



2015 IBC Multifamily Dwellings

Presenter: Todd Snider

Tuesday, September 12, 2017

1:30 PM - 4:30 PM



2015 IBC MULTI-FAMILY BUILDINGS

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Use Group R

- Residential Occupancies (IBC 420)
 - Walls separating units
 - Fire partitions
 - Floor assemblies separating units
 - Per Section 711
 - **Automatic Sprinkler System Required**
 - **NFPA 13 or NFPA 13R**
 - Fire and smoke alarms required



"You has me for companion on the ship." – Oh

Fire Alarms

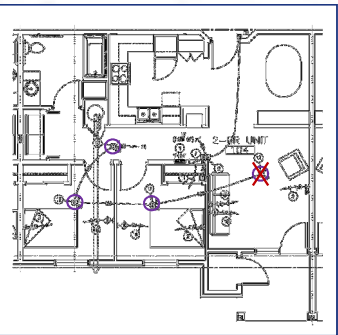
- IBC 907.2: **When Required**
 - Groups R-1, R-2 & R-4, not required if...
 - ≤ 2 stories, attics and crawl spaces are separated by a continuous 1-hour fire partition, and each sleeping unit has an exit directly to a public way.



Princess Leia: "It only takes one to sound the alarm"
Han Solo: "Then we'll do it real quiet like."

Smoke Alarms


- Group R-2, R-3, and R-4
 - Outside each sleeping area
 - In each room used for sleeping
 - On each story
- Group R-1:
 - In Sleeping Areas
 - In every room from sleeping room to exit
 - On each story



"Mom smokes in the car. Jesus is okay with it, but we can't tell dad." – Sheldon Cooper

Smoke Alarms

- ❑ Prohibited locations
 - Ionization alarms:
 - < 20 feet of cooking appliances
 - < 10 feet with silencing switch
 - Photoelectric alarms:
 - < 6 feet of cooking
 - < 3 feet from doors to bathrooms
- ❑ Alarms shall be interconnected
- ❑ Hardwired with battery backup





"And for gosh's sake, watch your language!" – Tony Stark

5

Carbon Monoxide

- ❑ Required in buildings with:
 - Forced air furnace
 - Fuel burning appliances
 - Attached private garages
- ❑ Location:
 - Dwelling units:
 - In the vicinity outside of sleeping areas
 - Within bedrooms containing fuel burning appliances
 - Within sleeping units
- ❑ Hardwired with battery backup





"You have reached the life model decoy of Tony Stark, please leave a message"
– Tony Stark

6

Horizontal Assemblies

- ❑ IBC 711.2.2: Continuity
 - Continuous w/out openings (except per IBC 712)
- ❑ IBC 711.2.3: Supporting Construction
 - Shall have same fire-resistance rating.
 - Exception:
 - In Type IIB, IIIB or **VB Construction**, Horizontal Assemblies separating dwelling units not required to be supported on rated assemblies.
- ❑ **IBC 803.11.2.1: Drop ceilings**
 - Framing for drop ceiling below rated assemblies are required to be of non-combustible construction.
 - Exception: FRT allowed in Type III and V

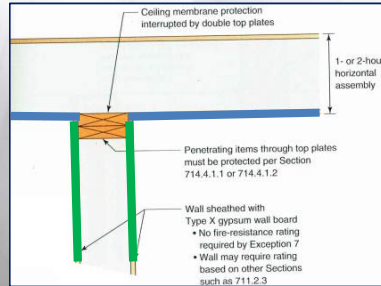


"Just because everybody hates it doesn't mean it's not good." – Gru

7


Membrane Penetrations

- ❑ **IBC 714.4.2: Exception 7:**



- 1-hr and 2-hr ceiling
- Double top plate
- Type X gypsum on wall
- Penetrations of top plate protected per 714
- Ceiling membrane tight to top plate

ICC, Significant Changes to the IBC ®

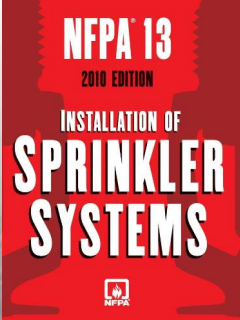


"I don't have a skull... Or bones." – Olaf

8

Fire Partitions

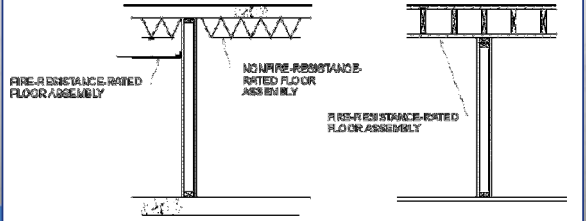
- ❑ IBC 708.3: **Fire-Resistance Rating**
 - Not less than **1-hour**
 - Exceptions:
 - Corridor walls may be ½-hour per Table 1020.1
 - Dwelling and sleeping unit separations in Types IIB, IIIB and VB construction may be ½-hour if **NFPA Sprinklered**.



"Really, I'm guessing you don't have much experience with heat." - Kristoff

Fire Partitions

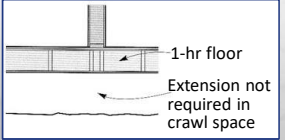
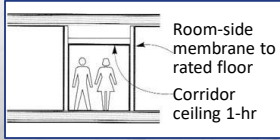
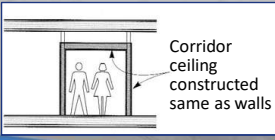
- ❑ IBC 708.4: **Continuity**
 - "...shall extend from the top of the foundation or floor-ceiling assembly below to the underside of the floor or roof sheathing, slab or deck **or** to the fire-resistance-rated floor/ceiling or roof/ceiling assembly above..."



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"And for gosh's sake, watch your language!" - Tony Stark

Fire Partitions

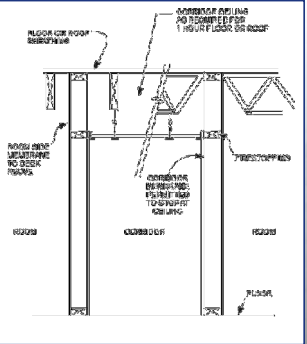
- ❑ IBC 708.4: **Continuity**
 - Exceptions...
 -  1-hr floor
Extension not required in crawl space
 -  Room-side membrane to rated floor
Corridor ceiling 1-hr
 -  Corridor ceiling constructed same as walls

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"It's against my programming to impersonate a deity." - C3PO

Fire Partitions

- ❑ IBC: **Continuity**
 - If not continuous to the sheathing... **fire blocking** and **draft stopping** is required.



