Combustible Decorative Features and Unique Themed Environments

Douglas H. Evans, P.E., FSFPE
DHE FPE LLC
Las Vegas, NV
2/20/2024

After 22 years as a Fire Protection Engineer with Clark County (Nevada) Building Department, Mr. Evans founded DHE FPE LLC to provide specialized consulting services to the construction industry. In his position with Clark County, his primary focus was coordinating fire protection aspects for the mega-resorts on the Las Vegas Strip. Although this specialization requires a working knowledge of most fire protection aspects, Mr. Evans is primarily known for his expertise in plastics/foam plastics in building construction, unique interior features, smoke management systems and combustible exterior claddings. Mr. Evans is a Fellow of the Society of Fire Protection Engineers, member of NFPA and a registered Fire Protection Engineer.

Unique themed environments:

- Can include artificial trees, large statues, giant signs/LED screens, hand-painted canvas murals adhered to walls and even buildings within the main structure.
- The materials used are most apt to be regulated by Chapters 8 and 26 of the IBC as interior finishes and plastics in building construction, but a number of additional requirements can also apply.
- These regulations along with applicable portions of the IFC are used to provide an understanding of not only those subjects, but also the ability to extrapolate to unique applications.
- This class covers notable fire losses, present code requirements, applicable fire tests and associated fire dynamics, as well as provides a way to think about unique applications to achieve a reasonable level of fire safety.
Combustible Decorative Features and Unique Themed Environments

Artificial Plants

Mannequins vs. Large Statues

Pictures vs. Wall Coverings
Combustible Decorative Features and Unique Themed Environments

History of this Subject:

• Interdepartmental agreement between Clark County Building and Fire Departments (1998)
• Developed into Clark County Unique Building Interiors Design Guide (2003) (periodic updates)
• Article published fall of 2004 SFPE Magazine
• Republished ICC Building Safety August 2005
• Versions of presentation given a number of times

Primary Focus of this Class

• Specific Requirements of the 2021 IFC
• Specific Requirements of Chapters 8 and 26 of the 2021 IBC
  • Identify appropriate tests
  • Understand related terminology
  • Code intent and limitations
• The level of protection intended by those requirements
  • Associated Hazards relative to:
    • Interior Finishes
    • Decorative Materials
    • Trim
    • Plastics
• Unique applications using the IBC for guidance

Learning Objectives:

An increased understanding of:

• Fire losses associated with interior finishes and decorative features.
• Recognize hazards attributable to interior finishes and decorative features.
• IFC/IBC requirements to limit losses and provide a safe environment.
• Applicable fire tests, associated challenges, along with appropriate and inappropriate applications of those tests.
• Related fire dynamics.
• Approaches to achieve reasonable fire safety when the fuel loading exceeds intended limitations.
• How to use the same thought process to achieve fire safety for other unique decorative features.
Notable Losses - Why we care

- Rhythm Club, MS 1940
  - 209 fatalities
- Cocoanut Grove, MA 1942
  - 492 fatalities
- Beverly Hills Supper Club, KY 1977
  - 165 fatalities
- Station Night Club, RI 2003
  - 100 fatalities
- Argentine Nightclub fire, 2004
  - 194 fatalities
- The Cosmopolitan, 2015
  - Exterior pool deck

April 23, 1940
The Rhythm Club
Natchez, Mississippi
(209 fatalities)

losses.in/whynightclubfire-wikipedia.pdf
Spanish moss that had been draped over interior's rafters as a decoration, quickly engulfed the structure. To ensure there were no bugs in the decorated moss, it had been sprayed with a petroleum-based insecticide. Under the dry conditions, flammable methane gas was generated from the moss. The windows had been boarded up to prevent outsiders from seeing or listening to the music. The back door was padlocked and boarded shut.

