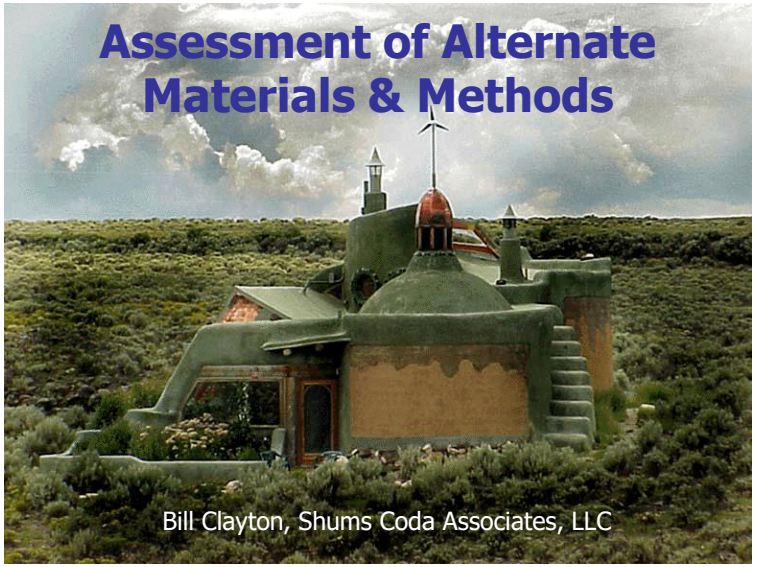

1

Instructor: Bill Clayton, CBO

- Builder/designer 15+ years
- 31+ years of Code Administration and enforcement experience
- ICC/IBC General Committee 2015 cycle
- ICC/IEBC Committee 2009 & 2012 cycle
- 8+ years as Code Consultant, Inspector, Plans Examiner, Instructor with CCC/Shums Coda
- RCBO!
- 22 ICBO, ICC, & FEMA IS 100, 200, 700, 800 Certifications
- State of Colorado 3rd party School inspector
- State of California Emergency Safety Assessment Inspector

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The Fine Print!

Bottom line: the AHJ makes the final interpretation.

- There are times when the code is vague.
- You may get my opinion.
- You have yours!
- We can discuss!

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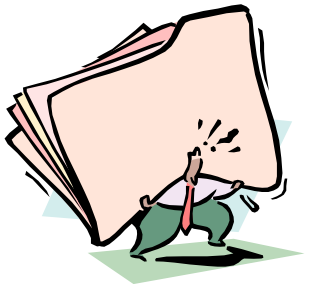
3

Today's Agenda:



1. Define "Alternative"
2. Provide tools required to assess an alternative.
3. Discuss processes used to approve alternatives. 104.11
4. Talk about a few alternates

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What is an alternate, anyway?

- Building Material
- Design
- Method
- Equipment
- System
- Anything that is not specifically addressed in the code.

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Why Alternates?

- Building codes lag behind creativity…
  - Product Development
  - Architectural Design Practices
  - Market Demands

Malls - Alternative Design until 1982

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Section 104.11

- 104.11 Alternative materials, design and methods of construction and equipment.
- The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code…

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Section 104.11

- …provided that any such alternative has been approved.

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Section 104.11

- An alternative material, design or method of construction shall be approved where the building code official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code…

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Section 104.11

- …and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code…
- …in quality, strength, effectiveness, fire resistance, durability and safety.

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Section 104.11

- Where the alternative material, design or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved.

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IBC Section 703.2.3

- Approved Alternate Method.
- The fire resistance of building elements, components or assemblies not complying with Section 703.2.1 or 703.2.2 shall be permitted to be established by an alternate protection method in accordance with 104.11

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Prescriptive Assessment

- We need to assess the prescriptive requirements to derive intent.
- With intent we can find the performance equivalency.

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Prescriptive v. Performance

- What is the difference between:
1. Prescriptive
2. Performance

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Prescriptive Codes

- Generic occupancy groups:
- Employ fixed values
  - Maximum Allowable Quanities
  - Occupant loads
- Assume requirements describe acceptable risk

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Prescriptive Codes

- History
  - Not necessarily based on current fire science or engineering principles
  - Often "consensus" based
  - Local changes to reflect local conditions
  - May provide for equivalencies
    - Alternate methods or materials

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Prescriptive Code Examples

- 0.2" of egress width shall be provided for each occupant
- 2 exits or exit access doors shall be provided when the occupant load is greater than 49
- The maximum allowable quantity of storage of a flammable liquid in a non-H occupancy is 120 gallons

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Performance-based Codes

- State goals and compliance methods
- Identify non-specific performance criteria
- Cover buildings and facilities
  - *Systems* still prescriptive
    - *Mechanical/Electrical*
    - *Fire protection*
- Can reference prescriptive codes

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Performance Codes

- IFC SECTION 601
- SOURCES OF FIRE IGNITION
-
- 601.1 Objective.
- To prevent unwanted ignition caused by building equipment and systems.

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INTENT!!

- Quick assessment…
- Chapter by Chapter
- What is the code's philosophy??
- Become comfortable with making modifications…

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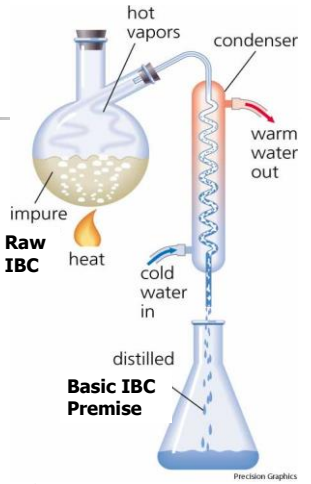
Distillation

- Distill the code to its very essence.
- Must get to the basic premise.
- How de we do this?
- What resources are available to aid in the decisions?



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Chapter 1 Administrative

- Building Official Authority.
- No occupancy without CO.
- Contractors and inspectors are expendable.

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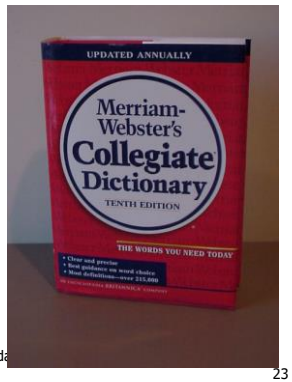
Chapter 2 - Definitions

- So that everyone is on the same page.



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Chapter 3 and 4 - Occupancies

- What is the intent behind division of occupancies?

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Chapter 3 and 4 - Occupancies

- Special hazards caused by special occupancies…

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Chapter 3 and 4 - Occupancies

- Divergent occupancies may not be harmonious.

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Assembly Occupancies (A)

- What are the unique considerations?
- First…need a thought provoking example…

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Business Occupancies (B)

- Occupants generally familiar with surroundings
- Typically not hazardous
- Moderate fuel loading

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Business Occupancies (B)

- Representative fire dynamics.

3-sided office

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Educational Occupancy (E)

- Age of occupants
  - Limited Reasoning Ability
  - Assisted Preservation
- Moderate Fuel Loading

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Factory Occupancies (F)

- Low Occupant Load
- Long Exit Paths
- Variable Fuel Loading

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Factory Occupancies (F)

- Livonia, Michigan
- GM Hydromatic Plant -1953
- 1.5 Million SF
- 30 minutes-6 dead

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Hazardous Occupancies (H)

- Low Occupant Load
- Incompatible and/or dangerous materials and/or processes

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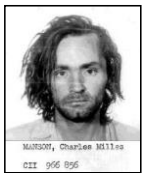
Institutional Occupancies (I)

- Limited ability for self assisted preservation (I-2)
- Security for general public

(I-3)



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Mercantile Occupancies (M)

- Variable occupant load
- Variable fuel load
- Variable travel distances

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Residential Occupancies (R)

- Familiar with environment?
- Sleeping
- Moderate to high fuel loading

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Storage Occupancies (S)

- Low occupancy
- Variable fuel loading
- Long exit paths

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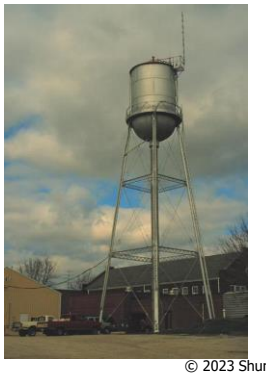
Utility Occupancies (U)



- Low occupant load
- Variable fuel load

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Special Provisions – Chapter 4

- Special Occupancy Buildings
  - Malls
  - High Rise
  - Atriums
  - Underground
  - Motor Vehicle
  - I Occupancies, etc.