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"My weakness. Small knives. Anything but knives!" - Spider man

Unvented Attics (Cont)

Insulation for unvented attics

- Air impermeable insulation only
 - Apply insulation to underside of roof sheathing
- Air permeable insulation only
 - Apply insulation to underside of roof sheathing
 - Rigid insulation above the roof per Table 1203.3
- Combination of permeable and impermeable
 - Impermeable directly to underside of roof sheathing
 - R-value for Impermeable insulation per Table 1203.3
 - Permeable insulation directly beneath impermeable
- Above roof rigid insulation only
 - Sufficient insulation such that roof sheathing average 45°F



"They got enough armed personnel to occupy Paris! Okay, bad example." – Reuben

Exterior Walls

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE^{a, b, h}

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H ^f	OCCUPANCY GROUP F-1, M, S-11	OCCUPANCY GROUP A, B, E, F-2, I, R, S-21, UP
X < 5 ^c	All	3	2	1
5 ≤ X < 10	IA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB	2	1	1 ^d
	IB, VB	1	0	0
	Others	1	1	1 ^d
X ≥ 30	All	0	0	0

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- Fire Separation Distance: The distance from the face of the building to one of the following:
 - The closest interior lot line
 - The centerline of a street or public way
 - An imaginary line between two buildings on the same lot
- Errata: Footnote h – Group U carports and private garages with FSD of 5 feet do not require fire rating.



"Keep your distance though, Chewie, but don't look like you're trying to keep your distance." – Han Solo

Exterior Walls

IBC 705.5: Fire-Resistance Ratings

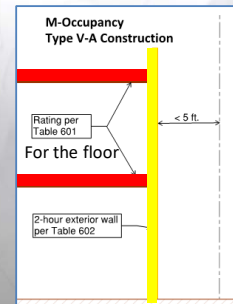
- Per IBC Tables 601 and 602
- FSD > 10-feet → "...rated for exposure to fire from the inside."
- FSD ≤ 10-feet → "...rated for exposure to fire from both sides."
- **Type III Construction**



"Listen to them, they're dying R2! Curse my metal body. I wasn't fast enough. It's all my fault!" – C3PO

Exterior Walls

IBC 705.6: Ext. Walls – Structural Stability



- "Interior structural elements that brace the exterior wall but that are **not located within the plane** of the exterior wall shall per **Table 601** for **that** element."
- Structural elements that brace the exterior wall but are located **outside** or **within the plane** of the exterior wall per **Tables 601 and 602** for the **exterior wall**."



"Can I come into the out now?" – Oh

Exterior Walls

Design Installation Guide #1500, Weyerhaeuser

FWH

2 Hour Fire-Rating

FWH hangers are tested per ASTM E814 standards. The test report states "When installed on one side of a maximum 2 hour fire-rated wall assembly, the penetration of the USP FWH Fire Wall Hanger through the gypsum board will not reduce the fire resistive rating of the 2 hour fire resistive assembly."

#USP2317, MiTek Industries, Inc.

"Oh, Jameson pays me a fair wage. If it was 1961." – Peter Parker 21

Exterior Posts

❑ **IBC 704.10: Exterior Structural Members**

- "Load-bearing structural members ... outside of a building or structure" provided the highest rating of:
 - Table 601 for its type of building element
 - Table 601 for exterior walls
 - Table 602 based on FSD
- Type III or V-A construction
 - *Exterior posts must be fire rated per Exterior Walls*

"How dare you shush a shushing" – Captain Smek 22

Projections

❑ **IBC 705.2: Projections**

- "Cornices, eave overhangs, exterior balconies and similar projections..."

FIRE SEPARATION DISTANCE (FSD)	MINIMUM DISTANCE FROM LINE USED TO DETERMINE FSD
0 feet to 2 feet	Projections not permitted
Greater than 2 feet to 3 feet	24 inches
Greater than 3 feet to less than 30 feet	24 inches plus 8 inches for every foot of FSD beyond 3 feet or fraction thereof
30 feet or greater	20 feet

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- **Projection = 1/3 FSD**

"This is the maintenance closet, Gwen. This is the most clichéd hiding place you could've chosen." – Peter Parker 23

Combustible Projections

❑ **IBC 705.2.3: Combustible Projections**

- If w/in **5-foot** lot line...
 - 1-Hour construction, or...
 - Type IV construction, or...
 - Fire-retardant-treated wood
 - IBC 1406.3 (Exceptions): Pickets & rails or Fire sprinklers

"We seem to be made to suffer. It's our lot in life." – C3PO 24

Exterior Openings

FIRE SEPARATION DISTANCE (ft=)	DEGREE OF OPENING PROTECTION	ALLOWABLE AREA*
0 to less than 20 ⁽¹⁾	Unprotected, Nonsprinklered (UP, NS)	Not Permitted
	Unprotected, Sprinklered (UP, S) ⁽²⁾	Not Permitted
	Protected (P)	Not Permitted
30 to less than 40 ⁽³⁾	Unprotected, Nonsprinklered (UP, NS)	Not Permitted
	Unprotected, Sprinklered (UP, S) ⁽²⁾	15%
	Protected (P)	15%
5 to less than 10 ⁽⁴⁾	Unprotected, Nonsprinklered (UP, NS)	10% ⁽⁵⁾
	Unprotected, Sprinklered (UP, S) ⁽²⁾	25%
	Protected (P)	25%

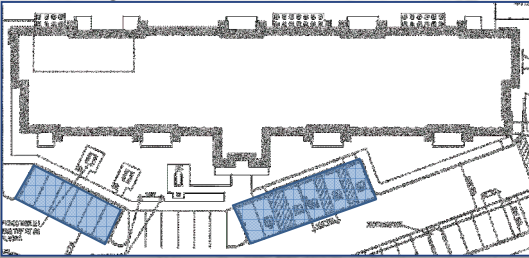
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- Footnote J: Use Group U Private Garages and carports with F.S.D. of 5'-0" or more unlimited openings
- NFPA 13R considered Nonsprinklered**
- Exception 2: Buildings with unrated exterior walls (Table 601 and 602) shall have unlimited openings:
 - **Type III-A, III-B, V-A**

"My brain hates me for seeing this." – Wasabi

Buildings on Same Lot

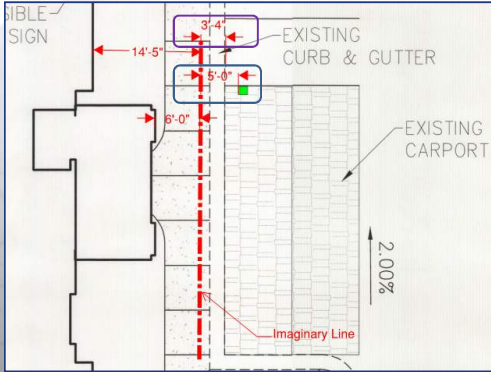
- Buildings on Same Lot (503.1.2)
 - Separate Buildings, or
 - Same building



"I choose Gru" – Lucy Wilde

Carport Example

- Table 602, Footnote h: FSD = 5'-0" no fire rating
- Table 705.8, Footnote J: FSD = 5'-0" unprotected openings
- Table 705.2: FSD = 5'-0" projections within 40"**



