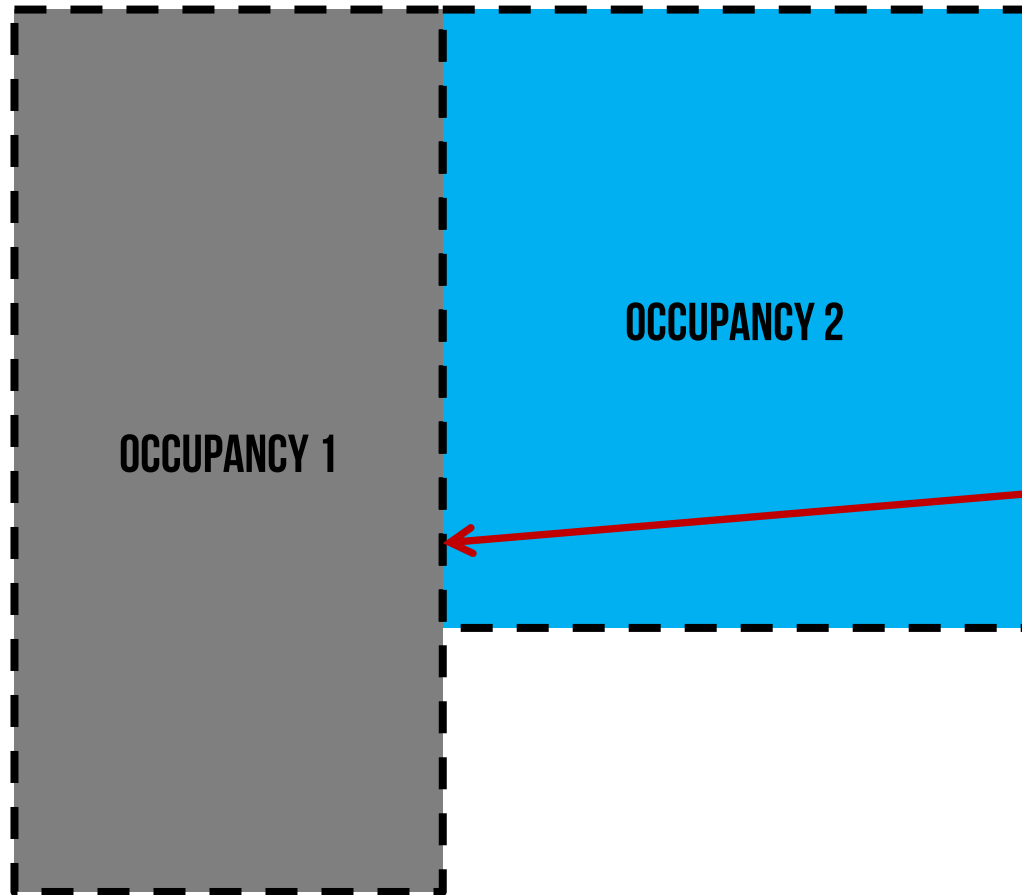
Allowable Height of each occupancy based upon construction type and occupancy

Allowable Area of each story

Sum of actual area over allowable area of each occupancy ≤ 1.0

SEPARATED OCCUPANCIES

IBC 508.4



SEPARATION PER
TABLE 508.4

$$\frac{\text{ACTUAL AREA FOR OCCUPANCY 1}}{\text{ALLOWABLE AREA FOR OCCUPANCY 1}} + \frac{\text{ACTUAL AREA FOR OCCUPANCY 2}}{\text{ALLOWABLE AREA FOR OCCUPANCY 2}} \leq 1.0$$

CHECK PERFORMED FOR EACH STORY.
SEPARATION BY FIRE BARRIERS AND HORIZONTAL ASSEMBLIES

SEPARATED OCCUPANCIES

IBC TABLE 508.4

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

NP = NOT PERMITTED, N = NO
SEPARATION REQUIRED

SEPARATION ACCOMPLISHED WITH:

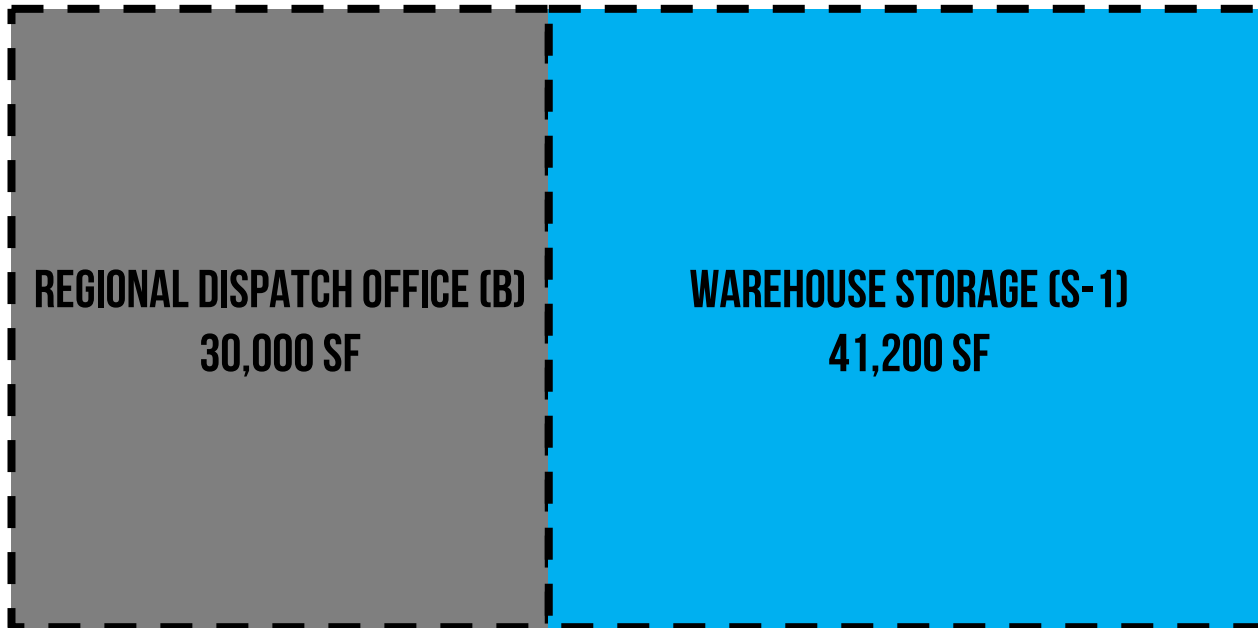
WALLS: FIRE BARRIERS (IBC 707)

FLOORS: HORIZONTAL ASSEMBLIES (IBC 711)