---

November 28, 1942
Cocoanut Grove Night Club
Boston, MA
(492 fatalities)

Losses Info/Cocoanut Grove Rev. - Wikipedia.pdf
Combustible Decorative Features and Unique Themed Environments

Area of Fire Origin

May 28, 1977
Beverly Hills Supper Club
Southgate, Kentucky
(165 fatalities)


Total Occupant Load estimated at 3000, but limited to 1500

Occupants: 900 – 1300

Area of fire origin
Combustible Decorative Features and Unique Themed Environments

EduCode 2024
February 20, 2003
The Station Nightclub
West Warwick, Rhode Island
(100 fatalities)

Losses Info/The Station nightclub fire - Wikipedia.pdf
December 30, 2004
República Cromañón Nightclub
Buenos Aires, Argentina
(194 fatalities)

Losses Info/República Cromañón fire - Wikipedia.pdf

Around 3,000 people were in attendance. Double the venue’s 1,500 capacity.

Materials used for decoration were mostly wood, Styrofoam, acoustic panels and a plastic net.

A pyrotechnic flare was determined to be the ignition source.

Four of the six doors were chained shut.
Videos posted on social media showed the inferno consuming the poolside tent-like cabanas, imitation palm trees, and just about everything else on the open-air deck of the Cosmopolitan of Las Vegas hotel sending thick black smoke billowing high above The Strip. Some of the hotel’s rooms sustained water damage from sprinklers.
The Director of Clark County's department of building and fire prevention, said that "an independent analysis shows the plastic fronds burned 10 times faster and hotter than an actual southern pine tree without needles. The artificial trunk was constructed of metal, polyurethane foam and fiberglass resin and burned five times more intensely."

Test results indicated that the tree's materials didn't meet flame and smoke resistance standards for indoor use and wouldn't be allowed inside buildings or as an exterior component on a building. The building and fire codes adopted by the county don't apply the same rules to outdoor decorative foliage. As such, "no policy changes are being recommended because it would be difficult to regulate, identify or standardize such adornments, and could cause an undue burden to the businesses." The county also said current fire and building codes were sufficient enough to keep the fire from spreading beyond the pool's deck where it started. Instead, the county urged resort properties to remove or test any such decorations on their site. The county took a cursory look at other buildings and didn't identify the same materials being used elsewhere.

The Cosmopolitan of Las Vegas Bamboo Pool Deck decorative palm trees

Pipe Column with expanded polyurethane, covered with hard coat plastic
Combustible Decorative Features and Unique Themed Environments

Kiss nightclub fire
January 27, 2013
Santa Maria, Rio Grande do Sul, Brazil, killing 242 people and injuring at least 630 others.

Investigators said soundproofing foams on the ceiling caught fire and released poisonous gases that killed those attending a university party.

Bucharest, Romania
Basement level Colectiv nightclub fire
64 deaths – 146 injured
Friday October 30, 2015
Between 300 to 400, mostly young people, were at the club, when a pyrotechnics show went awry. A spark from the band's pyrotechnics ignited polystyrene foam plastic deco.

"People rushed to the entrance but it was too narrow. People panicked and stampeded, climbing over each other trying to get out."

The losses continue

— December 5, 2009: 236 people died when a blaze broke out at the Lame Horse nightclub in Perm, Russia. It started when an indoor fireworks display ignited a plastic ceiling decorated with branches.

— January 1, 2009: An arson attack on a nightclub that New Year's Eve celebration started a fire. Two people died and 67 injured.

— September 21, 2008: A fire killed 44 people at the jammed nightclub in Shenzhen, China. A pyrotechnics show ignited plastic deco.

— December, 2000: A fire, blamed on a confetti cannon, killed 308 people at a disco in the central Chinese city of Luding.

— October, 1998: An arson attack on an overcrowded youth disco in the Swedish city of Gothenburg killed 63 people and injured 600 more. 400 people were trapped in the blaze.

— March, 1996: A fire at the Ozone Disco Pub in Quezon City, Philippines killed 162 people. A large proportion of the victims were students who jumped out the windows to escape the blaze.

— March, 1990: An arson attack at the Happy Land Social Club in the Bronx borough of New York City killed 87 people and injured 180 others. The fire started when a man angry with his girlfriend threw a Molotov cocktail and then jumped down the metal gate to trap people inside.