"Sir, the possibility of successfully navigating an asteroid field is approximately 3,720 to 1." – C3PO

Building Height

- IBC 504.2: No occupancy shall exceed the limits specified.
- IBC 504.3: The maximum height shall not exceed Table 504.3 (**NFPA 13R = NS**)
- IBC 504.4: The maximum number of stories per Table 504.4. (**NFPA 13R = NS**)
- Towers, spires, and steeples
 - No habitation or storage
 - Non-combustible – No Limit
 - Combustible – 20 feet higher than Table

"A fear of heights is illogical. Fear of falling on the other hand is prudent and evolutionary" – Sheldon Cooper

Table 504.4: # of Stories

TABLE 504.4^{a,b}
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	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	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	

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"Do not eat the blue mints! Thankfully there is a large bowl of lemonade." – Obi-Wan Kenobi

Building Area

☐ Allowable area determined by:

- Construction Type
- Use Group
- Automatic Fire Sprinklers
- Building Frontage

☐ Single Basement

- Limited by allowable area per story
- Does not count toward total area

"Wonderful girl. Either I'm going to kill her or I'm beginning to like her." – Han Solo

IBC 506: Building Area

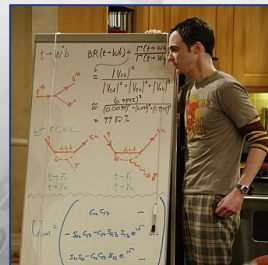
☐ Allowable Building Area *per story*

$$A_a = A_t + [NS \times I_f] \quad (\text{Eq. 5-1})$$

- A_a = Allowable building area
- A_t = Tabular Area (Table 506.2)
- I_f = Frontage increase factor
- NS = Tabular area for non-sprinklered building

Other Terms:

- UL – Unlimited
- NP – Not Permitted
- NS – Not Sprinklered
- S1 – 1 Story Sprinklered (NFPA 13)
- SM – Multi-story Sprinklered (NFPA 13)
- S13R – Sprinklered NFPA 13R



"It's just some quantum mechanics, with a little string theory doodling around the edges." – Sheldon Cooper

Table 506.2

TABLE 506.2^{a,b}—continued
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, or SM, as applicable) IN SQUARE FEET

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION									
		TYPE I		TYPE II		TYPE III		TYPE IV		TYPE V	
		A	B	A	B	A	B	HT	A	B	
I-1	NS ^a	UL	55,000	19,000	10,000	16,500	10,000	18,000	10,500	4,500	
	S1	UL	220,000	76,000	40,000	66,000	40,000	72,000	42,000	18,000	
	SM	UL	165,000	57,000	30,000	49,500	30,000	54,000	31,500	13,500	
I-2	NS ^a	UL	UL	15,000	11,000	12,000	NP	12,000	9,500	NP	
	S1	UL	UL	60,000	44,000	48,000	NP	48,000	38,000	NP	
	SM	UL	UL	45,000	33,000	36,000	NP	36,000	28,500	NP	
I-3	NS ^a	UL	UL	15,000	10,000	10,500	7,500	12,000	7,500	5,000	
	S1	UL	UL	45,000	40,000	42,000	30,000	48,000	30,000	20,000	
	SM	UL	UL	45,000	30,000	31,500	22,500	36,000	22,500	15,000	
I-4	NS ^a	UL	60,500	26,500	13,000	23,500	13,000	25,500	18,500	9,000	
	S1	UL	121,000	106,000	52,000	94,000	52,000	102,000	74,000	36,000	
	SM	UL	181,500	79,500	39,000	70,500	39,000	76,500	55,500	27,000	
M	NS	UL	UL	21,500	12,500	18,500	12,500	20,500	14,000	9,000	
	S1	UL	UL	86,000	50,000	74,000	50,000	82,000	56,000	36,000	
	SM	UL	UL	64,500	37,500	55,500	37,500	61,500	42,000	27,000	
R-1	NS ^a	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000	
	S13R	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000	
	S1	UL	UL	96,000	64,000	96,000	64,000	82,000	48,000	28,000	
	SM	UL	UL	72,000	48,000	72,000	48,000	61,500	36,000	21,000	

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"You usually don't see that in bunnies." – Gru

Mixed Use



- General (508.1)
 - Use Group
 - Classify each area
 - Requirements of Code apply to each use
 - Each floor level is calculated independently
 - 4 Methods:
 - Accessory (508.2)
 - Non-separated (508.3)
 - Separated
 - Mix and Match

Rendering of State Street Plaza, Salt Lake City, Utah



"I have a plan" – Peter Quill

33

IBC 508.2: Accessory

- Accessory Areas (IBC 508.2)
 - Allowable height (508.2.2)
 - Per Main Occupancy
 - Allowable Building Area (508.2.3)
 - Per Main Occupancy
 - Accessory Occupancy shall (508.2.3):
 - Not exceed 10% of floor area
 - Not exceed NS Area of Table 506.2



"Nobody wants to be alone. Except maybe you." – Anna

34

Nonseparated Uses

- Nonseparated
 - Use Groups not separated by fire rated construction
 - Most stringent requirement applies to whole building
 - Chapter 9 – Fire sprinklers or alarms
 - Chapter 5 – Height and area
 - Section 403 High rise buildings
 - Different Use Groups may control for different Sections



"I'm an interpreter. I'm not supposed to know a power socket from a computer terminal."
– C3PO


35

Separated Use Groups

- Separated Use Groups (Table 508.4)
 - Different Use Groups separated by:
 - Fire Barriers
 - Horizontal assemblies
 - **NFPA 13R is nonsprinklered**
 - Allowable Area
 - Determined for each Use
 - Sum of ratio actual/allowable < 1
 - Allowable height
 - Each use limited by Section 503

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

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"This drink is a wonderful example of how liquids with different specific gravities interact in a cylindrical container." – Leonard Hofstadter

36

Multiple Stories



- ❑ Single Occupancy (506.2.2)
 - Total Allowable Area
 - $A_a = [A_1 + (NS \times I_1)] \times S_a$
 - S_a = Actual number of stories
 - No more than 3
 - Each story
 - $< A_a$ for $S_a = 1.0$
- ❑ Mixed Occupancy
 - Each Story per 508
 - More than 3 Story
 - Sum of Ratio of Actual/Allowable per floor < 3.0

Tower 1, Salt Lake City, Utah

"Flying makes me a better care provider." – Baymax

37

Multistory Example

- ❑ V-A, 4-Story, NPFA 13R, No Frontage
 - A-2/A-3: $A_a = 11,500 \text{ ft}^2$
 - B: $A_a = 18,000 \text{ ft}^2$
 - M: $A_a = 14,000 \text{ ft}^2$
 - R-2: $A_a = 12,000 \text{ ft}^2$
 - $0.98 + 1.0 + 2 \times (1.0) = 3.98$
 - OK, Exception 506.2.4

