HISTORY OF FOAM PLASTICS IN THE BUILDING CODES

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LEARNING FROM THE PAST

- Understand the basis for current code requirements for foam plastic products
- Educate new entrants/personnel in the foam plastic industry on our fire testing history
- Prevent inappropriate uses of foam plastic products
  - Rhode Island Nightclub fire that used packaging foam as interior finish materials

OVERVIEW

- History of Foam Plastics in the Codes
- Current Code Requirements For Foam Plastics
HISTORY OF FOAM PLASTICS IN THE CODES

MARKET INTRODUCTION OF FOAM PLASTIC INSULATION

- Late 1960s and early 1970s
  - Response to a developing Energy Crisis
  - Roof and Wall Construction
  - Agricultural, Industrial, Commercial and Residential Buildings
- Questions on assessing the fire performance of these products

EARLY FIRE TESTING

- ASTM D1692 Method of Test for Rate of Burning or Extent and Time of Burning of Cellular Plastics Using a Specimen Horizontal
  - Introduced in 1959
  - Small-scale test
    - Sample size: 6"long x 2"wide x 0.5" thick
    - Fire source: Bunsen Burner
    - Test Results: Burning, Non-burning or self-extinguishing
- Standard withdrawn in 1976
EARLY FIRE TESTING

  - Introduced in 1941, promulgated by ASTM in 1950 to assess cellulosic materials for walls & ceilings and used for other interior finish materials
  - Also known as the “Steiner Tunnel”

EARLY FIRE TESTING: ASTM E84

- Small-scale test
  - Sample size: 24 ft. long x 2 ft. wide x product thickness (4” max.)
  - Fire source: Gas burner at one end of tunnel for ten minutes
  - Test Results: Flame Spread based on time and distance and smoke developed index measured optically

- Standard still in use today

FEDERAL TRADE COMMISSION (FTC) ACTIONS

- 1972 Investigations of fires involving cellular plastics
  - “Childress fire” – residential fire – exposed foam insulation – deaths of 2 small children

- Alleged misuse of small-scale fire tests in promotional materials
  - “Small scale tests are neither reliable nor accurate tests for determining, evaluating, predicting or describing the burning characteristics of plastic products under actual fire conditions.”
FEDERAL TRADE COMMISSION (FTC) FINDINGS

- Recognition that plastics burn differently than "conventional materials", such as wood or cotton
  - Flame spread was more rapid and likelihood of flashover was increased
  - Plastic products liberated more BTUs per pound than conventional materials
  - Greater amounts of dense smoke were produced
  - Toxic or flammable gases were released more quickly
  - Polystyrenes tended to melt or drip and contribute to spread of fire
  - Certain types of polyurethanes could self-ignite if improperly formulated or applied.

1974 FTC CONSENT CEASE & DESIST ORDER

- Issued November 4, 1974
- Signed by Respondents for settlement purposes, not as an admission that the law had been violated.
- Focused on the use of small-scale combustibility tests
  - Cease using "non-burning", "Self-extinguishing" or non-combustible" when describing foam plastic products
  - Any reference to numerical flame spread ratings based on small scale tests, such as ASTM E84 contain a disclaimer:
    - "This numerical flame spread rating is not intended to reflect hazards presented by this or any other material under actual fire conditions."

1974 FTC CONSENT CEASE & DESIST ORDER

- Notification of the Terms of the Order
  - Previous purchasers of the plastic products, government bodies & officials, insurance underwriters, building code bodies and members of ASTM.
- Establishment of a Research Program
  - 5 year, $5 million program to
    - Determine the "safest" method of using foam plastics
    - Develop guidelines for safe and effective use of the products
    - Develop tests or standards
      - Including large-scale tests to provide an accurate and reliable determination of the burning characteristics of the products under actual fire conditions.
1974 FTC CONSENT CEASE & DESIST ORDER

- Compliance Reporting to the FTC for 5 years
- 1974 Proposed Trade Regulation Rule to govern cellular plastic products
  - Withdrawn in 1980 due to widespread compliance with the terms of the Consent Order.

FOAM PLASTICS INDUSTRY COMPLIANCE EFFORTS

- Society of the Plastics Industry (precursor to current trade associations) took a leadership role on Education & Notification of the terms of the Order
  - Technical Bulletins
  - Issuance of Advisory Letters
- Development of Code requirements/language
- Establishment of the Products Research Committee
  - SPI/ National Bureau of Standards (now NIST) research associate program
  - Development of large scale corner wall tests
  - Programs to validate such tests with small-scale work
  - Development of combustion toxicity studies

PRODUCTS RESEARCH COMMITTEE RECOMMENDATIONS

- Educational efforts by the foam plastic industry
- Foam plastics should be covered with a thermal barrier unless there is a pass of large scale fire tests without the thermal barrier
- Continue development of full-scale fire tests
- Continue refinement of predictive models
- The Steiner Tunnel should be detailed and validated
- Evaluation of other combustion tests methods and apparatus
- Continued work on combustion toxicity, including correlating work from small-scale tests to full-scale fires.
SUNSET OF THE FTC ORDER

- January 2, 1996: Automatic “sunset” of FTC Order
- Signatories to the Order could no longer be cited for violating the Order

BUT

The FTC still view claims inconsistent with the Order as “false and misleading”

Therefore: Comply with the intent of the Order

BUILDING CODES ADDRESS FOAM PLASTICS

- 1976 Uniform Building Code
  - Complete new section (Section 1717) devoted to Foam Plastics
  - Required E84 testing
  - Required a 15 min. thermal barrier – typically ½” gypsum board – covering the foam insulation
  - Full-scale fire tests for foam plastic insulation were still under development
- Other Model Codes followed

CURRENT CODE REQUIREMENTS FOR FOAM PLASTICS
CODE DEFINITIONS

- **FOAM PLASTIC INSULATION.** A plastic that is intentionally expanded by the use of a foaming agent to produce a reduced-density plastic containing voids consisting of open or closed cells distributed throughout the plastic for thermal insulating or acoustic purposes and that has a density less than 20 pounds per cubic foot (320 kg/m³).