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Special Provisions – Chapter 4

- Malls
  - Multiple floor openings
  - Exiting within "shaft"
  - Higher fuel loading

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Special Provisions – Chapter 4

- High Rise
  - Exiting!
  - Exiting delay!
  - Fire department access

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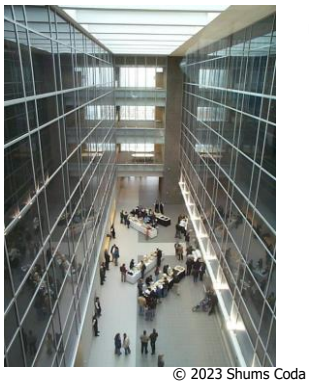
Special Provisions – Chapter 4



- Atrium
  - Multiple floor openings
  - Smoke and fire conveyance

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Special Provisions – Chapter 4

- Underground Buildings
- More than 30′ below
  - Exiting
  - Fire department access
  - Smoke management

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Special Provisions – Chapter 4

- Motor Vehicle
- Garages
- Repair Facilities
  - Flammable materials
  - Carbon Monoxide
  - Fluids
  - Fuel leaks
  - Torches
  - Welding

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Special Provisions – Chapter 4

- Special provisions for specific buildings with unusual circumstances.

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Chapter 4 - Live Work

- Live Work
- Residential with included public work occupancy

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Chapters 5, 6, 7, 8, and 9

- Chapters 5, 6, 7, 8, and 9 have one theme in common…
- Limit exposure and spread of fire based on compartmentalization, fire control, notification, size of building, type of construction.

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Code Philosophy

- What drives the code:
- Seismicity?
- Hurricanes & Wind?
- Terrorism?
- Fire!!!

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Fire Issues and the Code

- Chicago Fire 1871
  - Started in O'Leary Barn
  - Burned 30 hours (extinguished by rain)
  - 300 Dead
  - 100,000 homeless

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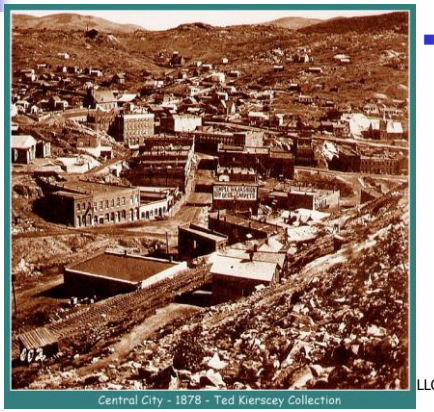
First Building Codes



- Central City, Colorado

1874 Fire –

150 buildings destroyed

Circa 1878 –
No Regulations
With Regulations

Wood buildings were prohibited

LLC 50

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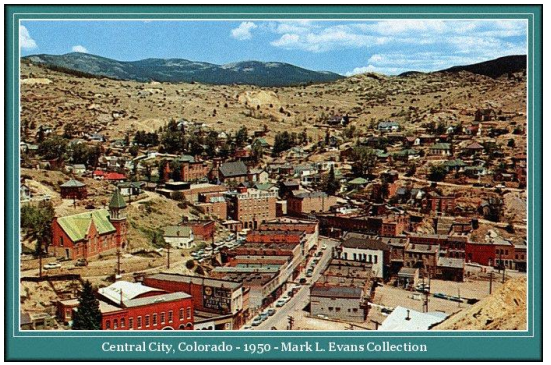
Addressing Fire Spread



- Fire Proof Const.

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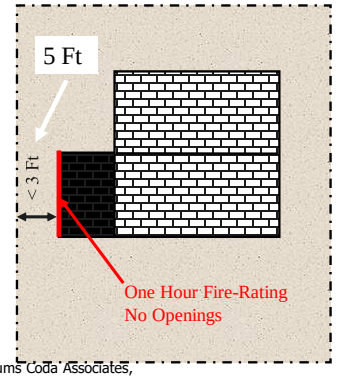
Addressing Fire Spread

- Separation from arbitrary location:
  - Exterior walls less than 3 feet from property line
    - Shall have not less than one-hour fire-resistive rating, exposure both sides



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Addressing Fire Spread

- Why Property Lines?
  - Confer special privilege for owners?
  - Limit of building official control.
  - Arbitrary, but convenient.

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Chapters 5-9

- Chapter 5 – Limits building area
- Chapter 6 – Defines construction types
- Chapter 7 – Assigns/defines fire resistance
- Chapter 8 – Controls interior flammability
- Chapter 9 – Fire protection features

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Chapter 6

- A little out of order…
- How does construction affect the size of a building?

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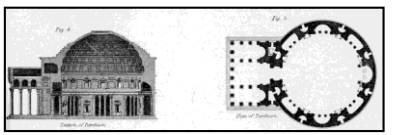
Chapter 6

- Two Categories:

1. Combustible
2. Noncombustible



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Chapter 6

- Subcategories:

1. Non Rated
2. Fire Resistive

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Chapter 6

Doesn't Burn! ← → Burns!

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	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS[b]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1, H-2, H-3, H-5	NS[c,d]	UL	160	65	55	65	55	120	90	65	65	50	40
	S												
H-4	NS[c,d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1 Condition 1, I-3	NS[d,e]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1 Condition 2, I-2	NS[d,e,i]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
I-4	NS[d,g]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
R[h]	NS[f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S13D	60	60	60	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

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Chapter 6

- The type of building construction must be considered when assessing overall building fire performance.

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Chapter 5 – Allowable Area

- How big can I make it?

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Chapter 5 – Area Modification

- Tabular Area (Basic Allowable)
  - Type of Construction
  - Occupancy
- Modified by:
  - Open Space
  - Sprinkler System
  - Stories

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Chapter 5 – Area Modification

- Open Space
- Fire is easier to control if access is provided.

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Chapter 5 – Area Modification

- Sprinkler System
- Extinguishes or controls fire

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Chapter 5 – Area Modification

- Story Increase:
- Multiply allowable area by number of stories:
  - x2 for two story
  - x3 for three story
  - Up to x4 for 13-R

??????????????????

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Ch. 5 - Compartmentalization

- If we can isolate it, we can control it.
  - Fire Area
  - Fire Walls
  - Fire barriers
  - Occupancy separation

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Chapter 5

- Does not take fire fighting capability or response time into account.
  - Equipment and response time
  - Quality of personnel
  - Hard to quantify
- Does not take fuel loading into account (aside from Occupancy Tabular Area).
  - Variable throughout life
  - Hard to quantify

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Chapter 5

- At the end of the day…
- Overall fire performance is determined by a number of variables.

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Chapter 7 – Fire Resistance Rated Construction

- Merely methodology to satisfy the prescriptive code.

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Fire Resistive Construction

- Method of qualification:
  - ASTM E119
  - or via 703.3

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Fire Resistive Construction

- 703.3 methods:
  - Documented in approved source
  - Prescriptive (721)
  - Calculation (722)
  - Engineering Judgement
  - Section 104.11

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Fire Resistive Construction

- Greatest area of awe and mystique in the code.
- Cake Recipe
- Fire resistance guaranteed?

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Fire Resistive Construction

Measurable, repeatable, scientific method…

- But not intended to represent actual performance.
  - Laboratory conditions
  - Site variability

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Fire Resistive Construction

- One of a number of tools available to:

1. Slow growth of fire (control at Prop L)
2. Buy time for egress
3. Buy time for fire department response

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Chapter 8 – Interior Finish

- Fire spread via finish materials
  - Nightclub fires:
  - The Station, W. Warwick Rhode Island, 2003
  - Beverly Hills Supper Club, 1977
  - Cocoanut Grove, Boston 1942
  - Rhythm Club, Natchez, 1940

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Flame Spread Measurement

- ASTM E84
- "Steiner Tunnel"
  - 0-200 Scale
  - Cement Board = 0
  - Red Oak = 100

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Chapter 8 Intent

- Can you outrun the flaming finish?
- DOES NOT regulate contents!!!

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Chapter 9 – Fire Protection

- Fire Protection Systems
- Tools to mitigate spread of fire

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Ch.9 – Fire Protection Systems

- Fire Sprinkler Systems
- Standpipes
- Portable Fire Extinguishers
- Fire Alarm and Detection Systems
- Emergency Alarms
- Smoke Control Systems
- Smoke and Heat Vents
- Fire Command Centers

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Chapter 10 – Means of Egress

- Another big theme
- How to get out of a building…
- Still driven by fire…
- Until recently!