A-2 3,000ft ²	B 4,000ft ²	M 7,000ft ²
0.26	0.22	0.50

Level 1

B 1,500ft ²	R-2 9,500 ft ²	A-3 1,500ft ²
0.08	0.79	0.13

Level 2

R-2 12,000ft ²
1.00

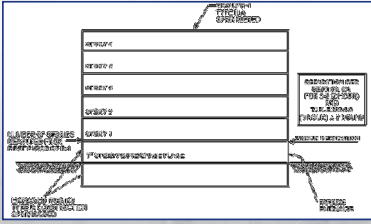
Level 3 & 4

"When I look around, you know what I see? Losers." – Peter Quill

38

Parking Below R (510.4)

- ❑ S-2 Parking
 - Open or enclosed
 - 1 story above grade
 - Type I or IV
- ❑ Group R
 - Any construction type
 - Only count stories above
- ❑ Floor between buildings
 - Same construction type as garage
 - Minimum Fire Rating per IBC 508.4



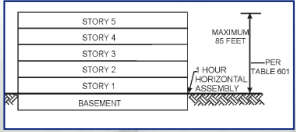
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"You're making me beat up grass!" – Rocket Raccoon

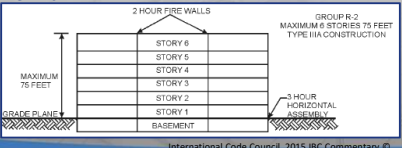
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R-1 or R-2 of III-A (510.5)

- ❑ IBC 510.5: R1 or R2 of III-A
 - 6 Stories Maximum
 - 75 feet max height
 - First floor above basement:
 - 3-hr fire rated
 - Floor area limited:
 - 3,000 ft² per area
 - Separated by 2-hr Fire Wall



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"O for 17" – Scott Voss

40

R-1 or R-2 Type IIA

- ❑ IBC 510.6: R-1 or R-2 of Type II-A
 - 100 feet max height
 - Max 9 stories
 - 50 foot separation from
 - Lot Lines
 - Other buildings
 - Exits separated by 2-hr rated **Fire Walls**
 - First floor assembly is 1-1/2-hr rated

IBC 503

IBC 510.6

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"And then he froze us up like popsicles" – Willie

41

Open Parking Below R

- ❑ IBC 510.7:
 - Parking Garage
 - Open Parking Garage
 - Height and area per 406.5
 - Building above
 - Per Section 503
 - Height and stories include parking
 - Separation
 - Separated per 508.4
 - Separate construction types
 - Fire rating of structural elements supporting building above to be most restrictive
 - Means of egress from building above
 - Separated by 2-hr fire barrier from parking
 - Openings to be 2-hour rated (not 90 min.)

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"Instead of tasing people and kidnapping them, maybe you should give them a call!" – Gru

42

Energy Code

- ❑ Commercial Provisions:
 - Required:
 - All R-1 Use Groups
 - Other Group R with > 3 stories
 - Dwelling or sleeping units
 - 75% high efficacy lights
 - Exempt from lighting requirements
 - Thermal Envelope in podiums
 - Parking garage included:
 - Automatic closing garage doors required
 - Walls required to be insulated
 - Parking garage not included:
 - No heating/cooling permitted in garage
 - Insulation required between garage and units above

"Don't pander to me, kid. One tiny crack in the hull and our blood boils in thirteen seconds." – Leonard McCoy

43

Shaft Enclosures

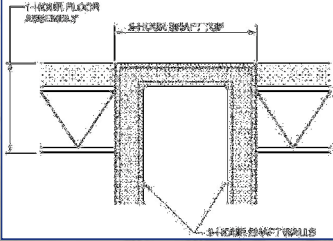
- ❑ "...shall be constructed as **fire barriers**... or **horizontal assemblies**... or both."
- ❑ IBC 713.4: **Fire-Resistance Rating**
 - ≥ 4 stories ≥ 2-hour rating
 - < 4 stories ≥ 1-hour rating
 - Shall include basements
 - Mezzanines not included

"I do some web designs." – Peter Parker

44


Shaft Enclosures

- ❑ IBC 713.12: **Enclosure at Top**
 - Must extend to underside of roof sheathing, or...
 - Must have the same rating as the top most floor penetration, but not less than shaft rating.



2-hr Stair Enclosure

International Code Council, 2015 IBC Commentary®

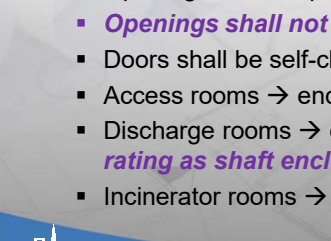


"Wait, you got engaged to someone you just met that day?" – Kristoff

45


Shaft Enclosures

- ❑ IBC 713.13: **Waste/Linen Chutes & Incinerator**
 - Must comply with NFPA 82, Chapter 5
 - Shall not be used for any other purpose
 - Openings shall be protected (3/4-hour rating)
 - **Openings shall not be located in corridors**
 - Doors shall be self-closing
 - Access rooms → enclosed by **1-hour fire barriers**
 - Discharge rooms → enclosed by **fire barriers of same rating as shaft enclosure**
 - Incinerator rooms → per IBC Table 509



2-hr Stair Enclosure

International Code Council, 2015 IBC Commentary®

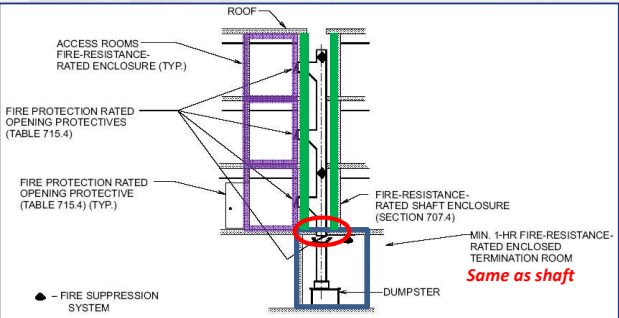


"We have been without an interpreter since our master got angry with our last protocol droid and disintegrated him." – EV-9D9

46


Shaft Enclosures

- ❑ IBC 713.13: **Waste/Linen Chutes & Incinerator**
 - Sprinklered per IBC 903.2.11.2.