SEPARATED OCCUPANCIES

IBC 508.4

SEPARATED OCCUPANCIES EXAMPLE

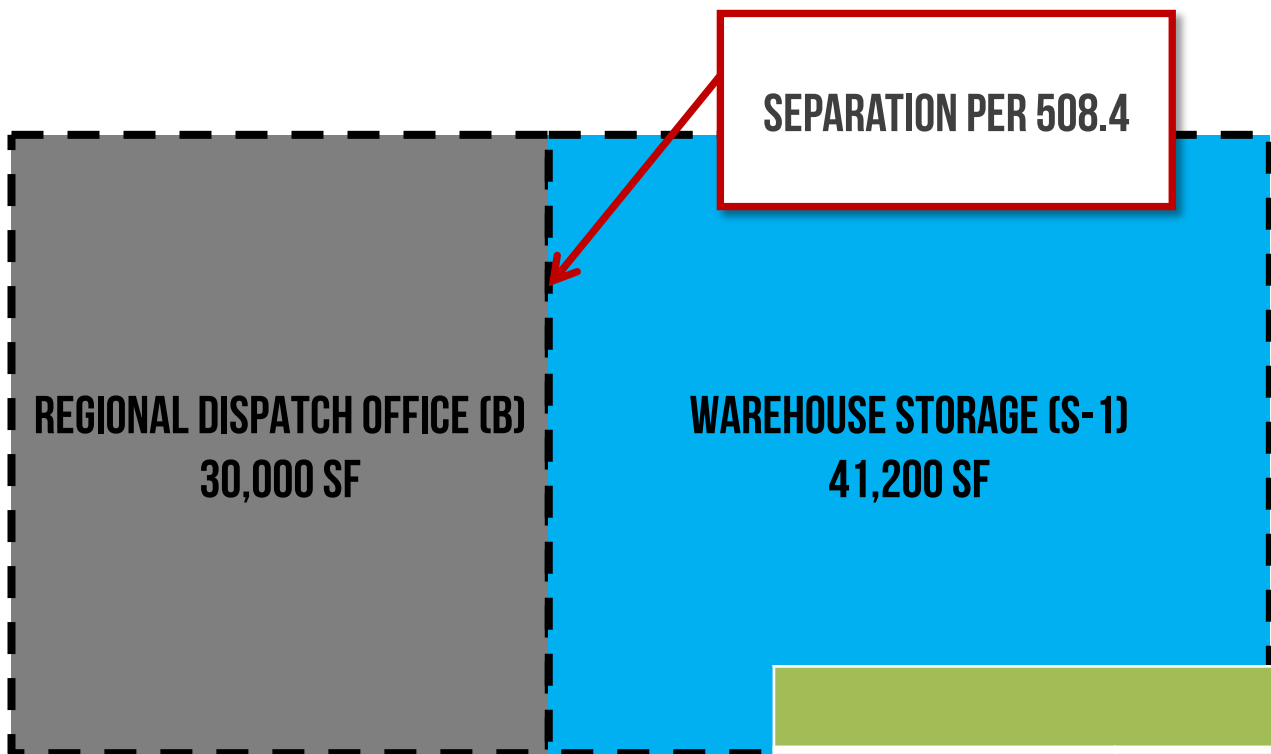


- 1 story building
- Total building area = 71,200 sf
- IBC section 903 does not require an automatic sprinkler in group B buildings but it does for S-1 buildings with fire area > 12,000 sf (903.2.9)
- NFPA 13 sprinkler required throughout building

ALLOWABLE BUILDING SIZE

IBC 508

SEPARATED OCCUPANCIES EXAMPLE CONT'D



CONSTRUCTION TYPE OPTIONS

- VB: $30,000/36,000 \pm 41,200/36,000 = 1.98 > 1.0$
INADEQUATE
- VA: $30,000/72,000 \pm 41,200/56,000 = 1.15 > 1.0$
INADEQUATE
- IIIB: $30,000/76,000 \pm 41,200/70,000 = 0.98 < 1.0$ OK. USE TYPE IIIB

ASSUMPTIONS:
NFPA 13 SPRINKLER THROUGHOUT. NO
FRONTAGE INCREASE.

ALLOWABLE 1 STORY BUILDING AREA				
	VB	VA	IIIB	IIIA
GROUP B	36,000 SF	72,000 SF	76,000 SF	114,000 SF
GROUP S-1	36,000 SF	56,000 SF	70,000 SF	104,000 SF

SEPARATED OCCUPANCIES

IBC TABLE 508.4

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

NP = NOT PERMITTED, N = NO
SEPARATION REQUIRED

FOR THIS EXAMPLE, NO
SEPARATION REQUIRED

SEPARATION ACCOMPLISHED WITH:

WALLS: FIRE BARRIERS (IBC 707)

FLOORS: HORIZONTAL ASSEMBLIES (IBC 711)