— December, 1983: A fire at the disco bar in Madrid, Spain left 153 people dead and more than 200 injured.
Summary of Contributing Factors

• Combustible interior finish
• Combustible decorative features
• Ignition source (including pyrotechnics)
• Lack of fire sprinklers
• Egress paths
  • Locked,
  • Blocked,
  • Inadequate for occupant load (overcrowding) or
  • Otherwise noncompliant
• Lack of occupant awareness of alternate egress paths

Definitions

DECORATIVE MATERIALS. All materials applied over the building interior finish for decorative, acoustical or other effect including, but not limited to, curtains, draperies, fabrics, streamers and all other materials utilized for decorative effect including, but not limited to, bulletin boards, artwork, posters, photographs, batting, cloth, cotton, hay, stalks, straw, vines, leaves, trees, moss and similar items, foam plastics and materials containing foam plastics. Decorative materials do not include wall coverings, ceiling coverings, floor coverings, ordinary window shades, interior finish and materials 0.025 inch (0.64 mm) or less in thickness applied directly to and adhering tightly to a substrate.
Definitions

• **FLAME SPREAD.** The propagation of flame over a surface.

• **FLAME SPREAD INDEX.** A comparative measure, expressed as a dimensionless number, derived from the time for a material tested in accordance with ASTM E 84 or UL 723.

• **INTERIOR FINISH.** Includes interior wall and ceiling finish and interior floor finish.

• **INTERIOR WALL AND CEILING FINISH.** The exposed interior surfaces of buildings, including but not limited to: fixed or movable walls and partitions; toilet partitions; coats of paint; plaster; wallboard; packaged wall systems; and interior wall and ceiling material or other finish applied structurally or for decorative, acoustic, acoustical, surface insulation, structural fire resistance or similar purposes, but not including trim.

• **INTERIOR FLOOR FINISH.** The exposed floor surfaces of buildings, including coverings applied over a finished floor or stair, including risers.

• **SMOKE-DEVELOPED INDEX.** A comparative measure, expressed as a dimensionless number, derived from measurements of smoke obscuration versus time for a material tested in accordance with ASTM E 84.

• **TRIM.** Picture molds, chair rails, baseboards, handrails, door and window frames and similar decorative or protective materials used in fixed applications.

• **Non-combustible.** Section 703.3.1 - ASTM E136—19 (Combustible not defined)

• **FLASHOVER.** A stage in the development of a contained fire in which all exposed surfaces reach ignition temperatures more or less simultaneously.

Fire-Resistant vs. Fire-retardant

• **Fire-Resistant** (primarily Chapter 7)
  • Applies to compartmentation
    • Structural frame
    • Walls
    • Floor/ceiling assemblies
    • Joints
    • penetrations

• **Fire-retardant** (Chapters 8, 23 and 26)
  • Resistance to ignition
  • Less apt to propagate
Methods of “Fire-retarding” Combustible Materials

- Chemical
- Plastics
- Impregnation
  - Natural fabrics
  - Dipping / soaking
- Coatings
  - Intumescence
  - Other topical applications
- Pressure Impregnation
- Pressure treated wood products

2021 IFC

- Decorative Materials
  - 806 & 807
  - Decorative Vegetation
  - Foam plastics
- Furnishings
  - 805 & 808

The Fire Code Primarily addresses fuel loading inside a building

2021 IBC

- Interior Finishes
  - Chapter 8
  - 806 addresses Decorative Materials
- Special Detailed Requirements
  - Chapter 4
- Type of Construction
  - Chapter 6
- Plastics
  - Chapter 26

Primarily addresses materials that make up the building
Chapter 8: Interior Finishes

• 801 Scope
• 802 General
• 803 Wall and Ceiling Finishes
• 804 Interior Floor Finishes
• 805 Combustible Materials in Types I and II construction
• 806 Decorations and Trim

SECTIONS 801 & 802

• 801.1 Scope. This chapter governs materials used as interior finishes, trim and decorative materials.

• 802.1 Interior wall and ceiling finish. These provisions limit the allowable fire performance and smoke development based on occupancy classification (see 803.13).

• 802.7 Foam plastics shall not be used as interior finish or trim except as provided in Sections 803.4 (2603.9), 806.5 or 2604.2. This applies to exposed foam plastics and foam plastics used in conjunction with a textile or vinyl facing or cover.