Same as shaft

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"Well somebody has to save our skins. Into the garbage fly-boy." – Princess Leia

47


Duct and Air Transfer

- ❑ Ducts/Air Transfer Openings
 - HVAC duct
 - Bathroom exhaust ducts
 - Dryer exhaust ducts
 - Dampers not permitted
 - Kitchen exhaust ducts
 - Combustion air
- ❑ Smoke and Fire Dampers Required
 - Fire Walls (no exceptions)
 - Shaft Enclosures
 - Corridors
 - Horizontal Assemblies



2-hr Stair Enclosure

International Code Council, 2015 IBC Commentary®



"You're afraid of insects and women. Ladybugs must render you catatonic." – Sheldon

48

Shaft Penetrations

□ IBC 717.5.3: Duct Penetration of Shafts

- Fire and Smoke Damper Required
- Exceptions:
 - Fire dampers not required:
 - 22" Vertical in shaft
 - Kitchen and clothes dryers per IMC 504.8
 - Smoke dampers not required:
 - Kitchen, clothes dryer, bathroom if:
 - » 26 gage, 22" Vertical, and Exhaust fan w/ Emergency power
 - Fire and smoke dampers not required:
 - In parking garage separated by 2hr rating from building
 - Smoke control system



"One cries because one is sad. For example, I cry because others are stupid, and that makes me sad." – Sheldon Cooper

49

Ducts in Fire Partitions

□ IBC 717.5.4: Duct penetration of unit separation walls

- Fire Damper Required
 - Exceptions:
 - Corridor walls with NFPA 13 or 13R
 - Duct meets following:
 - » < 100 in², 0.0217" steel, not open to corridor, above ceiling, no register in rated wall, 12" long 0.06" thick sleeve at penetration.
 - Part of HVAC system with following:
 - » Wall rating is 1 hour or less, NFPA 13 or 13R, 26 gage, continuous from air handler to outlet.



"I have an eidetic memory. Sometimes it's a curse." – Sheldon Cooper

50

Ducts in Corridors

□ IBC 717.5.4.1: Duct penetrations in corridors

- Corridor dampers required at rated ceiling through-penetrations
- Ceiling radiation dampers for membrane penetration
- Smoke dampers in rated or smoke barrier corridors
 - Exceptions:
 - Smoke control system
 - 0.019" duct, no opening into corridor



"Holy crap are we nerdy!" – Rajesh Koothrappali

51

Horizontal Assemblies

□ IBC 717.6.1: Duct through penetrations of rated floors.

- Fire damper required, except:
 - Connects only 2 stories
 - Penetrate 3 floors (4 stories) if:
 - Within a wall
 - 26 gage steel
 - Open into only (1) dwelling
 - Continuous to exterior
 - 4" diameter, less than 100in² in 100ft²
 - Annular space protected
 - Grille openings have ceiling radiation damper



"You can't incinerate a Bengal tiger with a magnifying glass." – Rajesh Koothrappali

52

Membrane Penetration

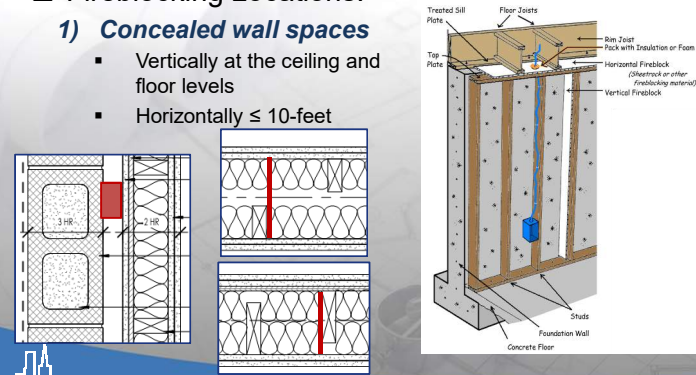
- ❑ IBC 717.6.2: Membrane penetrations of ducts
 - Protected by one of the following:
 - Shaft enclosure
 - A listed ceiling radiation damper
 - Damper not required for any of the following:
 - Assembly tested per ASTM E 119 with penetration
 - Exhaust ducts with following:
 - Penetration protected per 714.4.2 (Fire-Stop)
 - Located in wall cavity
 - Don't pass through another unit
 - **Duct outlet protection system tested per ASTM E 119**



"I'm too small for Twister. And roller coasters. And sitting with my feet on the floor." - Bernadette

Concealed Spaces

- ❑ Fireblocking Locations:
 - 1) **Concealed wall spaces**
 - Vertically at the ceiling and floor levels
 - Horizontally ≤ 10-feet



"Homo habilis discovering his opposable thumbs says what?" - Leonard Hofstadter

Fire Extinguishers

- ❑ Size & Distribution:
 - Class 'A' → Table 906.3(1)
 - Class 'B' → Table 906.3(2)
 - Maximum Travel Distance of 75-feet
 - **This includes to all areas within each unit.**

	LIGHT (Low) HAZARD OCCUPANCY	ORDINARY (Moderate) HAZARD OCCUPANCY	EXTRA (High) HAZARD OCCUPANCY
Minimum Rated Single Extinguisher	2-A*	2-A	4-A*
Maximum Floor Area Per Unit of A	3,000 square feet	1,500 square feet	1,000 square feet
Maximum Floor Area for Extinguisher ^b	11,250 square feet	11,250 square feet	11,250 square feet
Maximum Travel Distance to Extinguisher	75 feet	75 feet	75 feet

TYPE OF HAZARD	BASIC MINIMUM EXTINGUISHER RATING	MAXIMUM TRAVEL DISTANCE TO EXTINGUISHERS (feet)
Light (Low)	5-B	30
	10-B	50
Ordinary (Moderate)	10-B	30
	20-B	50
Extra (High)	40-B	30
	80-B	50

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"My hands are equipped with defibrillators." - Baymax

Two Means of Egress

- ❑ 1006.2 – 2 means of egress required for any of the following :
 - Occupant Load
 - Travel Distance

OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)		
		Without Sprinkler System (feet)		With Sprinkler System (feet)
		Occupant Load		
A*, E, M	49	OL ≤ 30	OL > 30	75*
		75	75	
B	49	100	75	100*
F	49	75	75	100*
H-1, H-2, H-3	3	NP	NP	25*
H-4, H-5	10	NP	NP	75*
I-1, I-2*, I-4	10	NP	NP	75*

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- Special uses:
 - Boiler rooms
 - Cold rooms
 - Refrigeration rooms
 - Day cares



"You take the blue pill – the story ends . . . You take the red pill you stay in wonderland" - Morpheus

Means of Egress

8,700 S.F. / 200
= 43.5 occ.

185 ft

OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)	
		Without Sprinkler System (feet)	
		Occupant Load	With Sprinkler System (feet)
S ^a	20	100	75
U	40	100	75

"Why don't you make like a tree and get out of here" - Biff

57

Means of Egress/Story

- Occupied Roofs same as stories
- Number of Exits per Table 1006.3.1

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

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- Egress Access through only (1) adjacent story
- Above 2 story at least (1) Exit Stair
- Stories with Single Exit per 1006.3.2

*"No! Listen, the only thing I want to do with your hair is to get out of it, literally!"
- Flynn Rider*

58

Means of Egress/Story

88'-0"

STORY	OCCUPANCY	MAXIMUM NUMBER OF DWELLING UNITS	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE
Basement, first, second or third story above grade plane	R-2 ^a	4 dwelling units	125 feet
Fourth story above grade plane and higher	NP	NA	NA

For SI: 1 foot = 304.8 mm.
NP = Not Permitted.
NA = Not Applicable.

a. Buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and provided with emergency escape and rescue openings in accordance with Section 1030.
b. This table is used for R-2 occupancies consisting of dwelling units. For R-2 occupancies consisting of sleeping units, use Table 1006.3.2(2).