SEPARATED OCCUPANCIES

IBC TABLE 508.4

MULTI-STORY SEPARATED OCCUPANCY BUILDINGS

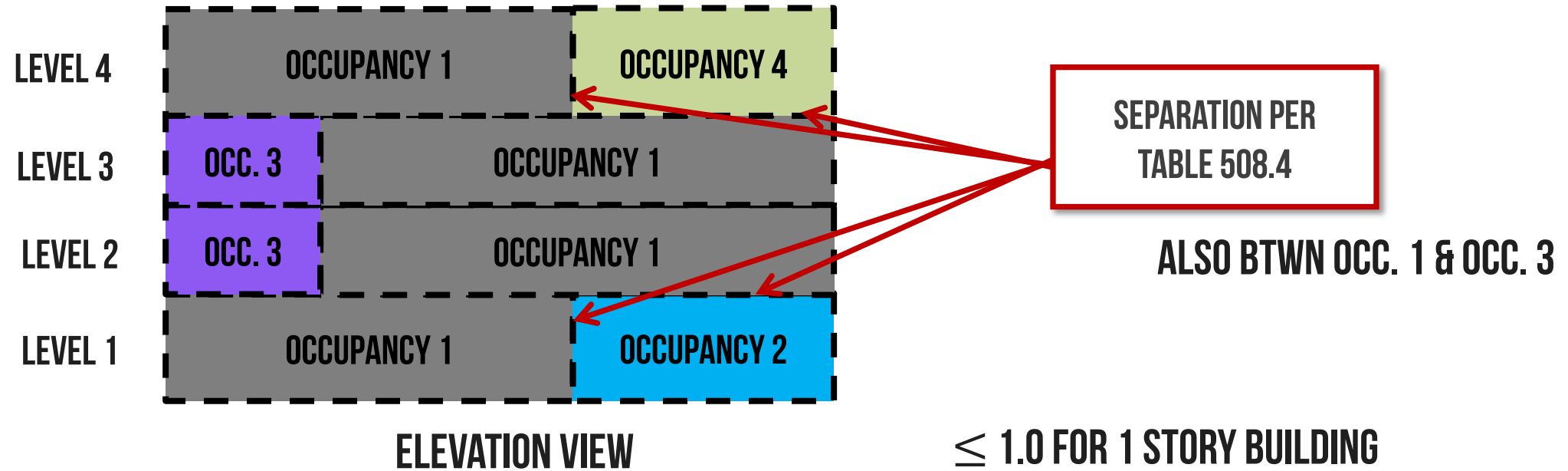


IMAGE CREDIT: CUBE 3 STUDIO LLC & RIXON PHOTOGRAPHY

SEPARATED OCCUPANCIES

IBC 2012 506.5 & 508.4 / IBC 2015 506.2.4 & 508.4

MULTI-STORY SEPARATED OCCUPANCY BUILDINGS



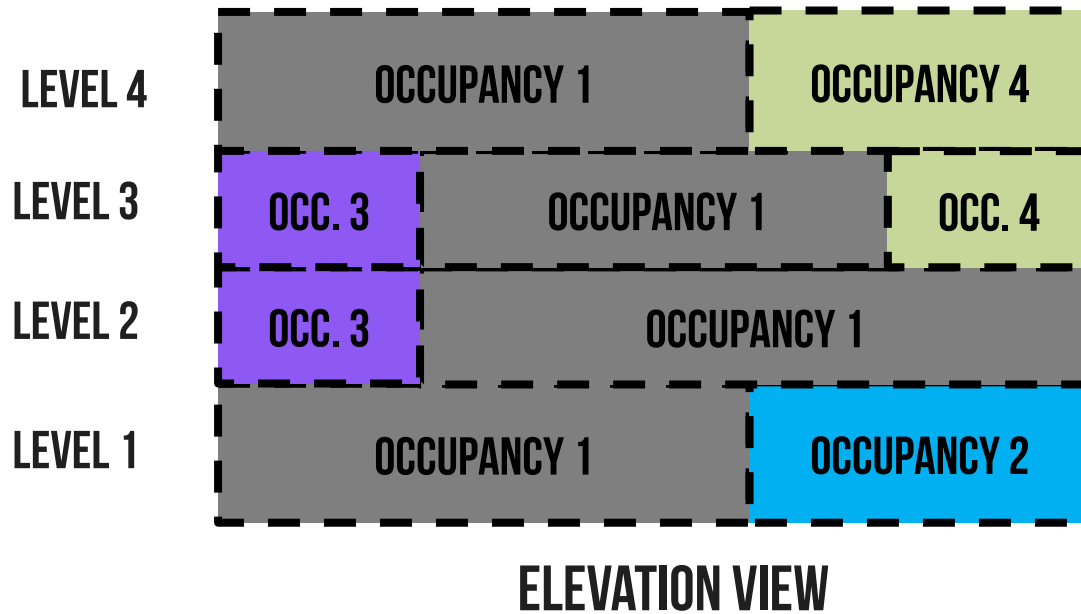
SUM OF RATIOS OF ACTUAL AREA/ALLOWABLE AREA FOR ALL
OCCUPANCIES PER FLOOR:

≤ 1.0 FOR 1 STORY BUILDING
 ≤ 2.0 FOR 2 STORY BUILDING
 ≤ 3.0 FOR 3 OR MORE STORY BUILDING
NO FLOOR CAN HAVE A RATIO > 1.0

SEPARATED OCCUPANCIES

IBC 508.4

MULTI-STORY SEPARATED OCCUPANCY EXAMPLE



- 4 story building
- Total building area = 120,000 SF
- Occupancy 1 = apartments (R-2)
- Occupancy 2 = retail (M)
- Occupancy 3 = restaurant (A-2)
- Occupancy 4 = professional offices (B)
- IBC section 903.2.8 requires buildings containing group R fire areas to be sprinklered throughout the building
- Provide NFPA 13 sprinkler throughout building

SEPARATED OCCUPANCIES

IBC 508.4

MULTI-STORY SEPARATED OCCUPANCY EXAMPLE



LEVEL 1 FLOOR PLAN

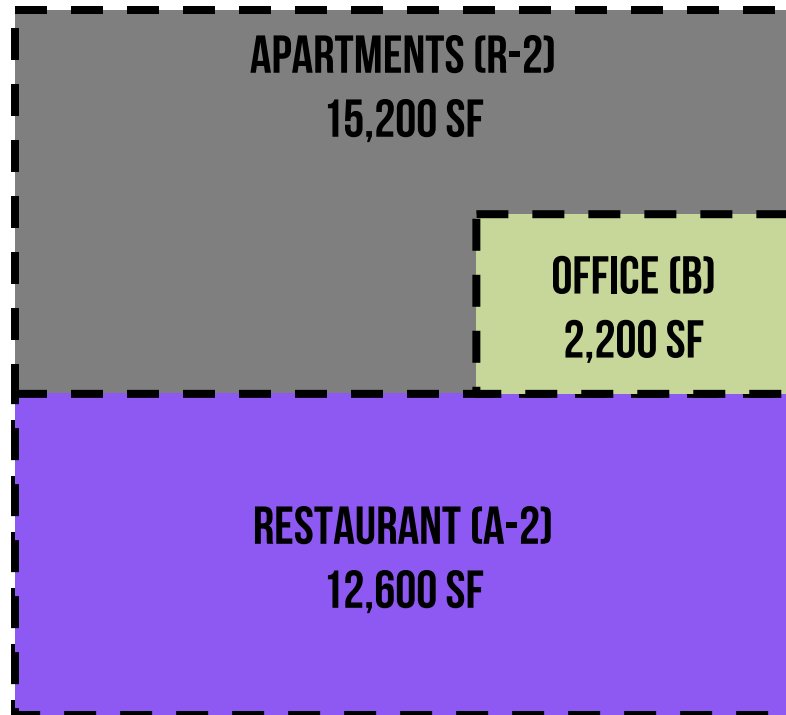


LEVEL 2 FLOOR PLAN

SEPARATED OCCUPANCIES

IBC 508.4

MULTI-STORY SEPARATED OCCUPANCY EXAMPLE



LEVEL 3 FLOOR PLAN



LEVEL 4 FLOOR PLAN

SEPARATED OCCUPANCIES

IBC 503

MULTI-STORY SEPARATED OCCUPANCY EXAMPLE

ALLOWABLE FLOOR AREA / # OF STORIES				
	VB	VA	IIIB	IIIA
GROUP A-2	18,000 SF / 2	34,500 SF / 3	28,500 SF / 3	42,000 SF / 4
GROUP B	27,000 SF / 3	54,000 SF / 4	57,000 SF / 4	85,500 SF / 6
GROUP M	27,000 SF / 2	42,000 SF / 4	37,500 SF / 3	55,500 SF / 5
GROUP R-2	21,000 SF / 3	36,000 SF / 4	48,000 SF / 5	72,000 SF / 5