SECTION 803 WALL AND CEILING FINISHES

• 803.1.1 NFPA 286
- Includes pass/fail constraints

• 803.1.2 tested to ASTM E84 or UL 723
  - Class A: flame spread 0-25
  - Class B: flame spread 26-75
  - Class C: flame spread 76-200
  - In all cases smoke-developed 0-450.

803.2 Thickness exemption. Materials less than 0.036 inch (0.9 mm) thick applied directly to the surface of walls or ceilings are not required to be tested.

803.14 Stability. 200 °F for 30 minutes

803.3 Heavy timber exemption. Exposed portions of building elements complying with the requirements for buildings of heavy timber construction in Section 602.4 or Section 2304.11 shall not be subject to interior finish requirements except in interior exit stairways, interior exit ramps, and exit passageways.
Section 803.15 Application

- 803.15.1 Limited Combustible Voids
  - Substantial contact with non-combustible substrate
  - Eliminate
  - Mitigate

- 803.15.2 Larger Combustible Voids
  - Eliminate
  - Mitigate

- 803.15.3 Heavy Timber
  - Eliminate
  - Mitigate

- 803.15.4 Materials ≤ ¼ inch thick
  - Exception 1 - noncombustible
  - Exceptions 2 & 3 - tested for the application

803.5 Textiles

- As Interior Finishes Includes: woven, nonwoven, napped, tufted, looped, carpet, or similar materials
- NFPA 286 per Section 801.1.1,
- NFPA 265 Test Method B
  - Fully lined protocol
  - Pass/Fail constraints
  - Defines flashover
  - or...Must be Class A and protected by automatic sprinklers
Combustible Decorative Features and Unique Themed Environments

803.10 SITE-FABRICATED STRETCH SYSTEMS

A system, fabricated on site and intended for acoustical, tackable or aesthetic purposes, that is composed of three elements:

1. A frame (constructed of plastic, wood, metal or other material) used to hold fabric in place.
2. A core material (infill, with the correct properties for the application).
3. An outside layer, composed of a textile, fabric or vinyl, that is stretched taut and held in place by tension or mechanical fasteners via the frame.

SECTION 804 - INTERIOR FLOOR FINISH

• 804.1 General. Interior floor finish and floor covering materials shall comply with this section.
  • Exception: Floor finishes and coverings of a traditional type, such as wood, vinyl, linoleum or terrazzo, and resilient floor covering materials which are not comprised of fibers.
• Pill Test (DoC FF-1 / CPSC 16 CFR, Part 1630 / ASTM D2859)
• NFPA 253 (Radiant flux test for specific exit paths)

Flooring Radiant Panel

Applicable standards

• ASTM E 648 or NFPA 253
  • (Floor coverings IBC Sec 804.2)
• Critical radiant heat flux is measured
Combustible Decorative Features and Unique Themed Environments

Section 805 Combustible Materials in Types I and II Construction

805.1 Application (in floors and flooring)
- 805.1.1 Subfloor construction
- 805.1.2 Wood finish flooring
- 805.1.3 Insulation boards

805.1.4 Combustible voids
- Fireblocking per 718 allowed

805.1.5 Application of 805.1.1
- Application of 805.1.2
- Application of 805.1.3

Section 806 Decorative Materials and Trim

806.1 Occupancies regulated
- A, B, E, I, M, R-1 and dormitories in R-2

806.2 Furnishings from walls or ceilings
- Curtains
- Draperies
- Fabric hangings
- Other combustible decorative materials

806.3 Testing
- Non-combustible, or
- NFPA 701 (Test 1 or 2)
- NFPA 289, using the 20 kW ignition source
- 805.4 approved testing agency required

Limitations

- Non-combustible
  - unlimited
- Flame-resistant materials
  - 75% in Group A auditoriums w/ sprinkler
  - 50% in R-2 Dormitories w/ sprinklers
  - 10% in all other
  - (specific wall or ceiling area)
806.5 & 806.6

- [F] 806.5 Foam plastic. Foam plastic used as trim in any occupancy shall comply with Section 2604.2.
- [F] 806.6 Pyroxylin plastic. Imitation leather or other material consisting of or coated with a pyroxylin or similarly hazardous base shall not be used in Group A occupancies.