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Buenos Aires Nightclub Fire

- 193 Killed
- 700+ Injured
- Ignited by pyrotechnic "flare"
- Sound control foam ceiling
- Blocked Exits

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Egress Basics

- Adequate Exits
  - Width
  - Swing Direction
- Occupant Load Controls
  - BA Fire: 4000 estimated for a 1500 OL Capacity

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Egress Basics

- Time of egress travel:
  - CPET
  - Travel Distance
  - Exit Protection
- Emergency Egress Lighting

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Warning…

- BUENOS AIRES - Five former municipal officials have been charged with manslaughter in connection with the December 2004 nightclub fire that claimed 193 lives.
- Judge Marcelo Lucini handed down the charges Friday against a city official, Fabiana Fiszbin, and four others who had oversight of the city's nightclubs at the time of the Dec. 30 fire at the Cromagnon Republic club in downtown Buenos Aires. Authorities earlier filed manslaughter charges against owner Omar Chaban, who has been in police custody since the fire.

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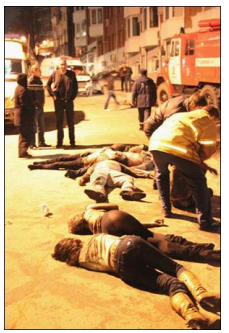
"Lame Horse" – Perm Russia



- 109 killed
- 130 injured
- Pyrotechnics ignite twig ceiling
- Limited egress
- Poor fire code enforcement

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Exiting assessment

- Be logical – Think it through.
- Use the prescriptive code as a guide to help you make your decision.

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Chapter 10 - Philosophy

- Exit Access
- Exit
- Exit Discharge
- Hold your breath!
- Temporary safety!
- Get away!

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Chapter 10 – Exit Access

- The first part of the exiting system.
- Travel distances are a concern.
- Obstructions are a concern.
- Smoke?

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Chapter 10 – Exit Access

- <u>Considerations:</u>
- Occupancy
  - School vs. Factory
  - Assembly vs. Residential
- Fire Protection
  - Sprinklers
  - Early Warning
  - Fuel loading

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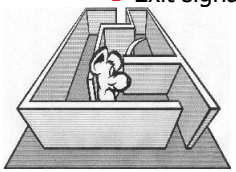
Chapter 10 – Exit Access

- How circuitous is the exit path?
  - Clarity / Confusion
  - Travel Distance
  - CPET exit availability
  - Exit signage as Req'd



Where's the *#@ Door?!?

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Chapter 10 – Exit Access

- What affects the speed of egress?
  - Stairs
  - Ramps
  - Change in width
  - Convergance

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Chapter 10 - Exits

- Interior and Exterior Stairs and Ramps
  - Fire protection?
  - Slows egress – inhibits dispersion?

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Chapter 10 – Exit Discharge

- Exits shall discharge directly to the exterior of the building.
- The exit discharge shall be at grade or shall provide direct access to grade.
- The exit discharge shall not reenter a building.

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Chapter 10 – Exit Discharge

- Once you are outside the building, you are "home free"

  ….right?

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Chapter 11 - Accessibility

- Not about getting out…
- It's about getting in!

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Chapter 11 - Accessibility

- Civil rights legislation intended to remove discrimination against those with disabilities…

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Chapter 11 - Accessibility

- Be cautious!
- Lots of federal regulations out there!
  - ADA - ADAAG
  - 1973 Rehab. – UFAS
  - FFHA – Design Manual
  - ABA

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Chapter 11 - Accessibility

- Accessible Means of Egress
- NOT self assisted in all cases:
  - Elevator
  - Area of Refuge
  - Exterior Area for Rescue Assistance

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Ch. 12 – Interior Environment

- New York Tenement Code of 1850.

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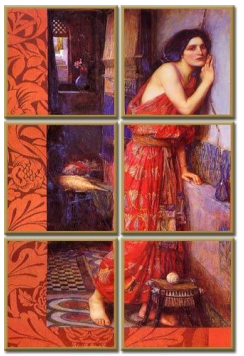
Ch. 12 – Interior Environment

- Now permits artificial light and ventilation.
- Sound control is latest issue.



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Chapter 13 – Energy Efficiency

- User is directed to the IECC.
  - Insulation intensive
  - No indoor air quality assessment
  - Passive solar not emphasized.

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Chapter 14 – Exterior Walls

- Water management:
- 1403.2 Weather protection…Exterior walls shall provide the building with a weather-resistant exterior wall envelope.

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Chapter 14 – Exterior Walls

- The exterior wall envelope shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a water-resistive barrier behind the exterior veneer

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Chapter 14 – Exterior Walls

- 1403.3 Vapor retarder.
- An approved vapor retarder shall be provided.

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Chapter 14 – Exterior Walls

- Presumes that we can control moisture from exterior and interior sources.
- Europe – Assume water intrusion

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Chapter 14 – Exterior Walls

- EIFS Issue:
- Alternate failure?
- Or installation failure?

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Chapter 15 – Roof Assemblies

- Roofs
- Keep rain out of the building
- Keep fire from spreading

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Fire performance

- ASTM E 108 or UL 790
- Class A, B or C
  - C – 1″ brands
  - B – 6″ brand
  - A – 12″ brand

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Chapter 15 – Roof Assemblies

- Moisture management
- Durability
  - Sun
  - Wind
  - Temperature variations

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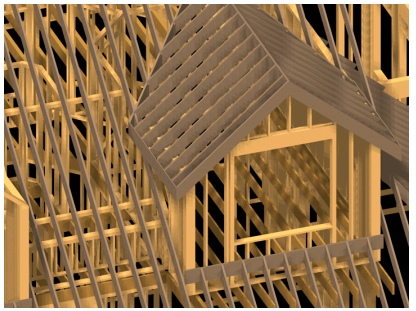
Chapter 23 - Wood

- Conventional framing methodology
- Case Study



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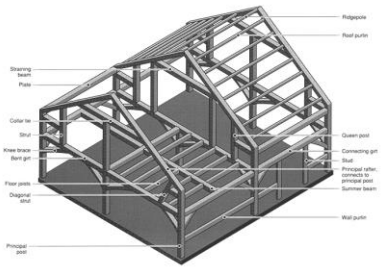
Chapter 23 - Wood

- US wood framing history
  - Log
  - Timber Frame



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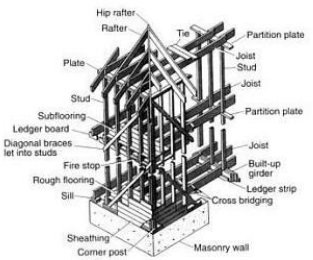
Chapter 23 - Wood

- Balloon Framing
- 1832 – George Snow
- Chicago, Illinois



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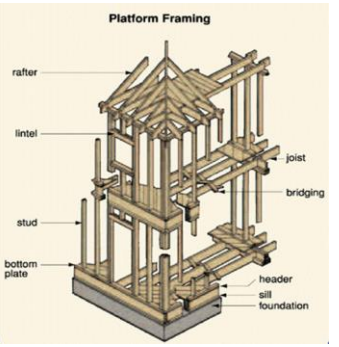
Chapter 23 - Wood

- Platform Framing
- 1920's?
- Allowed use of short studs
- Reduced fire spread in concealed spaces



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Chapter 23 - Wood

- Natural Material
- Strength is dependent upon species, growing region, grain characteristics, etc.
- Must be visually "graded" to assess defects
- Not usually durable unless protected

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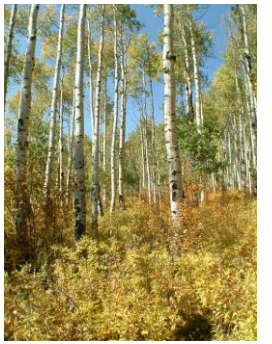
Chapter 23 - Wood



- Wood science
- Reproducible and repeatable?

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Chapter 23 - Wood

- 2303.1.2 Prefabricated wood I-joists.(still not prescriptive but an alternate material/method)
- Structural capacities and design provisions for prefabricated wood I-joists shall be established and monitored in accordance with ASTM D 5055.

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PART II

- Evaluation of Alternates
- The "easy" way!

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ICC – Evaluation Services, Inc.

- Provides product evaluation to ensure equivalency with the requirements of the building code.

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ICC – Evaluation Services, Inc.

- Who are they?
- Can I trust them?
  - More than 80 Years Experience
  - ICBO-ES
  - BOCAI – ES
  - SBCCI – ES
  - NES

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Evaluation Report Process

ACCEPTANCE CRITERIA FOR
COLD-FORMED STEEL FRAMING MEMBERS

AC46

Approved June 2012

(Editorially revised April 2015)

PREFACE

- How does it work?