WITH FULL NFPA 13 SPRINKLER INCREASES BUT NO FRONTAGE INCREASE

SEPARATED OCCUPANCIES

IBC 508.4

MULTI-STORY SEPARATED OCCUPANCY EXAMPLE



LEVEL 1 FLOOR PLAN

TRY CONSTRUCTION TYPE VA:

$$\text{VA: } 21,000/36,000 \pm 9,000/42,000 = 0.80$$

ALLOWABLE HEIGHT & STORIES:

R-2: 70 FT, 4 STORIES - OK

M: 70 FT, 4 STORIES - OK

SEPARATED OCCUPANCIES

IBC 508.4

MULTI-STORY SEPARATED OCCUPANCY EXAMPLE



LEVEL 2 FLOOR PLAN

TRY CONSTRUCTION TYPE VA:

$$\text{VA: } 17,400/36,000 \pm 12,600/34,500 = 0.85$$

ALLOWABLE HEIGHT & STORIES:

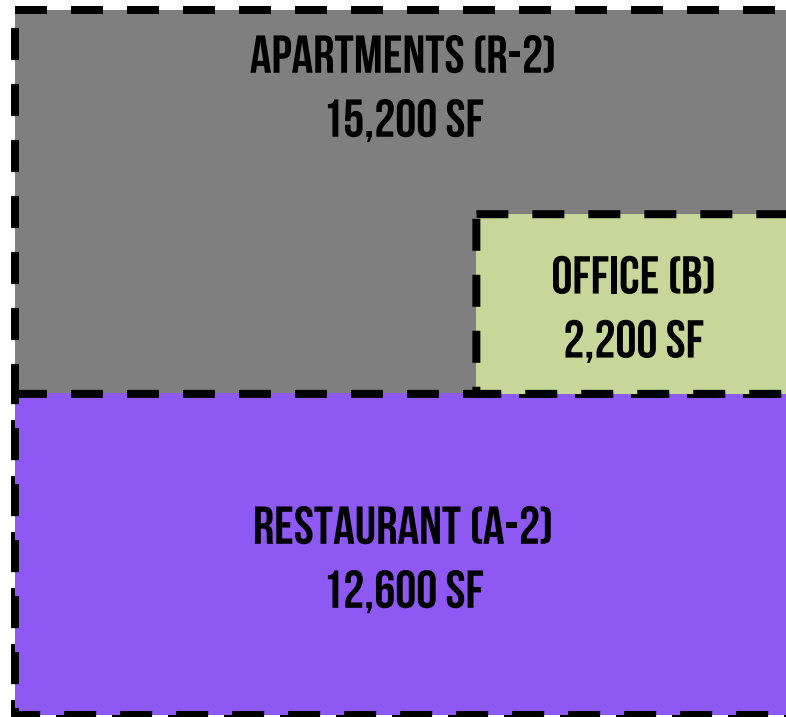
R-2: 70 FT, 4 STORIES - OK

A-2: 70 FT, 3 STORIES - OK

SEPARATED OCCUPANCIES

IBC 508.4

MULTI-STORY SEPARATED OCCUPANCY EXAMPLE



LEVEL 3 FLOOR PLAN

TRY CONSTRUCTION TYPE VA:

$$\text{VA: } 15,200/36,000 \pm 12,600/34,500 \pm 2,200/54,000 = 0.83$$

ALLOWABLE HEIGHT & STORIES:

R-2: 70 FT, 4 STORIES - OK

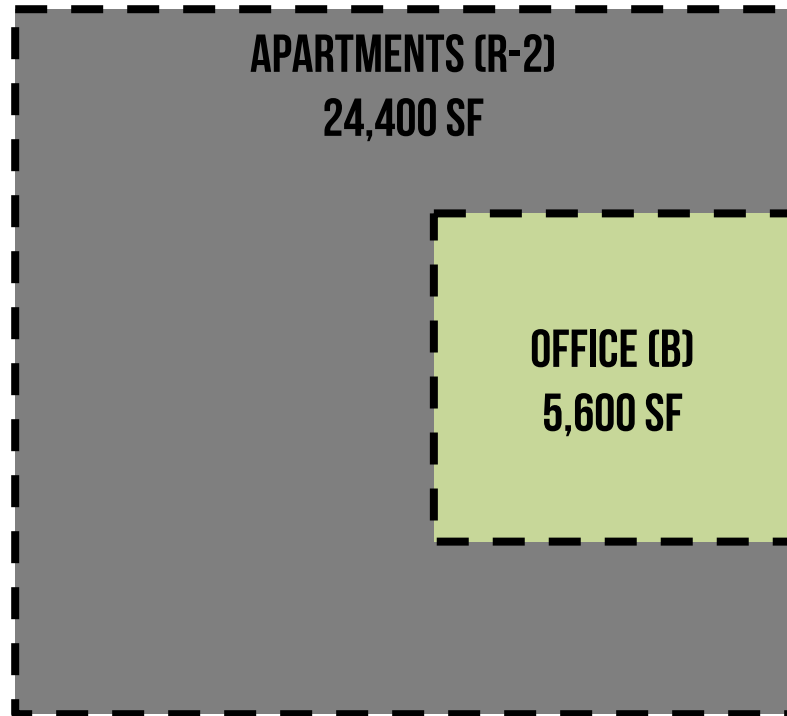
A-2: 70 FT, 3 STORIES - OK

B: 70 FT, 4 STORIES - OK

SEPARATED OCCUPANCIES

IBC 508.4

MULTI-STORY SEPARATED OCCUPANCY EXAMPLE



LEVEL 4 FLOOR PLAN

TRY CONSTRUCTION TYPE VA:

$$\text{VA: } 24,400/36,000 \pm 5,600/54,000 = 0.78$$

ALLOWABLE HEIGHT & STORIES:

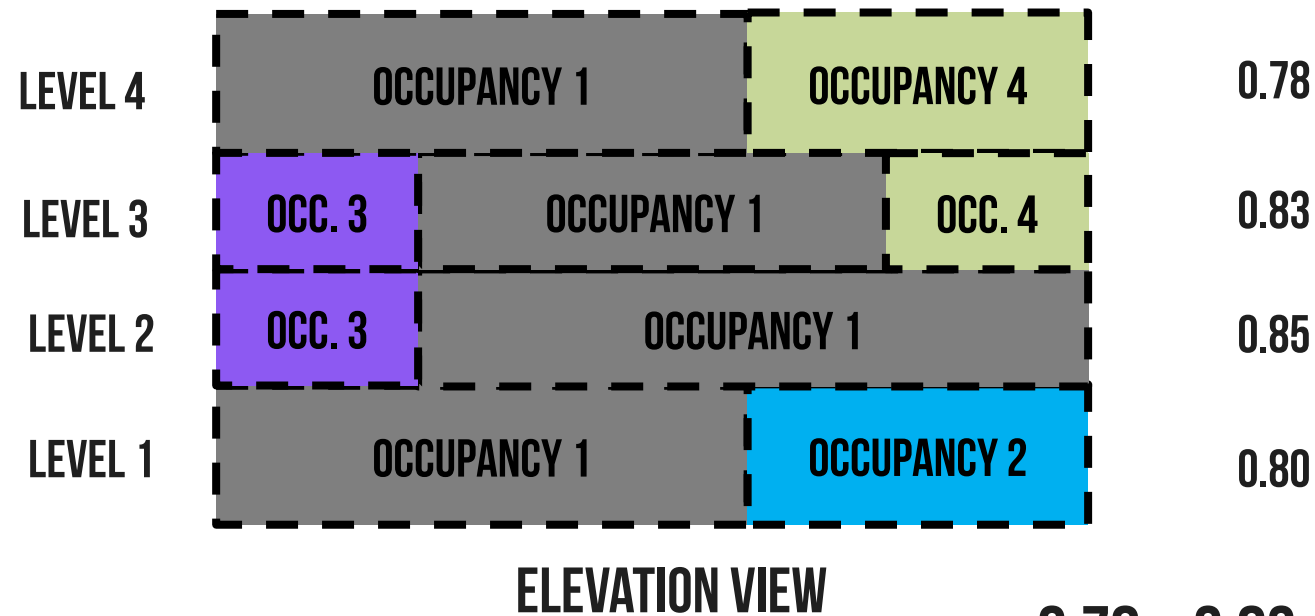
R-2: 70 FT, 4 STORIES - OK

B: 70 FT, 4 STORIES - OK

SEPARATED OCCUPANCIES

IBC 508.4

MULTI-STORY SEPARATED OCCUPANCY EXAMPLE



SUM OF RATIOS OF ACTUAL AREA/ALLOWABLE AREA FOR ALL
OCCUPANCIES PER FLOOR:

$0.78 \pm 0.83 \pm 0.85 \pm 0.80 = 3.26 > 3.0$ INADEQUATE;
TYPE VA CAN'T BE USED
USE TYPE IIIB

BUILDING CONFIGURATION OPTIONS



**EXAMPLE:
5 STORY HOTEL**

BUILDING CONFIGURATION OPTIONS

EXAMPLE: 5 story hotel

1st floor: lobby, restaurant
fitness center

conference rooms

Residential

2nd-5th floors residential

Option 1:

4-story, type V_A over 1 story type I_A (podium provision – IBC 510.2)

Mixed-use on 1st floor handled with separated/non-separated occupancies
considering that floor only



BUILDING CONFIGURATION OPTIONS

EXAMPLE: 5 story hotel

1st floor: lobby, restaurant
fitness center

conference rooms

Residential

2nd-5th floors residential

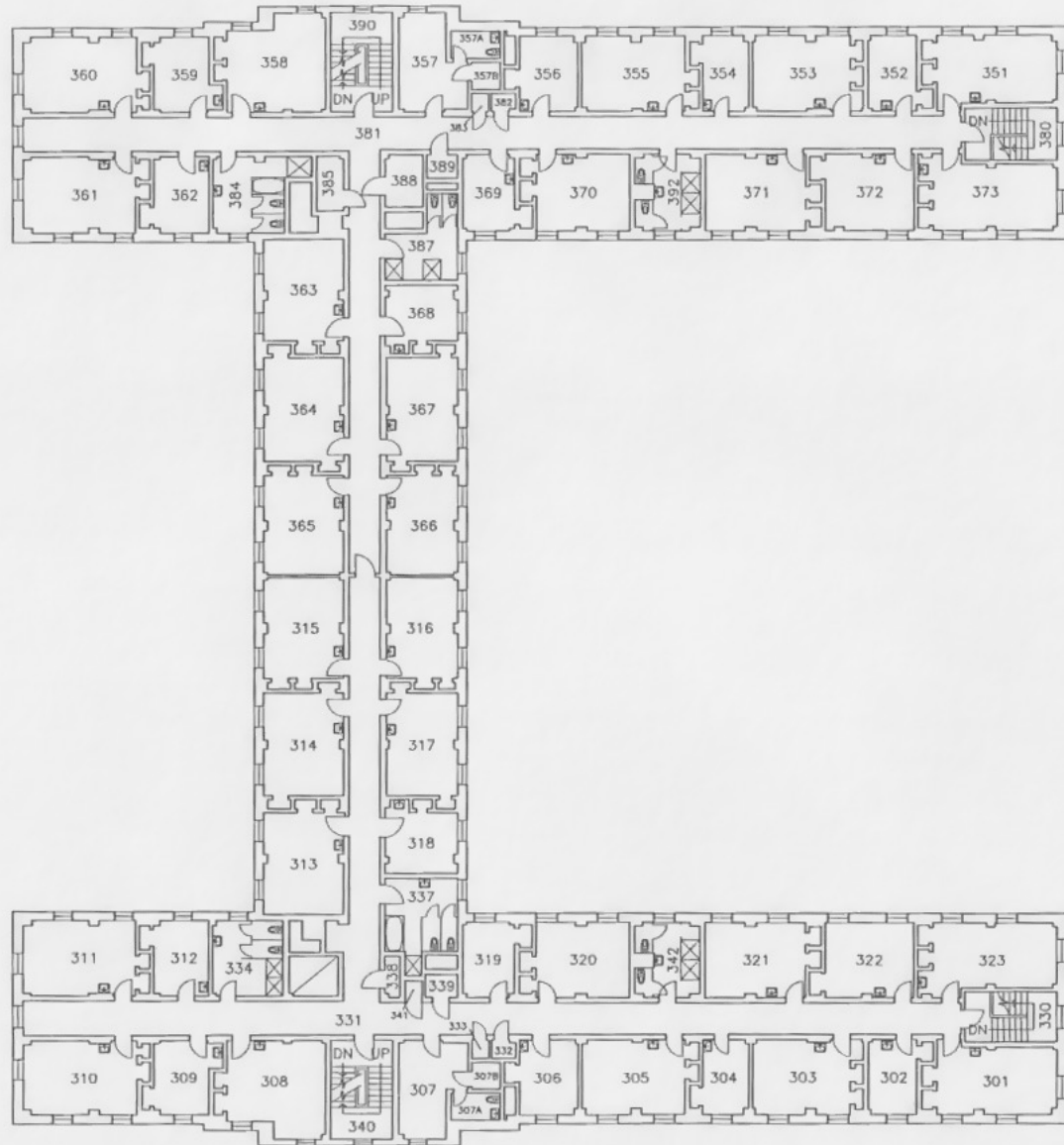
Option 2:

5-story, type III (with or without firewalls for area limitations)

Mixed-use on 1st floor handled with separated/non-separated occupancies
considering all floors