806.7 Trim

TRIM - Picture molds, chair rails, baseboards, handrails, door and window frames and similar decorative or protective materials used in fixed applications. Other than foam plastics.
- Crown molding?

- Limited to 10% of the specific wall or ceiling
- Class C flame spread index required

When does trim become interior wall finish?
Combustible Decorative Features and Unique Themed Environments

402 Covered Mall Buildings

- 402.6.2 Kiosks & similar structures
  - Temporary or permanent
  - Fire-retardant treated wood
  - Foam plastics ≤ 100 kW per UL 1975
  - Aluminum composite materials – Class A
  - Sprinkler protected
  - 300 sq ft max
  - Separated by 20 ft

- 402.6.3 Play structures
  - Per Section 424
  - Separated by 20 ft

402.6 Plastic Signs in Covered Mall Buildings

- 402.6.4 Plastic signs limited to:
  - 20% of tenant wall area facing mall
  - 36 inches max height if horizontal
  - 36 inches high by 36 inches wide if vertical
  - No closer than 18 inches to adjacent tenants

- 402.6.4.4 Non-foam plastic signs:
  - Edges and back incased in metal and
  - 2606.4 Light-transmitting plastics, or
  - Class B along with Ignition temp > 650 °F

- 402.6.4.5 Foam plastic signs:
  - < ½ inch thickness
  - > 20 pound per cu ft density
  - ≤ 150 kW per UL 1975

Other Chapter 4 Interiors Requirements

- 404.9 Atria Interior Finish
  - Class B

- 410.2.6 Stage Scenery
  - NFPA 701
  - Foam plastics per 2603

- 411.7 Special Amusement Buildings
  - Class A
  - even when sprinklered (411.2)

- 424 Play Structures
  - Non-combustible materials, or
  - Materials regulated
Chapter 6 Allowances

- Chapter 6 – Types of Construction
  - 603 – Combustible materials in Non-Combustible Buildings
  - Fire-resistant treated wood
  - Exposed thermal and acoustical insulation – Class A
  - Foam plastics in accordance with Chapter 26
  - Floor covering materials in accordance with Section 804
  - Millwork such as doors, door frames, window sashes and frames
  - Interior wall and ceiling finishes in accordance with Section 803
  - Trim in accordance with Section 806
  - Blocking such as for handrails, millwork, cabinets and window and door frames
  - Light-transmitting plastics as permitted by Chapter 26
  - Materials exposed within plenums complying with the Mechanical Code

Chapter 26

Although Chapter 26 governs the use of plastics for various aspects of building construction, the following overview is intended as guidance for the use of plastics inside buildings.

Chapter 26 Sections to discuss

- 2603 Foam Plastic “Insulation”
- 2604 Interior Finish and Trim
- 2605 Plastic Veneer
- 2606 Light-Transmitting Plastics
- 2611 Light-Transmitting Plastic Interior Signs
Combustible Decorative Features and Unique Themed Environments

Foam Plastic "Insulation"

- **Shortened Definition**
  - Intentionally expanded to produce a reduced-density plastic
  - For insulating or acoustical purposes
  - Density less than 20 pounds per cubic foot

2603 Foam Plastics

- 2603.1 Foam Plastic in buildings and structures
- 2603.2 Listed and labeled at the job site
- 2603.3 Surface-burning characteristics
  - Class B
- 2603.4 Thermal barrier
  - Required to separate foam from interior
  - Initially based on 1/2-inch (12.7 mm) gypsum wallboard

2603.4 - Thermal Barrier

- Required to separate foam from interior of building
- ½ inch gypsum wallboard or equivalent
- NFPA 275
  - Temp rise on unexposed surface limited to 250 °F after 15 minutes
  - Encapsulation must remain in place
- Several construction approaches recognized to mitigate thermal barrier
- Exposed foam on interior of buildings essentially not allowed
- EIFS not allowed inside buildings
- 2603.9 Special tests allow exposed foam