"Escape is not his plan. I must face him alone. - Darth Vader"

59

Means of Egress Configuration

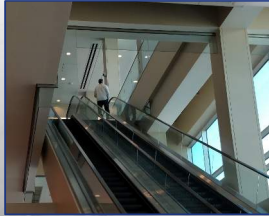
- 1/2 or 1/3 longest diagonal between exit or exit access doorways

"Looks like you've managed to cut off our only escape route." - Princess Leia

60

Access Stairs

- ❑ 1019.3: Other than I-2 or I-3, Unenclosed:
 - Open to only 2 floors
 - **Within Group R dwelling unit**
 - **Within R-3 or R-4**
 - Draft Curtain W/NFPA 13
 - Other than B and M limited to 4 stories
 - Within Atriums
 - Open Parking garages
 - Open air seating areas
 - Serving balconies or galleries in theaters or auditoriums



Utah Valley Convention Center, Provo, Utah

"To the windy stairs . . . Up, up, up the stairs we go and then we come to the tunnel" – Smeagol

61

IBC 1020: Corridors

- ❑ Corridors (IBC 1020)
 - Air movement restricted




TABLE 1020.1
CORRIDOR FIRE-RESISTANCE RATING

OCCUPANCY	OCCUPANT LOAD SERVED BY CORRIDOR	REQUIRED FIRE-RESISTANCE RATING (hours)	
		Without sprinkler system	With sprinkler system*
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
I-2*, I-4	All	Not Permitted	0
I-1, I-3	All	Not Permitted	1*

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TABLE 1020.2
MINIMUM CORRIDOR WIDTH

OCCUPANCY	MINIMUM WIDTH (inches)
Any facilities not listed below	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

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"If you want to know who killed Mr. Body, I did. In the hall. With the revolver." – Mr Green

62

Corridor Openings

- ❑ Corridor doors
 - 716.5.3: Corridor doors
 - Smoke and draft control
 - **S rating required**
 - 20 minute rating
 - Self closing
 - 3002.6: Elevator Doors
 - Doors must be:
 - Readily openable from car
 - No key or special knowledge

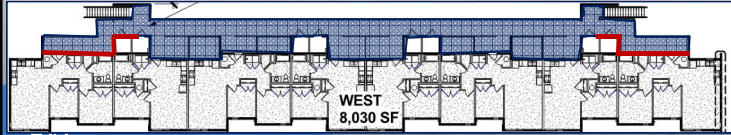



"I may be as pretty as an angel, but I sure as hell ain't one." – Yondu Udonta

63

Egress Balconies

- ❑ IBC 1021: Balconies used for egress
 - Wall Separation (1021.2):
 - Separated from interior per corridors
 - Exception: 2 stairs w/out deadend
 - Openness (1021.3):
 - "Long side" shall be 50% open
 - Location (1021.4):
 - 10 feet from lot lines, other buildings, or the same building



"Can I come into the out now?" – Oh

64

Interior Exit Stairs

- ❑ IBC 1023: Interior exit stairs
 - Enclosed and lead directly to exterior
 - 1-hr rating < 4 stories
 - 2-hr rating 4 or more stories
 - Penetrations limited for items for stairs only
 - Exterior walls not required to be rated
 - Exterior walls <180° within 10 feet
 - 1-hour rated
 - ¾-hr openings

2-HOUR FIRE-RESISTANCE RATED FIRE BARRIER PER SECTION 1023.1

10'-0"

INTERIOR

10'-0"

EXTERIOR

<180°

NON-FIRE-RESISTANCE-RATED WALLS

FIRE-RESISTANCE-RATED WALL AND OPENING PROTECTIVES

"It's not nice to throw people." – Anna

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Stair Signage

- ❑ IBC 1023.9: Stairs connecting >3 stories
 - Sign at each floor landing
 - 5 ft above landing
 - Visible when door open
 - Include the following:
 - Terminus at top and bottom
 - Stairway designation
 - Level of exit discharge
 - Availability of roof top access
 - Floor-level sign
 - Raised letters and braille
 - Located adjacent door on each level

"I'm sorry, I did not see you there... or there." – Gru

66

Exterior Exit Stairs

- ❑ IBC 1027: Exterior Exit Stairs
 - Prohibited for:
 - > 6 stories
 - High rise buildings
 - Use Group I-2
 - Open side
 - At least one side open
 - 35 ft² aggregate open/level
 - Opening located > 42"
 - Located 10ft from:
 - Adjacent lot lines
 - Other buildings

"And I thought they smelled bad on the outside" – Han Solo

67

Ext. Stair Separation

- ❑ IBC 1027.6: Separated from interior
 - Separation per 1023.2
 - Exterior walls per 1023.7

EXTERIOR WALL AREA INSIDE DASHED LINE REQUIRED 2-HR. PROTECTION OPENINGS LIMITED BY SECTIONS 1023.4 & 1023.5 (E.G. NO WINDOWS PERMITTED IN CROSS-HATCHED AREA)

NO PROTECTION REQUIRED

¼-HR. OPENING PROTECTIVE

¼-HR. OPENING PROTECTIVE

1 HR. PROTECTION

10'-0"

10'-0"

10'-0"

10'-0"

10'-0"

10'-0"

SECTIONS 1023.7 & 1027.6

SECTIONS 1023.2 & 1027.6

SECTIONS 1023.7 & 1027.6

"The only one crazy enough to be out in this storm is you, dear. You and this fellow." – Oaken

68

Exterior Stair Examples

- ❑ Open Ended Corridor
 - Not required to be separated from exit stairs:

1. NFPA 13 or 13R
2. Ext. Stair at each end
3. 35ft² open at >45° bend in corridor

Fire Barrier per 1022.2
(Restricted openings)

10 ft - 1hr rated wall
(¼ hr rated openings)

"Would it help if I got out and pushed?" – Princess Leia

69

Exit Discharge

- ❑ To Public Way (1028.1)
 - (3) exceptions
 - 50% may reenter building
- ❑ Egress Court (1028.4)
 - >44" wide
 - < 10 feet 1hr fire separation