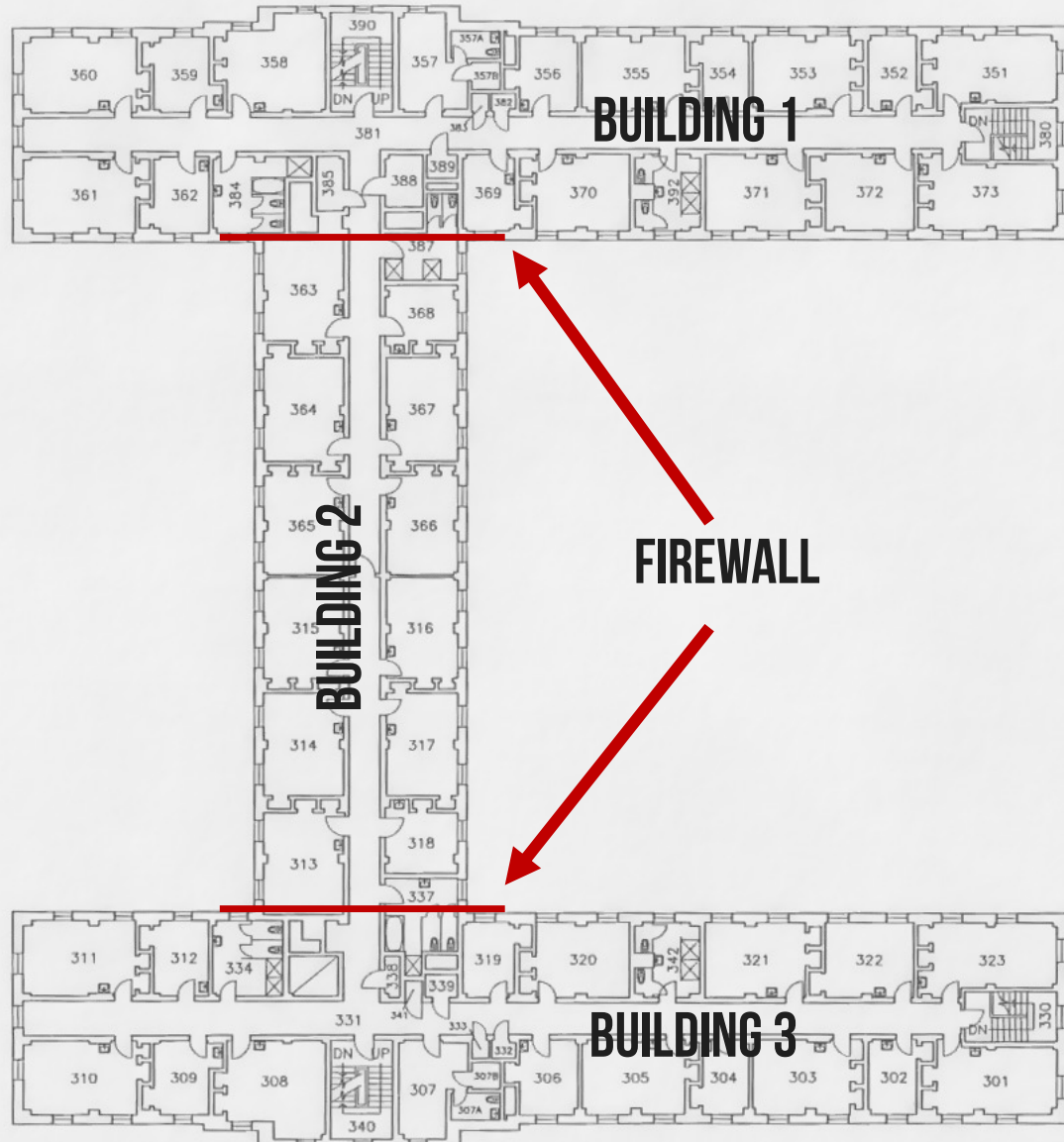
BUILDING CONFIGURATION OPTIONS



THIRD FLOOR PLAN

EXAMPLE:
**T- AND L-SHAPED BUILDINGS — COMMON IN HOTELS, OFTEN
WITH LARGE FLOOR AREAS**

BUILDING CONFIGURATION OPTIONS



THIRD FLOOR PLAN

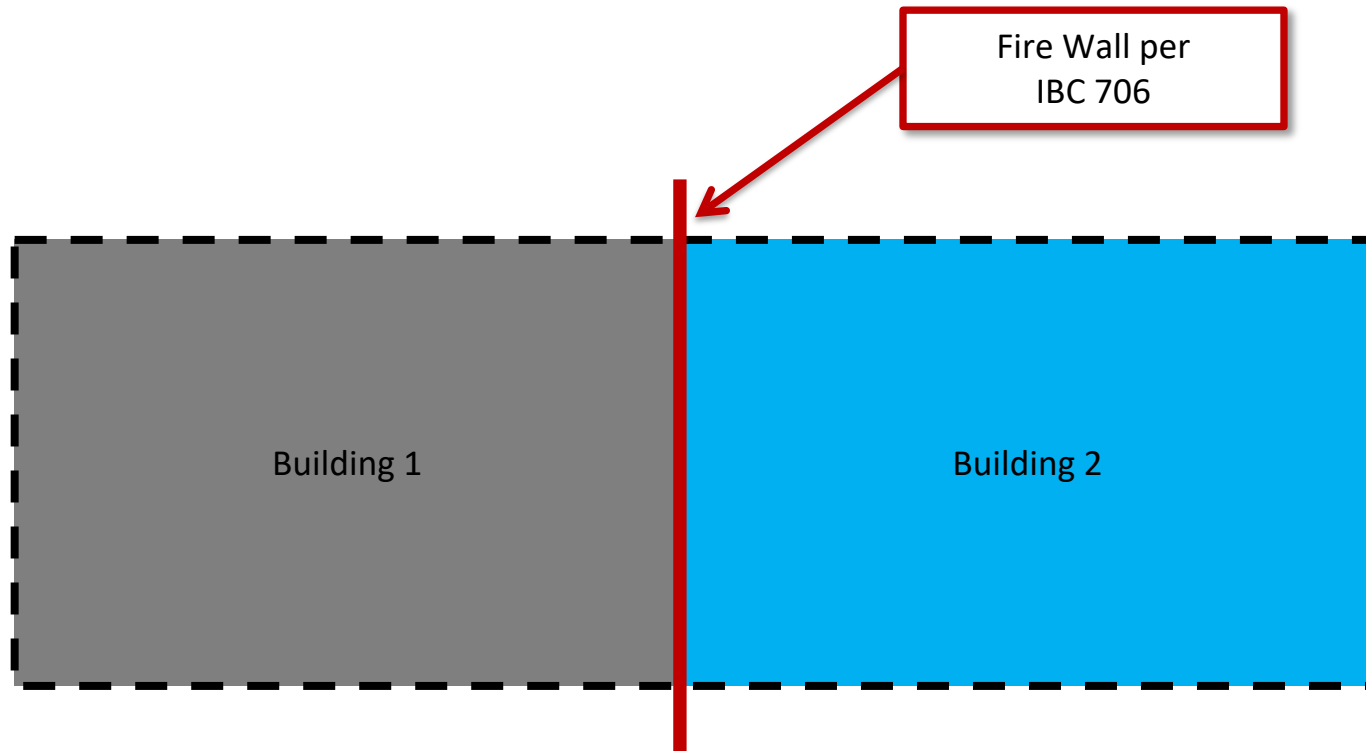
These building configurations may lend themselves well to use of firewalls at building intersections.