1. Manufacturer submits product
2. Judged against <u>Acceptance Criteria</u>
3. Report issued

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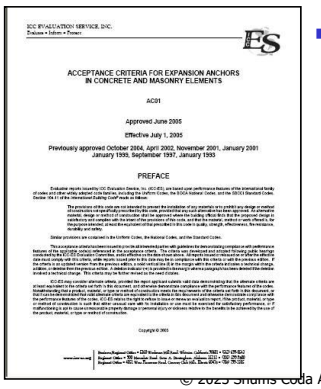
Evaluation Report Process



ICC EVALUATION SERVICE, INC.

ACCEPTANCE CRITERIA FOR EXPANSION ANCHORS
IN CONCRETE AND MASONRY ELEMENTS

AC01

Approved June 2005

Effective July 1, 2005

Previously approved October 2004, April 2002, November 2001, January 2001
January 1999, September 1997, January 1995

PREFACE

- Over 450 criteria available to judge products for code compliance.

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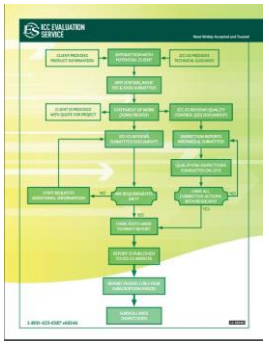
Evaluation Report Process



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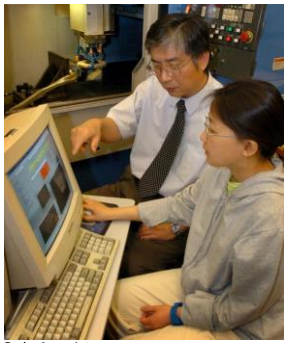
Evaluation Report Process

- If no appropriate Acceptance Criteria (AC), then one must be created.



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Evaluation Report Process

- Staff works with applicant to determine:
  - Code Equivalency
  - Appropriate Testing
  - Limitations on Use

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Evaluation Report Process

- New AC is discussed in open public hearing.
- Reviewed by 9 building official members on the ICC-ES Evaluation Committee

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Evaluation Report Process

- Leaders of the industry
- Testimony can be very lengthy

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Evaluation Report Process

ACCEPTANCE CRITERIA FOR COLD-FORMED STEEL FRAMING MEMBERS

AC46

Approved June 2012

(Editorially revised April 2015)

Previously approved February 2011, February 2010, February 2007, June 2006, October 2004, January 2001 March 2000, April 1998, January 1994

(Previously editorially revised August 2013)

- AC is created
- Product is evaluated to the criteria in the AC

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Evaluation Report Process

1.0 INTRODUCTION

1.1 Purpose: The purpose of this criteria is to establish requirements for cold-formed steel framing members to be recognized in an ICC Evaluation Service, LLC (ICC-ES), evaluation report under the 2015 *International Building Code*® (IBC) and the 2015 *International Residential Code*® (IRC). The basis of recognition under the IBC is the United States of America provisions of AISI S100, AISI S200 and AISI S220 (2015 IBC and IRC) as referenced in IBC Sections 1604.3.3, 2210 and 2211. Bases of recognition under the IRC are IRC Sections R301.1.3, R505, R603, and R804. See Appendix A of this criteria for requirements for cold-formed steel framing members to be recognized in an evaluation report under the 2012 *International Building Code*® and the 2012 *International Residential Code*®. See Appendix B of this criteria for requirements for cold-formed steel framing members to be recognized in an evaluation report under the 2009 *International Building Code*® and the 2009 *International Residential Code*®.

1.2 Scope: This acceptance criteria applies to cold-formed steel framing members.

- Cold-formed steel framing members is scoped within the AC.

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Evaluation Report Process

1.3 Codes and Referenced Standards:

1.3.1 2015 *International Building Code*® (IBC), International Code Council.

1.3.2 2015 *International Residential Code*® (IRC), International Code Council.

1.3.3 AISI S100-12, North American Specification for Design of Cold-formed Steel Structural Members, published by the American Iron and Steel Institute (AISI). The United States provisions of AISI S100 are applicable under this criteria.

1.3.4 AISI S200-12, North American Standard for Cold-Formed Steel Framing—General Provisions, American Iron and Steel Institute (AISI).

1.3.5 AISI S211-07/S1-12(2012), North American Standard for Cold-Formed Steel Framing—Wall Stud Design, 2007 including Supplement 1, dated 2012 (Reaffirmed 2012), American Iron and Steel Institute (AISI).

1.3.6 AISI S220-11, North American Standard for Cold-Formed Steel Framing—Nonstructural Members, American Iron and Steel Institute (AISI).

1.3.7 ASTM A370-13, Test Methods and Definitions for Mechanical Testing of Steel Products, ASTM International.

1.3.8 ASTM A924-13, Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process, ASTM International.

1.3.9 ASTM A1003-12, Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members, ASTM International.

1.3.10 ASTM E1966-07A(2011), Test Method for Fire-resistant Joint Systems, ASTM International.

1.3.11 S909-13, Standard Test Method for Determining the Web Crippling Strength of Cold-Formed Steel Beams, American Iron and Steel Institute (AISI).

- References codes and Standards for product evaluation and testing

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Evaluation Report Process

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 Material Specifications:

3.1.1 Steel: Steel specifications shall comply with Section A2 of the AISI S100, Section A3 of the AISI S200, or Section A4 of AISI S220, as applicable. Nonstructural grades of steel shall be limited to interior nonload-bearing walls with transverse loads of 10 psf (480 Pa) or less.

3.1.2 Thickness: Minimum steel thicknesses shall comply with Section A2.4 of AISI S100, Section A5.1 of AISI S200, and Section A6.1 of AISI S220.

3.1.3 Protective Coating: A minimum metallic coating as specified for Type H and Type L in Table 1 of ASTM A1003 is required for all applications with the exception of minimum metallic coating as specified for Type NS in Table 1 of ASTM A1003 for interior nonload-bearing walls with transverse loads of 10 psf (480 Pa) or less.

3.2 Cold-formed Steel Framing Members: Evaluation reports on cold-formed steel framing members shall address the section properties and design approach as applicable:

3.2.1 Section Properties: Section properties shall be determined in accordance with AISI S100. Structural properties data for steel members shall include the minimum information noted in Section 7.0 of this criteria. Information on additional properties is optional and can be furnished.

Exception: When design parameters are determined by testing in accordance with Section 3.2.2 of this criteria or by direct strength method (DSM), the pertinent design limitations shall be provided. Any of the information noted in Section 7.0 may be omitted when not applicable.

3.2.2 Structural Performance: Capacity of members shall be determined in accordance with Chapters C and D or Appendix 1 of AISI S100. For members that exceed limitations specified in AISI S100 or do not conform to the requirements of AISI S100, tests are necessary to determine applicable strength and stiffness. See Section 4.2 (4.3 for web crippling) of this criteria.

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Evaluation Report Process

- Assurance that quality will be maintained

6.0 QUALITY CONTROL

6.1 The manufacturer of the cold-formed steel members shall maintain an in-house quality control program complying with the following:

6.1.1 Quality documentation complying with the ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted for each facility manufacturing or labeling products that are recognized in the ICC-ES evaluation report.

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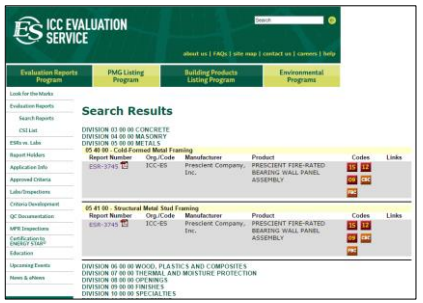
Evaluation Report Process

- Check to see results
- Assuming that there are any!!



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Evaluation Report

- Effective use of an Evaluation Report

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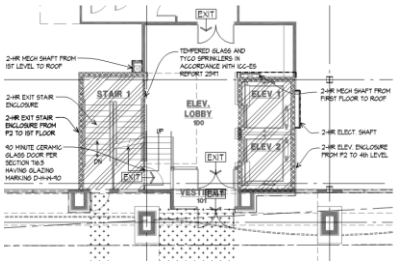
Tyco Fire Sprinklers



- An alternative to a two-hour fire-resistance rated wall assembly

Code References 2018 IBC

- 703.3 Alternative methods for determining fire resistance.
- The application of any of the alternative methods listed in this section shall be based on the fire exposure and acceptance criteria specified in ASTM E 119 or UL 263. The required fire resistance of a building element, component or assembly shall be permitted to be established by any of the following methods or procedures:
-
- 5. Alternative protection methods as allowed by Section 104.11.