EduCode 2024 2/20/2024
2604 Plastics as interior finish and trim
- Meet Chapter 8
- Foam plastics in accordance with 2603.9
  - Foam plastic trim
    - Density ≥ 20 pounds per cu ft
    - Thickness ≤ ½ inch
    - Width ≤ 8 inches
    - ≤ 10% the specific wall or ceiling
    - Class B or meets NFPA 286

2605 Plastic Veneer
- Interior finish must meet Chapter 8
- Exterior use limited

2606 Light-Transmitting Plastics
- 2606.4 Specifications
  - Self-ignition temp > 650 °F
  - Smoke generation limited to:
    - 450 per E84 or 75 per ASTM D2843
    - Either CC1 or CC2 per ASTM D635
    - CC1 - 1 inch burning extent
    - CC2 - 2.5 inches per minute burning rate
- In accordance with Sections 2607 – 2610 essentially only allowed on exterior of building
Light-Diffusing System Defined

Construction consisting in whole or in part of lenses, panels, grids or baffles made with light-transmitting plastics positioned below independently mounted electrical light sources, skylights or light-transmitting plastic roof panels. Lenses, panels, grids and baffles that are part of an electrical fixture shall not be considered as a light-diffusing system.

2606.7 Light-Diffusing Systems

- 2606.7.2 Shall comply with chapter 8
  - Unless fall from mounting at ≤ 200 °F below ignition temperature
  - Remain in place at 175 °F for 15 minutes
- 2606.7.3 Size limitations
  - 10 feet long nor
  - 30 square feet in area
- 2606.7.4 Sprinkler protection
  - Above and below
  - Unless not adversely affect sprinklers
  - Area unlimited

2611 Light-Transmitting Plastic Interior Signs

- Must comply with 2606
- Size limitations:
  - 24 square feet maximum
  - 100 square feet if CC1 and protected by sprinklers
  - Separation by 4 feet horizontal and 8 feet vertical constitutes separate signs
- Non-illuminated portions fully encased in metal
- For malls see 402.6.4
Combustible Decorative Features and
Unique Themed Environments

2607 Light-Transmitting Plastic Wall Panels
2608 Light-Transmitting Plastic Glazing
2609 Light-Transmitting Plastic Roof Panels
2610 Light-Transmitting Plastic Skylight Glazing

These materials limited to use on exterior walls and roofs

SECTION 2612 PLASTIC COMPOSITES
Exterior use where combustible construction is permitted

SECTION 2613 FIBER-REINFORCED POLYMER
Interior uses must meet Chapter 8

Fire Dynamics
The physics of how fires start, spread and develop.

The study of how chemistry, fire science, material science, fluid mechanics and heat transfer interact to influence fire behavior.

Conditions affecting Fire Dynamics
- Proximity to and significance of ignition source(s) and adjacent fuel package(s)
- Magnitude and duration of heat energy the ignition source projects onto target
- Combustibility/flammability characteristics of target
  - Ignition temperature, heat release rate
- Mass to surface area ratio
  - Thin combustible materials
- Density
- Orientation of material (horizontal vs. vertical)
- Floors vs. ceilings
- Assemblies vs. single materials
- Type of substrate and method of attachment
- Size of the fire compartment
Heat Release Rate (HRR)
A common term used in fire dynamics.

- HRR is the driving force of fire development.
- Measurement of "how big the fire is."
  - Quantity of heat energy being expended.

**Examples of Peak Heat Release rate:**

- Cigarette lighter: 50 - 100 W
- One candle: 80 W
- Tinti Burner (for small scale fire testing): 50 - 500 W (0.05 - 0.5 kW)
- Bunsen Burner: 1.5 kW
- Small waste basket: 20 - 50 kW
- Flashover in small room: 1 MW
- Polyurethane easy chair: 1.5 MW
- 100 sq. ft. cubicle & associated fuel load: 2 MW
- Polyurethane sofa: 3 MW
- Fully developed fire in compartment: 1 - 4 MW
- Motor home, Bus, 18 wheeled tractor trailer: 100-150 MW

Wooden Kiosk with T-shirts ≈ 1.8 MW
Combustible Decorative Features and Unique Themed Environments

**Polyurethane Furniture:** 2 - 3 MW

- **HRR of Sofa & Easy Chair**

**Christmas Tree:** 4+ MW

- **HRR of Dry Christmas Trees**

**HRR of Automobiles**

- **HRR of 3175 lb Minivans**
Common Fire Tests for:
Decorative materials and Interior Finishes