Minimize length/impact of firewall while maximizing allowable building area may allow lower construction type (i.e. type IIIB instead of IIIA)

FIRE WALLS

IBC 706

SEPARATE BUILDINGS — FIRE WALLS



EACH PORTION OF A BUILDING SEPARATED BY ONE OR MORE FIRE WALLS SHALL BE CONSIDERED TO BE A SEPARATE BUILDING



FIRE WALLS

IBC 706

- MATERIALS: NONCOMBUSTIBLE EXCEPT TYPE V
- HOURLY RATINGS PER TABLE 706.4
- PROTECTED OPENINGS
- CONTINUOUS FROM FOUNDATION TO/THROUGH ROOF
- STRUCTURAL STABILITY

IF FIRE WALL IS SEPARATING 2 OCCUPANCIES,
USE MOST RESTRICTIVE FIRE RATING FROM
TABLE

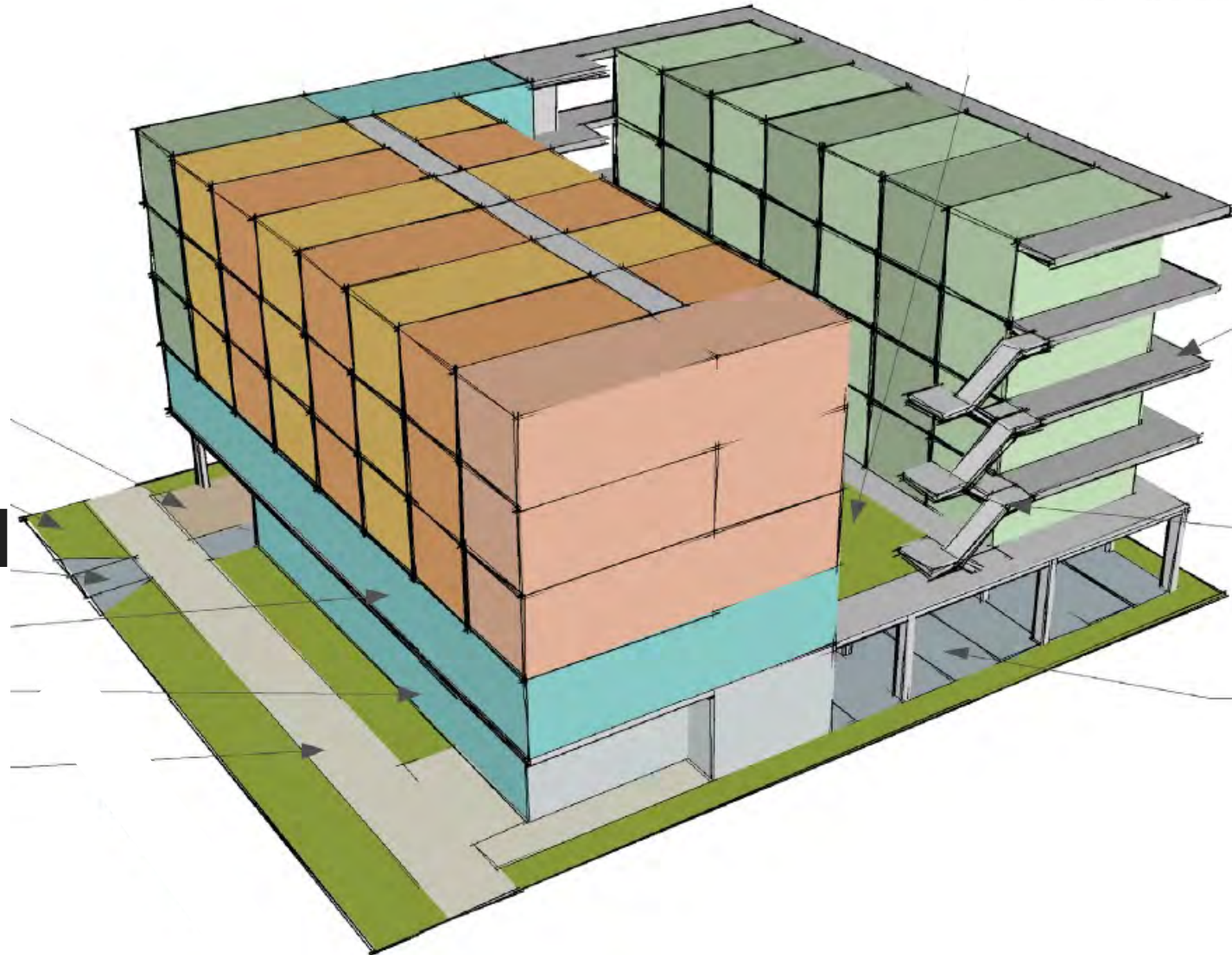
TABLE 706.4
FIRE WALL FIRE-RESISTANCE RATINGS