Code References 2018 IBC

- 703.4 Automatic sprinklers.
- Under the prescriptive fire-resistance requirements of the International Building Code, the fire-resistance rating of a building element, component or assembly shall be established without the use of automatic sprinklers or any other fire suppression system being incorporated as part of the assembly tested in accordance with the fire exposure, procedures, and acceptance criteria specified in ASTM E 119 or UL 263.
- However, this section shall not prohibit or limit the duties and powers of the building official allowed by Sections 104.10 and 104.11.

Tyco Sprinklers Code Equivalency

- Alternative to a fire-resistance-rated wall assembly

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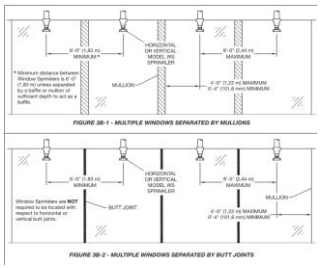
"Standard" Fire Performance?

- Is there some level of performance expectation?



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Acceptance Criteria

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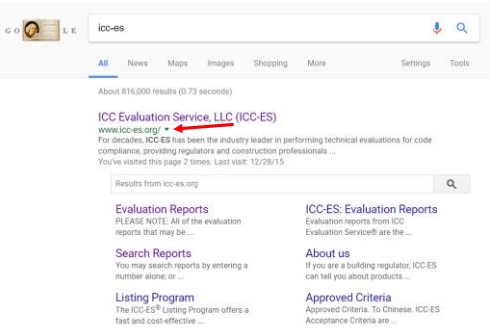
How to obtain a report



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How to obtain the report

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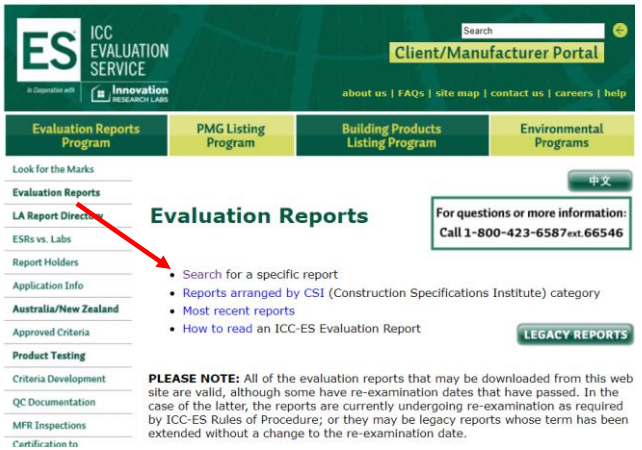

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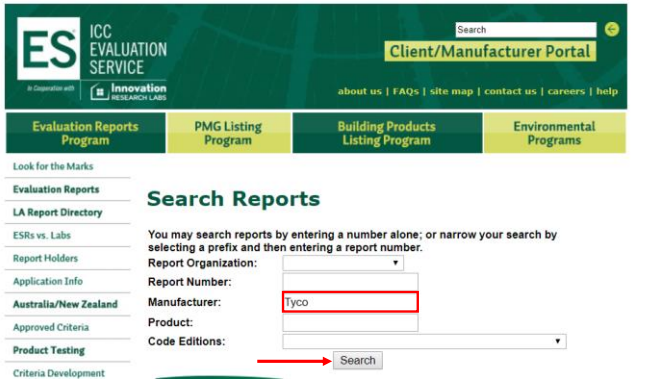

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Search Results

DIVISION 03 00 00 CONCRETE
DIVISION 04 00 00 MASONRY
DIVISION 05 00 00 METALS
DIVISION 06 00 00 WOOD, PLASTICS AND COMPOSITES
DIVISION 07 00 00 THERMAL AND MOISTURE PROTECTION
DIVISION 08 00 00 OPENINGS
DIVISION 09 00 00 FINISHES
DIVISION 10 00 00 SPECIALTIES
DIVISION 11 00 00 EQUIPMENT
DIVISION 13 00 00 SPECIAL CONSTRUCTION
DIVISION 21 00 00 FIRE SUPPRESSION

21 13 13 - Wet-Pipe Sprinkler Systems

Report Number	Org./Code	Manufacturer	Product	Codes	Links
ESR-2397	ICC-ES	Tyco Fire Products Research and Development	Model WS™-5.6 K-Factor Specific Application Window Sprinklers, Horizontal Sidewall and Pendant Vertical Sidewall	15 12 09 06	

DIVISION 22 00 00 PLUMBING
DIVISION 23 00 00 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)
DIVISION 25 00 00 INTEGRATED AUTOMATION
DIVISION 26 00 00 ELECTRICAL
DIVISION 27 00 00 COMMUNICATIONS
DIVISION 28 00 00 ELECTRONIC SAFETY AND SECURITY
DIVISION 31 00 00 EARTHWORK
DIVISION 32 00 00 EXTERIOR IMPROVEMENTS
DIVISION 33 00 00 UTILITIES
DIVISION 40 00 00 PROCESS INTEGRATION

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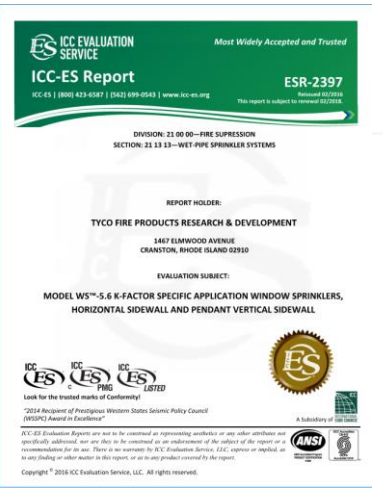

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Is this the right report?

- Check for:
- Report Holder
- Subject

ICC EVALUATION SERVICE — Most Widely Accepted and Trusted

ICC-ES Evaluation Report — **ESR-2397**

Reissued February 2016

This report is subject to renewal February 2018.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 — *A Subsidiary of the International Code Council®*

DIVISION: 21 00 00 FIRE SUPPRESSION
Section: 21 13 13—Wet-Pipe Sprinkler Systems

REPORT HOLDER:

TYCO FIRE PRODUCTS RESEARCH AND DEVELOPMENT
1467 ELMWOOD AVENUE
CRANSTON, RHODE ISLAND 02910
(401) 781-8220
www.tyco-fire.com

EVALUATION SUBJECT:

MODEL WS™—5.6 K-FACTOR SPECIFIC APPLICATION WINDOW SPRINKLERS, HORIZONTAL SIDEWALL AND PENDENT VERTICAL SIDEWALL

fire-resistance rating of the wall. For exterior glazed assemblies that are permitted to be rated only from the interior, the sprinklers must be located on the interior side of the glazing. For interior glazed assemblies, the sprinklers must be located on both sides of the assembly. The primary components of the fire-resistance-rated assembly are as described in Sections 3.2 and 3.3.

3.2 Model WS™ Window Sprinklers:

The Model WS™ window sprinklers described in this report are quick-response sprinklers that are available in models that activate to release water flow when they reach an ambient temperature of either 155°F or 200°F (68°C or 93°C). The sprinklers have an orifice and thread size of ½ inch (12.7 mm). The sprinklers are manufactured for two orientations. The horizontal sidewall type (product number TY3388), as shown in Figure 1, is designed to face

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Check Report Holder - Subject

REPORT HOLDER:

TYCO FIRE PRODUCTS RESEARCH AND DEVELOPMENT
1467 ELMWOOD AVENUE
CRANSTON, RHODE ISLAND 02910
(401) 781-8220
www.tyco-fire.com

EVALUATION SUBJECT:

MODEL WS™—5.6 K-FACTOR SPECIFIC APPLICATION WINDOW SPRINKLERS, HORIZONTAL SIDEWALL AND PENDENT VERTICAL SIDEWALL

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Is this the right report?

- Check for appropriate code.

1.0 EVALUATION SCOPE

Compliance with the following code:

- 2015, 2012, 2009 and 2006 *International Building Code®* (IBC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)†

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

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How is the product used?

- There may be some limits…

2.0 USES

The automatic special-purpose sprinkler system incorporating the Model WS™ sprinkler is used in conjunction with a fixed glazed wall assembly to provide an alternative to a two-hour fire-resistance-rated nonload-bearing interior fire barrier assembly prescribed in IBC Section 707, fire partition assembly prescribed in IBC Section 708 or exterior wall assembly prescribed in IBC Section 705. The Model WS™ sprinklers are recognized as a means to achieve a fire-resistance rating on fixed glazed wall assemblies in exterior fire-resistance-rated walls only when the horizontal fire separation distance is 5 feet (1525 mm) or greater.

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What do they look like?