- Small Scale
  - ASTM D635
  - NFPA 701, Test Method 2
    - The preceding tests use a "Tirril" Burner (similar to a Bunsen Burner) 500 W = 0.5 kW max.
  - UL 1975 (18 kW)
- Intermediate Scale
  - Steiner tunnel test / ASTM E84 (88 kW)
- Large Scale
  - Room-corner tests (160 kW)
    - NFPA 265 (textiles)
    - NFPA 286 (non-textiles)

Bench-scale Testing Vs. Larger Scale

- "Bench-type" testing should initially be conducted to determine if adverse behavior of the specific material can be predicted under actual fire conditions.
- Failure to achieve ignition in small-scale tests is not substantial proof of non-combustibility.
- Many materials incapable of achieving self-supporting fire in bench test configurations prove to be very combustible when subjected to larger scale testing.

FM Data Sheet 1-4

ASTM D 635 for CC1/CC2 Plastics 0.5 kW Max
Combustible Decorative Features and Unique Themed Environments

NFPA 701
Test Method 1
50 W
Applications:
• Curtains/drapes
• Decorative materials
• Textiles

NFPA 701
Test Method 2
500 W = 0.5 kW max
Six foot high test chamber
Applications:
• Fabrics in excess of 700 g/m²
• Tents/tarps/awnings
• Decorative materials
• Textiles

UL 1975
18 kW
(20 kW)
Combustible Decorative Features and Unique Themed Environments

UL 1975 Wood Crib (18 kW)

Maximum 10 inches long and 6 inches high

Foam Plastic Decorative Object

Photo Courtesy Hughes Associates

Steiner Tunnel Test (ASTM E 84) (88 kW)
The most common fire test specified in US codes

Applications:
- Interior finish
- Building products
- Insulation
- Plenum materials

Photo Courtesy Hughes Associates
Combustible Decorative Features and Unique Themed Environments

**View of Flames Through Windows**

*Photo Courtesy Hughes Associates*

Used to Determine:
- Flame Spread and
- Smoke-Developed Indices

---

**Steiner Tunnel Test**

- 25 feet long

---

**Steiner Tunnel Test**

- Fire Box one foot by 1.5 foot

---

EduCode 2024
Combustible Decorative Features and Unique Themed Environments

Room Corner Test (40 – 150/160 kW)

Room Corner Test Standards:

- NFPA 265-19
  - Textile wall coverings
- NFPA 286-15
  - Wall & ceiling interior finish
  - Thermal barrier exemption
- UL 1715-97
  - Interior finish for foam plastics
  - Thermal barrier exemption

Wood Crib Version
Combustible Decorative Features and Unique Themed Environments

Screening Protocol

Overview of Recognized Test Methods

- Proximity to and significance of, ignition source(s) and adjacent fuel package(s)
- Magnitude and duration of heat energy the ignition source projects onto target
- Combustibility/flammability characteristics of target
  - Ignition temperature, heat release rate
  - Mass to surface area ratio
  - Thin combustible materials
  - Density
- Orientation of material (horizontal vs. vertical)
- Floors vs. ceilings
- Assemblies vs. single materials
- Type of substrate and method of attachment
- Size of the fire compartment

Wu dew we dew w/ the *weird* stuff?

Wall Applications
Ceiling Applications
Artificial Plants and Statues
Decorative Structures within, on and adjacent to Buildings
Primary Concept

The main concept of this portion of the presentation is:

When decorative materials exceed the intent of the fire code they can be constructed out of the same materials allowed for the building.

Q: When do decorative materials exceed the intent of the fire code?

Fire Code

Decorative materials inside buildings are regulated by the fire code as fuel loading.

- Artificial plants
- Mannequins
- Table umbrellas
- Signs
- Pictures
- Draperies
- Murals

Building Code

The building code regulates what the building components are constructed out of.