Option:
Safe Dispersal Area

"You never left that tower. And you're still gonna go back?" – Flynn Rider

70

Stairways

- ❑ IBC 1011 – General Stair Requirements
 - 44" Wide (1011.2)
 - 6'8" Headroom (1011.3)
 - 7:11 Rise:Run (1011.5.2)
 - 7 ¾":10" within unit
 - Solid Risers (1011.5.5.3)
 - 48" Landings (1011.6)
 - Fire rate enclosures below
 - 12 foot vertical w/out landing
 - Handrails each side (1011.11)
 - One side within unit

Farmington, Utah

"If the height of a single step is off as little as 2 millimeters, most people will trip."
– Sheldon Cooper

71

Window Openings

- ❑ Applies to R-2 or R-3 Occupancies
- ❑ Required when operable windows are located:
 - Sill height > 72" above adjacent grade (one side)
 - Bottom of opening < 36" above adjacent grade (other side)
- ❑ Window opening is limited to 4" sphere

"We jumped out a window" – Baymax

72

Escape and Rescue

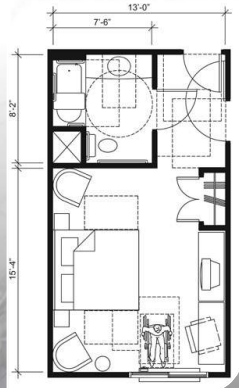


- ❑ Similar to requirements in IRC
 - R-2 and R-3 occupancies only
 - *R-2 not required in stories w/ (2) means of egress.*
 - Windows located in basement and below 4th story
 - Opening size:
 - > 5.7 ft² net opening
 - > 24 inches tall
 - > 20 inches wide
 - 44 inch maximum sill height

"Esc-a-pay! That's funny, it's spelled just like the word escape" - Dory 73

Dwelling Units (IBC)

- ❑ Types of Units (1107.2)
 - Accessible Units
 - Required in Group R-1, R-2*, R-4
 - Type A Units
 - Only in R-2 (Apartments)
 - Type B Units
 - > 4 units all others (except...)
- ❑ Chapter 10 of A117.1
 - *Type C unit (Visitable)*
 - Never required in Code



"You know, for a crazy homeless person, he's pretty cut." - Darcy 74

Dwelling Units (IBC)

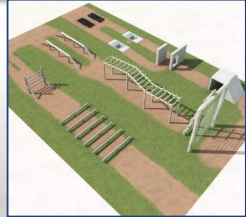


- ❑ Accessible Spaces (1107.3)
 - Available to general public
 - Serving; Accessible, Type A, or Type B Units
 - "Covered" Units
 - Includes following:
 - Toilet and Bathing rooms
 - Kitchen, living, and dining areas
 - Exterior areas
 - Patios, terraces, and balconies

"Phenomenal cosmic powers! Itty bitty living space!" - Genie 75

Accessible Route (IBC)

- ❑ Accessible Route (1107.4)
 - From entrance of "Covered" units
 - To accessible building entrance
 - To interior spaces serving units
 - To exterior spaces serving units
 - Exceptions:
 1. A vehicular route may be provided to exterior features where one of the following prevent an accessible route:
 - Slope > 1:12, physical barriers, or legal restrictions
 2. In R-2, R-3, R-4, and within individual units of R-1, no route to mezzanines and stories, where:
 - "Covered" units and public areas are on an accessible route



"Go up to the roof, hop over to the next building, there's a small gap, don't look down if you're subject to vetiaa, and use their stairwell." - Sheldon 76

Accessible Site

- ❑ At least one route within site to the accessible entrance from all of the following:
 - Public transit
 - Access. parking
 - Loading zone
 - Public Streets
 - Sidewalks

"Looks like you've managed to cut off our only escape route." – Princess Leia

Accessible Parking

❑ Parking and Passenger Loading Facilities

TOTAL PARKING SPACES PROVIDED	REQUIRED MINIMUM NUMBER OF ACCESSIBLE SPACES
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	2% of total
1,001 and over	20, plus one for each 100, or fraction thereof, over 1,000

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- Per Table 1106.1
 - Separate calculations for each lot
- For R-2, R-3, and R-4 (1106.2)
 - At least 2% of each type of stall
 - Assigned parking at least (1) for each Type A and Accessible unit
 - Include parking below and garages
- 1 of 6 Van accessible (1106.5)

"Everybody remember where we parked." – James T. Kirk

Accessible Parking

- ❑ Location of Parking (1106.6)
 - Along shortest route to entrance
 - Where no building closest to accessible route
 - Multiple Entrances
 - Disperse parking near all entrances
- Exceptions:
 - Multilevel Parking
 - Van parking on one level
 - Located in different facility, if:
 - Substantially equivalent; distance, fee, and convenience

"They've gone their separate ways, some pretty extremely far." – Agent Hill

Group R-1 (IBC)

- ❑ Group R-1 (1107.6.1)
 - Accessible Units
 - Table 1107.6.1
 - Dispersed class
 - **Not (1) of each class**
 - > 50 units in a building
 - Treat buildings independent
 - Type B Units
 - All dwelling/sleeping units
 - Except:
 - Not intended as residence
 - < 4 residences
 - Section 1107.7


TOTAL NUMBER OF UNITS PROVIDED	MINIMUM REQUIRED NUMBER OF ACCESSIBLE UNITS WITHOUT ROLL-IN SHOWERS	MINIMUM REQUIRED NUMBER OF ACCESSIBLE UNITS WITH ROLL-IN SHOWERS	TOTAL NUMBER OF REQUIRED ACCESSIBLE UNITS
1 to 25	1	0	1
26 to 50	2	0	2
51 to 75	3	1	4

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"I remembered somebody saying last week that her fantasy was to live in a chocolate house." – Georae Stacy

Group R-2 (IBC)

- Group R-2 (Dormitories 1107.6.2.3)
 - Accessible Units
 - Table 1107.6.1.1 (R-1)
 - Type B Units
 - All dwelling/sleeping units
 - Except:
 - Not intended as residence
 - < 4 residences
 - Section 1107.7



College Dorms
Fraternities
Boarding Houses
Non-Transient Hotels
Time shares




"I love college" – James T. Sullivan


81

Group R-2 (IBC)

- Group R-2 (Apartments 1107.6.2.2)
 - Type A Units
 - Only > 20 units
 - 2% (at least 1)
 - Dispersed class
 - **Not (1) of each class**
 - Reduced per 1107.7
 - Type B Units
 - All dwelling/sleeping units
 - Except:
 - Not intended as residence
 - < 4 residences
 - Section 1107.7

Apartments
Condominiums
Convents
Monasteries





"We are but 8 score young blondes and brunettes, all between 16 and 19 1/2." – Zoot


82

Group R-3 and R-4

- Group R-3 (1107.6.3)
 - Type B Units
 - All dwelling/sleeping units
 - Except:
 - Not intended as residence
 - < 4 residences
 - Section 1107.7
- Group R-4 (1107.6.4)
 - Accessible
 - Condition 1 at least 1
 - Condition 2 at least 2
 - Type B
 - Same as above