3.0 DESCRIPTION

3.1 General:

The Model WS™ window sprinklers are used as part of a wet-pipe fire suppression system to provide a two-hour fire-resistance rating to an interior nonload-bearing fire barrier, fire partition or exterior wall assembly consisting of fixed glazing as described in this report. When activated, the sprinklers are designed to wet the entire surface of the affected side of the fixed glazed openings in the fire barrier and exterior wall assembly in order to achieve the fire-resistance rating of the wall. For exterior glazed assemblies that are permitted to be rated only from the interior, the sprinklers must be located on the interior side of the glazing. For interior glazed assemblies, the sprinklers must be located on both sides of the assembly. The primary components of the fire-resistance-rated assembly are as described in Sections 3.2 and 3.3.

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Material Specifications

3.2 Model WS™ Window Sprinklers:

The Model WS™ window sprinklers described in this report are quick-response sprinklers that are available in models that activate to release water flow when they reach an ambient temperature of either 155°F or 200°F (68°C or 93°C). The sprinklers have an orifice and thread size of $^1/_2$ inch (12.7 mm). The sprinklers are manufactured for two orientations. The horizontal sidewall type (product number TY3388), as shown in Figure 1, is designed to face the glazing of the fire barrier assembly in a horizontal orientation. The pendent vertical sidewall type (product number TY3488), as shown in Figure 2, is designed to face the glazing of the fire barrier assembly in a vertical orientation.

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Material Specifications

3.3 Glazed Fire Barrier Assembly:

The glazing used in the fire barrier must be nominally $^1/_4$-inch-thick heat-strengthened or tempered glass complying with ASTM C1048 or Federal Specification DD-G-1403B, installed as a single pane or dual pane. The exposed glass component of the wall assembly must not exceed 13 feet (4 m) in height. There is no exposed width restriction for the horizontal span, except where necessary to comply with the requirements of IBC Sections 2403 and 2404.

All interfaces between the fixed glazed wall assembly and adjacent wall assemblies must include termination of the glazing within a window frame as described in this section. The glazing is held in place by a metallic frame with an elastomeric seal allowing for thermally initiated contraction and expansion. Unframed vertical joints between glazing panels are permitted provided that such joints are sealed with silicone sealant. Intermediate horizontal mullions are not permitted as part of the fixed glazed wall assembly. The interface details and mounting method must be approved by the code official.

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Installation Requirements

4.0 INSTALLATION

4.1 Sprinkler Orientation:

For the Model WS™ horizontal sidewall sprinkler, the deflector of the sprinkler must be placed from $^1/_2$ inch to 4 inches (12.7 to 102 mm) away from the glass and 1 to 3 inches (25 to 76.2 mm) down from the top of the noncombustible frame as shown in Figure 3.

The Model WS™ pendent vertical sidewall sprinkler must be located 4 to 12 inches (102 to 305 mm) from the face of the glass and 2 to 4 inches (51 to 102 mm) down from the top of the noncombustible frame as shown in Figure 4.

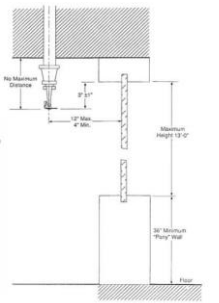

FIGURE 4—WS™ PENDENT VERTICAL SIDEWALL SPRINKLER INSTALLATION

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Installation Requirements

Intermediate horizontal mullions are not permitted as part of the glass wall assembly. All combustible materials must be kept a minimum distance of 2 inches (51 mm) from the face of the glass. This can be accomplished by a 36-inch-high (914 mm) "pony wall" as shown in Figures 3 and 4. This "pony wall" is constructed using construction methods and materials as recognized in the applicable codes based on the building's type of construction. The "pony wall" must be constructed in a manner which meets the minimum required fire-resistance rating which is sought for the fixed glazed wall assembly. This "pony wall" construction must be approved by the code official. The evaluation of alternative methods other than the "pony wall" to maintain a minimum 2-inch (51 mm) clearance of combustibles from the face of the assembly is outside the scope of this report.

The maximum distance between window sprinklers is 8 feet (2440 mm) on center and the minimum distance is 6 feet (1830 mm) on center, except where the sprinklers are separated by a noncombustible vertical mullion located between sprinklers. In this case, the maximum distance maintained between the sprinkler and the mullion must not exceed one-half of the distance required between sprinklers.

The automatic water supply must have the capability to supply water to the assembly for a time not less than the rating of the assembly. The maximum fire-resistance rating recognized in this report is two hours.

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Hydraulic Requirements

4.2 Hydraulic Requirements:

The code official must be consulted to determine the hydraulic requirements for each installation. Hydraulic calculations must show a maximum pressure of 175 psi (1207 kPa) on the vertical sidewall sprinklers and horizontal sidewall sprinklers separated by a noncombustible vertical mullion. Hydraulic calculations must show a maximum pressure of 70 psi (483 kPa) for horizontal sidewall sprinklers that are not separated by a noncombustible vertical mullion between sprinklers.

Interior Protection—Sprinklered Building: The compartmented area that has the most hydraulically demanding window sprinklers must be identified. The most demanding 46.5 linear feet (14.2 m) of Model WS™ Window Sprinklers is calculated based on $L=1.2\sqrt{A}$, where A is system area of operation, and when A equals 1,500 square feet (139.4 m^2), in accordance with NFPA 13 Light/Ordinary Hazard density curves.

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Conditions of Use

5.0 CONDITIONS OF USE

The Model WS™ window sprinklers described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The installation of the special-purpose sprinkler systems must be in accordance with the manufacturer's published installation instructions, this report and the applicable code. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs. A copy of the installation instructions and this report must be available at all times on the jobsite during installation.

5.2 The design, with plans and details of the specific installation of the fixed glazed assembly with special-purpose sprinklers, must be submitted to the code official for approval. The design must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

tyco Fire Protection Products

Worldwide Contacts www.tyco-fire.com

Model WS Specific Application Window Sprinklers Horizontal and Pendent Vertical Sidewall
5.6 K-factor

General Description

The TYCO Model WS Specific Application Window Sprinklers are fast response, quick response, fast response, and standard response sprinklers available in Horizontal Sidewall and Pendent Vertical Sidewall styles. These sprinklers are also intended for specifically called for protection of regular wall and overhead glass in fixed glass windows using closed sprinklers. Specifically, the Model WS is required to achieve the fire/sprinkler glazing relationship specified in NFPA 13 Light/Ordinary Hazard density curves without sprinkler protection. A window assembly protected with the TYCO Model WS Window Sprinklers has been evaluated in the wall furnace and hose stream test in accordance with ASTM E119 requirements for a two-hour fire-rated assembly. The Model WS Window Sprinklers are also intended for use in window wall assemblies during hot-dip galvanizing, even when at most efficient rate of galvanizing (Class 5).

The success of the Model WS Window Sprinklers is based on their fast response, quick response, fast response, and specially designed deflectors that ensure that the spray pattern wets the glass surface and the sill.

Based on successful testing, the Model WS Window Sprinklers can be used in fixed glass window assemblies or glazing in a sprinklered building or non-sprinklered building in accordance with NFPA 13 Light Hazard Occupancies, Standards, Design, and Methods of Construction and (Guarantee?). Also, the Model WS Window Sprinklers are intended for use in Special Purpose Sprinkler Systems in accordance with NFPA 13 Ordinary

Conditions of Use

5.6 Use of the system is limited to wet-type special-purpose sprinkler systems and nonload-bearing wall assemblies.

5.7 Use of the special-purpose fire sprinkler system in exterior wall applications is limited to installations where the fire separation distance is greater than 5 feet (1524 mm) for the 2006 IBC, and 10 feet (3048 mm) for the 2015, 2012 and 2009 IBC.

5.8 The assembly is not permitted to incorporate penetrations. Openings must be protected in accordance with applicable requirements of the IBC for opening protection.

5.9 The fixed glazed assembly is not permitted to be used in lieu of firewalls. Where the assemblies are used as an alternative to fire barriers for exit-passageways, horizontal exits, or exit enclosures, the fire area (Section 202 of the IBC) in which the assembly is located shall be fully sprinklered in accordance with Section 903.3.1 of the IBC. The water supply duration for sprinklers, where used, shall be not less than the fire resistance rating that would have been required for a fire barrier. In addition, the registered design professional shall provide the code official with documentation in accordance with Section 104.10 of the IBC for a code modification or Section 104.11 of the IBC for an alternative method of construction that addresses any anticipated impact on the functionality of the means of egress.

5.10 The fixed glazed assembly must not have intermediate horizontal mullions that interfere with the uniform distribution of water over the surface of the glazing.