- Floors
- Walls
- Columns
- Ceilings
- Interior finishes
Combustible Decorative Features and Unique Themed Environments

Artificial Plants

McCarran Airport, Satellite D

Mannequins vs. Large Statues

Luxor Registration Desk

Pictures vs. Wall Coverings

NYNY Registration Area
Combustible Decorative Features and Unique Themed Environments

When do signs become the wall?
McCarran Airport Baggage Claim

Umbrellas vs. Ceilings

Child’s Playhouse vs. Interior Structures

Luxor Atrium
Combustible Decorative Features and Unique Themed Environments

Consideration Of The Potential Fire Hazard (Slide 1 of 2)

- Proximity to fire sprinklers.
- Obstruction to sprinkler discharge.
- Burning characteristics.
  - Ignition temperature, heat release rate
- Type of substrate and method of attachment.
- Physical properties of the decorative item.
  - Size, thickness and product type
- Properties of topical applications.
  - Pigments, varnishes

Consideration Of The Potential Fire Hazard (Slide 2 of 2)

- Combustible concealed voids.
  - Compartmentation, sprinkler installation and plenums
- Fire-retardant applications.
- Applicability of recognized fire tests.
- Temporary vs. Permanent.
- Proximity to, and significance of, ignition sources and adjacent fuel packages.
- Obstruction to occupant evacuation.

Organizing the approach for unique interior applications

- Trim
- Wall Applications
- Ceiling Applications
- Artificial Plants and Statues
- Decorative Structures within, on and adjacent to Buildings
Combustible Decorative Features and Unique Themed Environments

Trim

- Limited in size and quantity
- Baseboards
- Chair rails
- Crown molding
- Door/window frames
- Handrails
- 10% of walls and ceiling

* When does trim become wall or ceiling finish?*  
  - 6 to 8 inches? (IBC Section 2604.2.2 – 8 inches)

Wall Applications

- Murals
- Tapestries
- Pictures
- Signs

* When does a picture become a wall covering?*
  - 10 feet by 10 feet?
Combustible Decorative Features and Unique Themed Environments

Fabric Room Dividers

Interior Signage

Aladdin Desert Passage Mall

Ceiling Applications

- Umbrellas
- Awnings
- Canopies
- Non-occupiable/decorative balconies
- Interior eves/horizontal projections
- Lattice ceilings
- Roofs of interior structures

- When do these features become a ceiling?
  - 10 feet by 10 feet
Artificial Plants and Statues

- Artificial plants
- Statues
- Preserved plants
- Mannequins
- Models
- Small, non-occupiable decorative structures

When do these features exceed the intent of the fire code?

- If diameter is 2 ft, height 3 ft?
Combustible Decorative Features and Unique Themed Environments

- **Foam Plastic Palm Trees**
  - McCarran Satellite D

- **Plastic Column Covers**
  - Caesars Forum Mall

- **Aladdin Casino**
Combustible Decorative Features and Unique Themed Environments

Decorative Structures Within Buildings

Break decorative structures into components

- Interior wall/ceiling finishes
- Decorative ceilings/roofs
- Nonbearing partitions
- Columns and bearing walls
- Mezzanines
- Occupicable floors/balconies

Photo Courtesy Luxor
Combustible Decorative Features and Unique Themed Environments

Photo Courtesy New York New York

Starship Bridge

Photo Courtesy New York New York

The Luxor Hotel and casino

Photo Courtesy Luxor
Combustible Decorative Features and Unique Themed Environments

Photo Courtesy Luxor

FAO Schwarz in The Forum Mall

EduCode 2024
Decorative Features Summary

• When does fuel loading become building materials?
  • If anyone at anytime can pick it up and carry it inside the building, it’s likely fuel loading.
  • If the decorative item takes a crew of people to haul it inside the building and assemble it, it may be more appropriate to construct the decorative feature out of the same materials allowed for the base building.

This Presentation Focused On

• The fire protection aspects of interior finishes and decorative features inside buildings
• Why these requirements exist
  • Fire losses
  • Applicable Code requirements
  • Applicable fire tests, associated challenges, along with appropriate and inappropriate applications of those tests.
• Related fire dynamics
• How to use the same thought process to achieve fire safety for other unique decorative features.

The End

Any Questions?

Douglas H. Evans, P.E., FSFPE
DHE FPE LLC