Halfway House

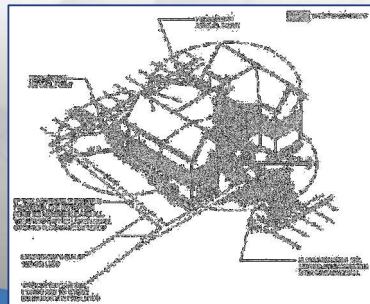


"I don't feel right. I feel like I'm leaking!" – James T. Kirk


83

Exceptions (IBC)

- Reduction for Type A or B Units
 - NO ELEVATOR (1107.7.1)
 - At least one story accessible
 - Levels which have entrances:
 - 50 ft of arrival point
 - < 10% slope
 - Minimum number per 1107.7.4



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"This isn't a substitution, it's a reduction." – Leonard Hofstadter

84

Exceptions (IBC)

- ❑ Reduction for Type A or B Units
 - Site Impracticality (1107.7.4)
 - No elevator provided
 - % of units = % site < 1:10 slope
 - Prior to development
 - Minimum 20%
 - Units w/ 1:12 slope to arrival point
 - Levels with elevated walkway from arrival point
 - Units served by elevator

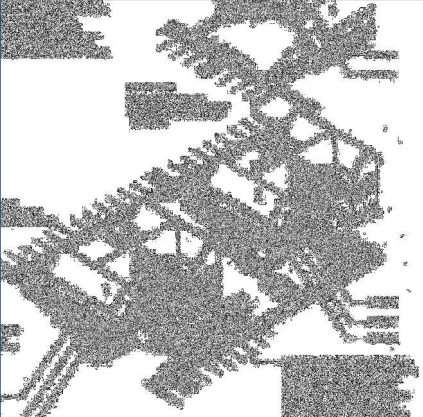


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"He's engaging in Reductio ad absurdum. And I do not appreciate it." – Sheldon Cooper 85

Site Impracticality

- ❑ Step A
 - < 10% slope
 - = 75%
- ❑ Step B
 - 26 ground floor units
 - 75% of 26 = 20 Type B
- ❑ Step C
 - All units on accessible floors are Type B
 - 22 Total Type B

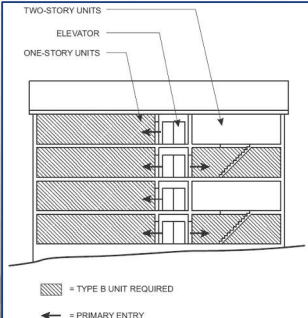


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"For the first time in my life, I have no idea what I'm supposed to do." - Thor 86

IBC 1107.7: Exceptions

- ❑ Reduction for Type A or B Units
 - Multi-story Units (1107.7.2)
 - Elevator access
 - Level with elevator Type B
 - Provide bathroom
 - Provide Kitchen
 - Provide living space
 - Elevator Service (1107.7.3)
 - Elevator to lowest level
 - Units w/ elevator access
 - Type B




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"It's not like they have the floor number on the outside of the building." – Nick Fury 87

Exceptions (IBC)

- ❑ Reduction for Type A or B Units
 - Flood Elevation
 - Lowest level at or above flood:
 - 30" above site access w/in 50ft
 - > 10% slope to site access



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"Because I love you, Anna, I insist you run." – Olaf 88

Recreational Facilities

- ❑ Groups R-2, R-3, and R-4
 - Accessible Type units
 - All facilities accessible
 - Serves Type A or Type B
 - 25% of all facilities
 - At least one of each Type
 - **Includes all features serving all buildings on site**





"You hit a guy, with glasses. That's ... that's well-played." – King Candy
89

Recreational Facilities

- ❑ IBC 1110.4
 - "Recreational facilities to be accessible and shall be on an accessible route to the extent specified in this Section."
 - Area of Activity
 - Swimming Pools
 - Court Sports
 - Hot Tubs/Spas
 - Exercise Rooms


"The physics is theoretical but the fun is real" – Sheldon Cooper
90

Recreational Facilities



- ❑ Sports Activity (1110.4.1)
 - Accessible route to field
 - Field not required to be accessible
- ❑ Court Sports (1110.4.4)
 - Both sides of court
- ❑ Team/Player seating
 - One wheelchair space
- ❑ Not Required to be Accessible
 - Raised boxing/wrestling rings
 - Raised refereeing/scoring areas


"Do you really think I'd break up a couple just to win a bowling game?" – Wil Wheaton
91

Section 1104 – A117.1

- ❑ Exercise Equipment
 - Clear Floor (1104.1)
 - 30"x48"
 - Positioned for transfer/use
 - Clear spaces may overlap




- Section 1101.2.4
 - Operable parts not required to comply


"Physical fitness is very important to Shannon." - Shannon
92

Swimming Pools



IBC 1110.4.13:

- Swimming Pools, Wading Pools, Hot tubs and spas
- All are required to be accessible
- Exceptions
 - Catch pools for water slides
 - Portion of pool edge must be on accessible route
 - Clusters of Hot Tubs or Spas
 - 5% per cluster
 - Swimming Pools serving Type A or B units
 - *Accessible entry into water is not required.*


"Okay, that's a shark. Quit befriending it!" – Trawler Captain, Walter Mitty
93


Exhaust (IMC)

TABLE 403.3.1.1—continued
MINIMUM VENTILATION RATES

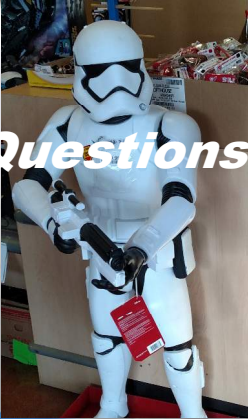
OCCUPANCY CLASSIFICATION	OCCUPANT DENSITY #/1000 FT ² ^a	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, ft ³ /CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, ft ³ /CFM/FT ² ^a	EXHAUST AIRFLOW RATE CFM/FT ² ^a
Private dwellings, single and multiple	—	—	—	—
Garages, common for multiple units ^b	—	—	—	0.75
Kitchens ^c	—	—	—	25/100 ^d
Living areas ^e	—	—	—	—
	Based upon number of bedrooms. First bedroom, 2; each additional bedroom, 1		0.35 ACH but not less than 15 cfm/person	—
Toilet rooms and bathrooms ^f	—	—	—	20/50 ^f


Exhausts for kitchens and common garages

- Footnote 'b' – Exhaust to exterior
 - IMC 403.2.1 recirculation allowed when restricted to kitchen
- Footnote 'f':
 - 25 CFM continuous
 - 100 CFM intermittent
- Refer to IMC 505 for Kitchen hood requirements


"I can't breathe in this thing!" – Dark Helmet
94

Questions?




"These are not the droids you're looking for." – Obi Wan Kenobi
95