5.11 All combustible materials must be kept a minimum distance of 2 inches (51 mm) from the face of the glass, such that the complete coverage of the glass by the sprinklers is not impeded. This is accomplished by a minimum 36-inch-high (914 mm) knee or "pony" wall at the base of the assembly. The means for maintaining clearance must be as set forth in this evaluation report.

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Evidence Submitted

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Special-purpose Sprinklers Used with Fixed Glazed Assemblies to Provide an Alternative to a Fire-resistance-rated Wall Assembly (AC385), dated February 2015.

ICC EVALUATION SERVICE

Most Widely Accepted and Trusted

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ACCEPTANCE CRITERIA FOR SPECIAL-PURPOSE SPRINKLERS USED WITH FIXED GLAZED ASSEMBLIES TO PROVIDE AN ALTERNATIVE TO A FIRE-RESISTANCE-RATED WALL ASSEMBLY

AC385

Approved February 2015

Previously approved October 2013, February 2013 and October 2007

(Previously editorially revised April 2014)

PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (ICC-ES), are based upon performance features of the international family of codes. (Some reports may also reference older code families such as the BOCA National Codes, the Standard Codes, and the Uniform Codes.) Section 104.11 of the International Building Code® reads as follows:

> The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided any such alternate has been approved. The material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

This acceptance criteria has been issued to provide interested parties with guidelines for demonstrating compliance with the provisions of the codes. The criteria is based on a review of pertinent data and a transparent process involving public hearings of the ICC-ES Evaluation Committee, and/or online postings and public comment periods.

Date acceptance criteria will only have an "approved" date, which is the date this document was approved by the Evaluation Committee. Minor existing acceptance criteria are revised the Evaluation Committee will decide whether the revised document should carry only an "approved" date, or an "approved" date combined with a "revised" date. The "revised" date will be used when the revision is deemed significant enough to warrant a change in requirements of the criteria. See the ICC-ES web site for more information on acceptance dates.

If this criteria is a revised edition, a solid vertical line (|) in the margin within the criteria indicates a change from the previous edition. A deletion indicator (↓) is provided in the margin where any significant wording has been deleted.

ICC-ES may consider alternate criteria for report approval, provided the report applicant submits data showing that the criteria is equivalent to the criteria contained herein. ICC-ES may also consider reports of alternate demonstration compliance with the performance features of the codes. ICC-ES retains the right to refuse to issue or revoke any evaluation report, if the application product, material, or method of construction is such that in the judgment of ICC-ES, it does not comply with the intent of the provisions, for satisfactory performance, or if misleading or said to cause injury or consequential damage.

NOTE: The Preface to the AC-series criteria was revised in July 2011 to reflect changes in policy.

Acceptance criteria are developed for use solely by ICC-ES for purposes of issuing ICC-ES evaluation reports.

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Identification

7.0 IDENTIFICATION

For field identification, all Tyco Model WS™ window sprinklers are labeled with the manufacturer's name (Tyco), the product name, and the evaluation report number (ESR-2397).

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PART III

- Evaluation of Alternates
- The "more difficult" way!

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Section 104.11

- … not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

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Storage container buildings

- Are they equivalent?
- How do we evaluate them?
- What are the issues?
- Is there an evaluation report?

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Storage container buildings

- Let's compare to Section 104.11
- Do they meet the requirements?

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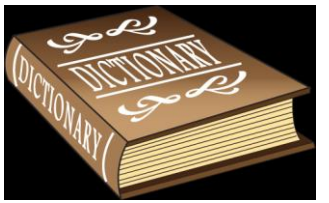
Quality

- the standard of something as measured against other things of a similar kind;
- the degree of excellence of something.



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Quality

- What standard to they meet?
- ISO 1496-1
  - Series 1 Freight Containers - Specification and Testing – Part 1: General Cargo Containers for General Purposes
- ISO 6346
  - Marking requirements

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Quality

- What standard should they meet?
- AISI S100
  - North American Specification for the Design of Cold-formed Steel Structural Members
- AISI S110
  - Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Moment Frames
- Other AISI Standards?

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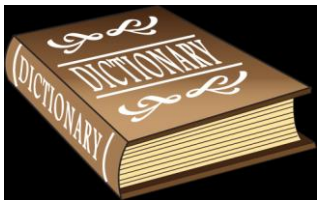
Strength

- the capacity of an object or substance to withstand great force or pressure.



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Strength

- Chapter 16
  - Structural Design
- Design Professional Review
- Structural Analysis

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Strength

- Single unit
- Multiple units tied together
- Altered container
  - Cut away
  - Wall removed
- Stacked units

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Strength

- Special Inspections
  - Welds
  - Connections

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Strength

- Foundation
- Seismic
- Wind
  - Uplift
  - Overturning

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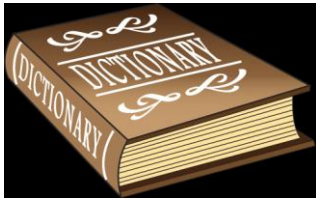
Effectiveness

- the degree to which something is successful in producing a desired result; success.



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Effectiveness

- What is the desired result that a building should provide?

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Effectiveness

- Shelter from the weather
  - Exterior wall construction
  - Roof construction
    - Slope
  - Insulation
    - R-Value of containers

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Effectiveness

- Building Materials
  - Type of construction
  - Combustible vs. noncombustible
- Interior Environment
  - Ventilation
  - Lighting
  - Sanitation

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Fire-resistance rating

- The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function or both, as determined by the tests, or the methods based on tests prescribed in Section 703.

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Fire resistance

- Does it need to be fire-resistant?
  - Type VB
  - Type IIB

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Fire resistance

- Is there any testing?
- Can we use spray applied fireproofing to obtain fire-resistance?
- Gypsum Board Assemblies

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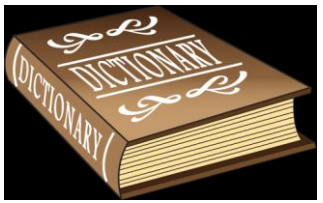
Durability

- the ability to withstand wear, pressure, or damage.



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Durability

- Withstand ocean crossings
  - Wind
  - Rain
  - Waves
  - Ice build up
  - Weight of stacked containers

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Durability

- Withstand weather
  - Wind
  - Rain
  - Seismic

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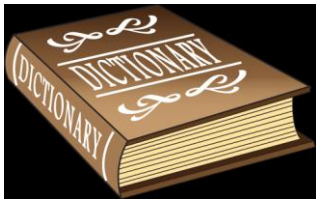
Safety

- the condition of being protected from or unlikely to cause danger, risk, or injury.
- denoting something designed to prevent injury or damage.



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Safety

- Are these things safe?
- Is there an acceptable level of risk?
- Does it meet the intent of the code?

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Safety

- The purpose of this code is to establish the minimum requirements to provide a reasonable level of **safety**, public health and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life and property from fire and other hazards attributed to the built environment and to provide a reasonable level of safety to fire fighters and emergency responders during emergency operations.

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Other Issues

- Is there anything else that should be considered?

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Verdict?

- Based on the information we have, would you approve or deny this alternate material or method of construction?
- If not, what the basis of denial?

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Project Rio

PROJECT RIO
FULFILLMENT CENTER

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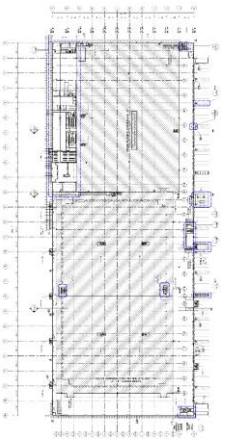
Project Rio

- Base building
  - Group S-1
  - 857,400 SF floor plate
  - One story, 53 feet height
  - Fire sprinklered
  - 60+ feet open space around entire building
- How do we build this?



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Project Rio

- Tenant wants to construct four levels of "proprietary robotic storage and retrieval system".
- Total area of all levels and ground floor
  - 2,313,835 Square Feet

- Now what?

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Project Rio

- Prescriptive code
  - Base building
    - Unlimited area per Section 507.2
    - Type VB or IIB Construction
  - Proposed building
    - Unlimited area per Table 506.2
    - Type IA

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Difference in Types of Construction

- Type IIB
  - Primary structural frame – non-rated
  - Bearing walls – non-rated
  - Floor construction – non-rated
  - Roof construction – non-rated

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Difference in Types of Construction

- Type IA
  - Primary structural frame – 3-hour FRR
  - Bearing walls – 3-hour FRR
  - Floor construction – 2-hour FRR
  - Roof construction – 1½-hour FRR

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Project Rio

- Cost of fireproofing steel for Type IA Construction
- $15,000,000

Now What?