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

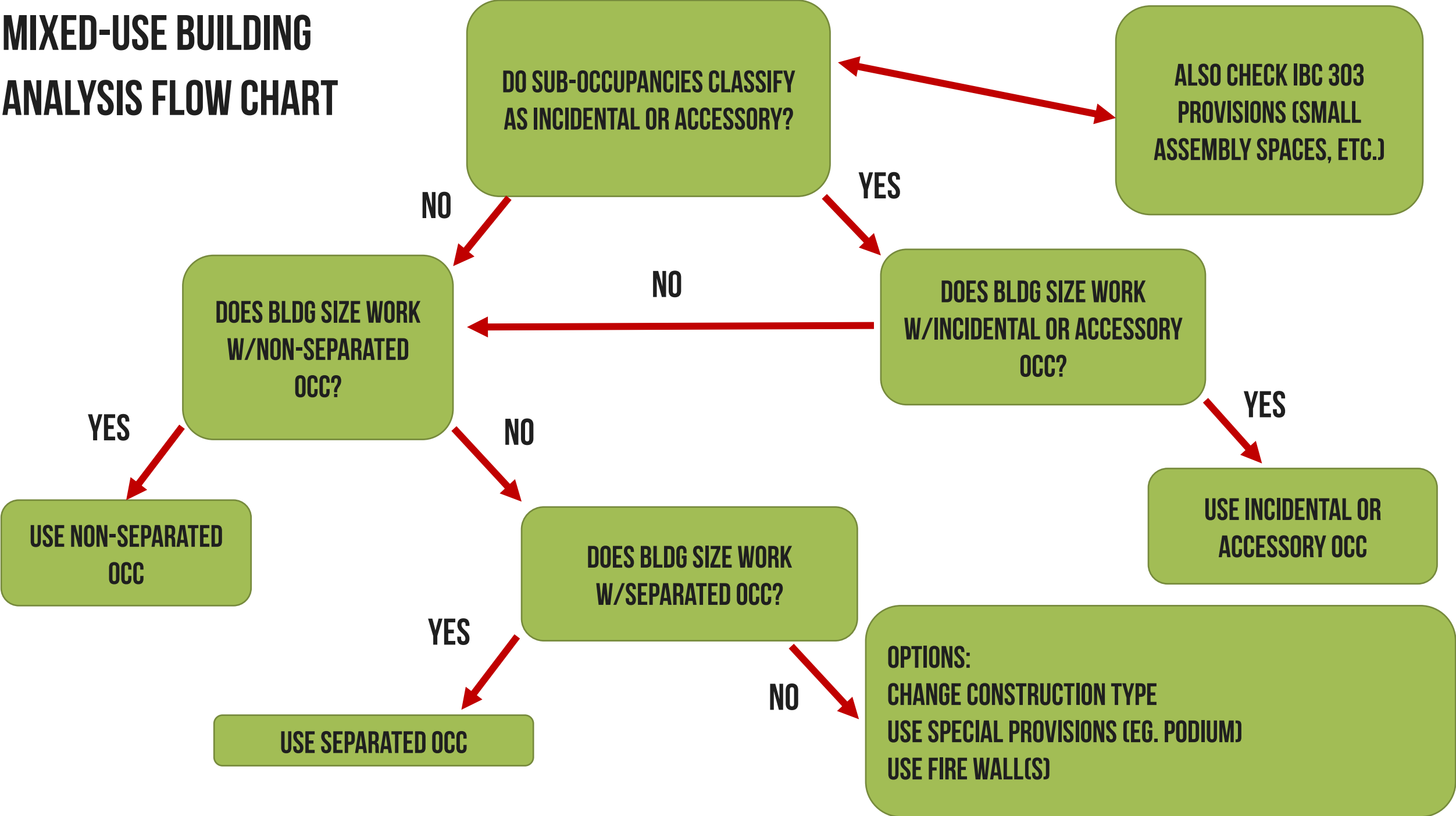
- a. In Type II or V construction, walls shall be permitted to have a 2-hour fire-resistance rating.
- b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.6 and 415.7.

BUILDING CONFIGURATION OPTIONS

**THERE ARE MULTIPLE WAYS TO
CLASSIFY A BUILDING. CHALLENGE
TRADITION AND CONSIDER ALL
OPTIONS IN AN EFFORT TO ACHIEVE
THE MOST COST EFFECTIVE SOLUTION**



MIXED-USE BUILDING ANALYSIS FLOW CHART



Questions? Contact us anytime!

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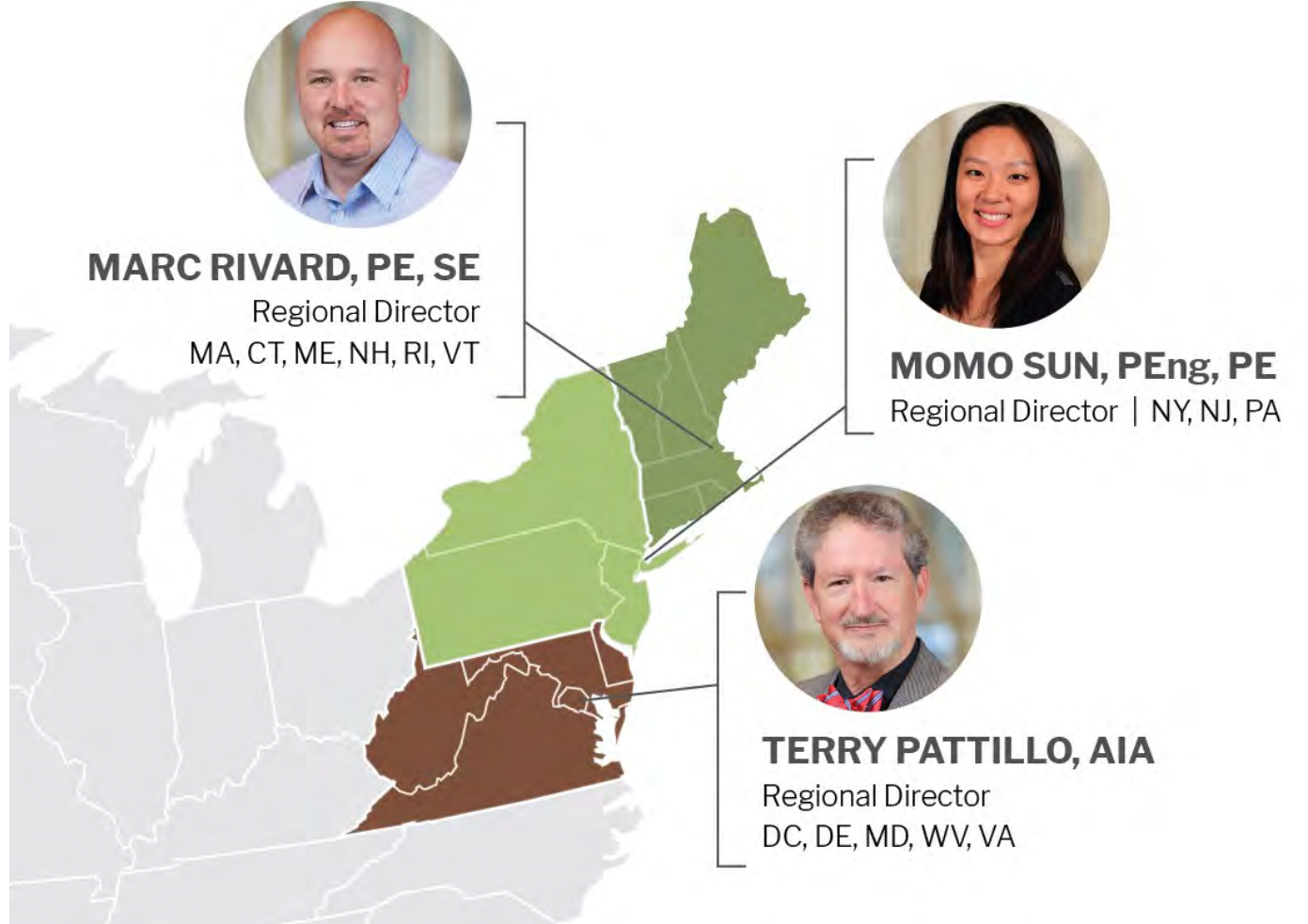
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