- Tenant says no way!
  - They don't want to spray the structure

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Performance Design

- Design Professional provides a performance design completed by a fire protection engineering firm

Project Rio
Thornton, Colorado

PERFORMANCE-BASED DESIGN ANALYSIS

EXECUTIVE SUMMARY

The project is a new, approximately 855,000 sq ft building for storage and distribution of consumer products that will be occupied and operated by a single tenant, whom is a large internet retailer ("Facility"). The proposed Facility will be constructed of concrete and steel and will be equipped with automatic sprinkler protection throughout. The maximum height to the underside of the roof deck will be 48 ft. The Facility will be considered a Group S-1 occupancy according to the local codes.

The City of Thornton enforces the 2015 edition of the *International Building Code* ("IBC") and 2015 edition of the *International Fire Code* ("IFC"). There are several features of the building design that are not as specifically prescribed by these codes and need to be approved as alternatives under the provisions Section 104.11. This report is intended to provide supporting data and justification for this alternative design and method of construction as permitted in IBC Section 104.11, *Alternative Materials, Design, and Methods of Construction and Equipment*.

The size and arrangement of the Facility necessary for operations requires exit access travel distances of 400 ft. While the IBC permits increases in exit access travel distance up to 400 ft*, the building layout must meet several requirements, including a 26 ft clear height from the floor to ceiling. The layout of the Facility requires several large platforms, which will not meet the clear height requirement. The intent of the code with respect to travel distance limitations is understood to provide safe egress for occupants during a fire emergency within the building. Therefore, one objective of this report is to demonstrate that the intent of the code will be met by the proposed design and construction.

As part of Tenant's operation, several large, open elevated platforms will be included in the Facility. These elevated platforms will include a large, single level platform on one end of the building that will be used primarily for material handling equipment (i.e., network of conveyors). On the other end of the building will be large, multi-level platforms used primarily for a proprietary robotic storage and retrieval system. The multi-level structure will consist of a ground level plus three elevated levels above it. The total footprint of the elevated platforms will be approximately 1,415,614 sq ft.

The arrangement of the elevated platforms does not conform to the applicable code provisions for mezzanines, stories, or atriums. The performance-based design ("PBD") analysis presented in this report considers the platforms from each perspective. However, through discussion with the authority having jurisdiction ("AHJ") and its consultants, it was agreed to focus on the code requirements associated with stories and atriums.

Unfortunately, the elevated platforms will not meet the following code requirements for stories:

IBC, Tables 503.1 & 601B – Number of Stories & Construction Type – The IBC does not permit unlimited area buildings of Type II-B construction where more than two stories are present. If the elevated platforms are considered stories, the building elements would need to be of fire resistance rated construction in order to meet the code requirements for area limitations.

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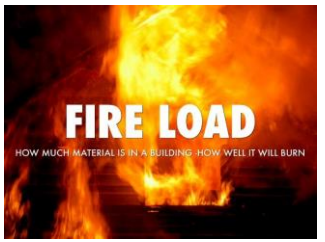
What are the issues?

- Size of the building
- Fire load of contents
- Protection of the occupants
- Protection of the structure
- Others?



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Quality

- What standards are applicable?
  - IBC
  - Structural Standards
- The building will comply with most of the prescriptive code

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Strength

- The building will comply with the structural requirements of the IBC.
- No alternate evaluated

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Effectiveness

- Will the building meet the other desired results of the code?
- Prescriptive requirements

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Fire resistance

- Will the building comply with the fire-resistance requirements of the code?
- NO!
- So…

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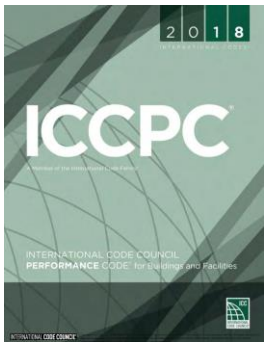
Fire resistance

- The design professional will need to present an alternative to fireproofing the structure as required by the code
- Performance Based Design submitted for review



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Proposed alternate

- Provide sprinkler protection for each elevated platform with a higher level of sprinkler discharge than the hazard being protected would minimally require.
- ESFR sprinklers at the roof

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Proposed alternate

- Provide a completely independent and redundant water source for the facility fire sprinkler systems.

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Proposed alternate

- Automatic mechanical smoke and heat removal in the form of mechanical smoke exhaust will be provided.

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Proposed alternate

- Stated goals
  - Provide a safe environment for occupants to egress the building by maintaining tenable conditions during the time it takes to exit.
  - Protect the structure for a time commensurate with what is required for Type I-A.

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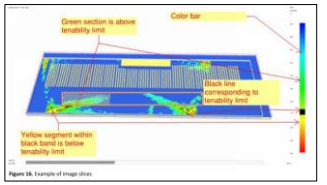
Proposed alternate

- Design Approach
- Building & Hazard Description
- Code Analysis
- Building Design Characteristics
- Occupant Characteristics
- Evaluation Methodology
- Evaluation of Results



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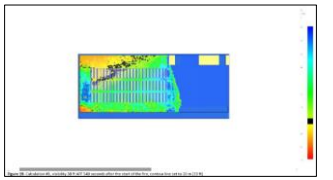
Proposed alternate

- Evaluation Methodology
  - Fire Scenarios
  - Other Considerations
  - Fire Modeling
  - Egress Analysis



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Proposed alternate

- Reviewed by:
  - Building Department
  - Fire Department
  - Code Consultant
  - Fire Protection Engineer
- Comments provided and responded to

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Durability

- Addressed by prescriptive code

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Safety

- Mostly addressed by prescriptive code
- Performance-Based Design Approach used for travel distance and openings between floors

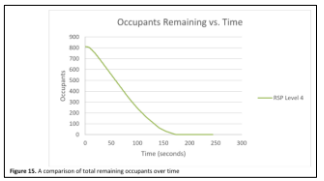

Figure 15. A comparison of total remaining occupants over time

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Verdict?

- Based on the information we have, would you approve or deny this alternate design?
- If not, what the basis of denial?

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Another example:

Alternative Method of Design Request No. 3

Luminous Egress Path Markings

Code Requirement

Luminous egress path markings, in accordance with IBC Section 1025, are required to be provided in all Group A, B, M, and R-1 high-rise buildings.

Request

In lieu of providing luminous egress path markings, the Design Team proposes to utilize the means of egress illumination fixtures within interior exit stairways and exit passageways to provide sufficient lighting for occupants within the building in the event of a total building power failure.

Justification

Emergency lighting fixtures will have three (3) sources of power consisting of the following.

- Normal power provided from the building.
- Emergency power provided by the emergency generator via the emergency lighting circuits, and
- Emergency power provided by the emergency lighting fixture batteries.

The emergency lighting fixture batteries will charge under normal building power (similar to luminous egress path markings) and will be tested weekly for a minimum duration of 30 seconds and annually for a minimum duration of 90 minutes. The emergency lighting fixtures will be wet sealed with gaskets as well.

The proposed design does not intend to lessen the degree of safety required by the Code. The intent of IBC Section 1025 is to provide a means for occupants to identify stair nosings, handrails, landing boundaries, and wall boundaries such that occupants can evacuate a high-rise building in the event of total power failure.

The proposed emergency lighting fixtures will provide greater durability than egress path markings due to the constant maintenance of the egress path markings since they deteriorate over time when occupants use the exit stairs as a means of accessing other floors in lieu of utilizing the elevators. In addition, the amount of egress path markings which is required to be maintained within exit stairs is significant when compared to the hours of maintenance required for the emergency lighting fixtures, particularly since exit stairways serve a high-rise tower.

The fixtures will provide enhanced lighting quality and strength compared to that required within the code. Since the fixtures will be mounted outside the plan of travel (i.e., not on the floor / walls to be marked, scuffed, or broken) the fixtures can be considered a more effective and durable solution compared to the luminous egress path marking stripes required by the Code. The fixtures will be located within the interior exit stairways and will be protected within the 2-hour smokeproof enclosure (similar to the level of protection provided to luminous egress path markings).

Summary

It is requested that three (3) sources of power for emergency egress lighting fixtures within exit stairways and exit passageways be permitted in lieu of luminous egress path markings.

This request is approved in that luminous marking strips are often not maintained and are torn and removed through use. An additional means of lighting the stairwell is an equal or better method of safety.

Reviewed for Code Compliance
Colorado Code Consulting, LLC
CO-IAHO-CM
Jurisdiction Date Verified: 05/30/2021 - 07:00:00 PM

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Shums Coda Associates, LLC

4610 S Ulster Street, Suite 150, Denver, CO 80237

Ph. 925-463-0651-California office
303-400-6564-Denver office

www.shumscoda.com
Bill.clayton@shumscoda.com

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