- Other definitions for other foam plastic applications and other types of plastics (light transmitting, etc.)

CBC SECTION 2603 & CRC SECTION R316

- **Basic Requirements for both the CBC and CRC**
  - Labeling & Identification
  - Surface Burning Characteristics - ASTM E84 or UL723
    - < 75 flame spread index
    - < 450 smoke developed index
  - Thermal Barrier Requirements
    - Typically 0.5" gypsum wall board

CBC SECTION 2603.2

- **Labeling and identification.** Packages and containers of foam plastic insulation and foam plastic insulation components delivered to the job site shall bear the label of an approved agency showing the manufacturer’s name, the product listing, product identification and information sufficient to determine that the end use will comply with the code requirements.
LABELING OF FOAM PLASTIC

The requirement for labeling involves an approved agency (UL, etc.) that requires:
- QC manual be developed & compliance
- Unannounced inspections to verify manufacturing process & compliance
- Use the FSI & SDI results to determine compliance with the Code

CBC – SECTION 2603.3

Surface burning characteristics. Unless otherwise allowed in this section, all foam plastic or foam plastic cores used as a component in manufactured assemblies used in building construction shall have a flame-spread index of not more than 75 and shall have a smoke-developed index of not more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E84 or UL 723. Loose fill type foam plastic insulation shall be tested as boardstock for the flame spread index and smoke developed index.

E84 / UL723

- Studies by ULI in mid-1970s showed a “rough” correlation between the E84 results and vertical wall tests.
  - Work involved various materials
- Require foam plastic to have FSI better than wood (B versus C)
EXCEPTIONS TO SECTION 2603.3

- Interior Trim – SDI is exempt, but not FSI
- Cold storage buildings – Tested & sprinklers
- Roofing – but meet other tests
- Greater than 4 inches in thickness – test in full-scale test.
- Interior signs in malls – meet other tests

CBC SECTION 2603.4

Thermal barrier. Unless otherwise allowed in Section 2603.4.1 and Section 2603.10, foam plastic shall be separated from the interior of a building by an approved thermal barrier of minimum ½-inch (12.7 mm) gypsum wallboard or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test on NFPA 275. Combustible concealed spaces shall comply with section 718.

WHY IS A THERMAL BARRIER REQUIRED?

- To isolate the foam plastic from an ignition source
- To delay fire growth if the foam plastic ignites

THERMAL BARRIER INFORMATION

- Provides protection to the underlying foam for a finite period of time when exposed to a moderate fire.
- The ½-inch thick gypsum wallboard was selected based on full-scale testing by ULI and others.
- Other materials are in use (Spray-applied Fire Resistive Materials, Cellulosic insulation, etc.)
- 2015 IRC will allow wood

EXCEPTIONS TO THERMAL BARRIER REQUIREMENT BASED ON SPECIFIC USE OR TESTING

- Masonry & concrete – 1-in. minimum
- Cooler & Freezer walls – <25 FSI, meet other reqmts & AS
- Walk-in coolers – coverings, size limits
- Exterior walls – 1 story Bldg. – <25 FSI, coverings, AS
- Roofing – Wood structural panel or meet other tests
- Attics/crawlspace – Cover with ignition barrier
- Doors – No Fire-Resistance (F-R), then covered
- Garage doors – No F-R, coverings or full-scale test
- Siding/backer board – limit on amount, separate from interior
- Interior trim – meet other requirements
- Interior signs – meet other requirements
- Sill & Headers – Type V – .25 FSI, limits on size, density

CBC – SECTION 2603.5

Exterior walls of buildings of any height. Exterior walls of buildings of Type I, II, III or IV construction of any height shall comply with Sections 2603.5.1 through 2603.5.7. Exterior walls of cold storage buildings required to be constructed of noncombustible materials, where the building is more than one story in height, shall also comply with the provisions of Sections 2603.5.1 through 2603.5.7. Exterior walls of buildings of Type V construction shall comply with Sections 2603.2, 2603.3 and 2603.4.

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CBC SECTION 2603.5
EXTERIOR WALLS OF BUILDING
OF ANY HEIGHT

2603.5.1 Fire-resistance-rated walls.
- Where the wall is required to have a fire-resistance rating, data based on tests conducted in accordance with ASTM E 119 or UL 263 shall be provided to substantiate that the fire-resistance rating is maintained.

2603.5.2 Thermal barrier.
- Any foam plastic insulation shall be separated from the building interior by a thermal barrier meeting the provisions of Section 2603.4, unless special approval is obtained on the basis of Section 2603.8.
  • Exception: One-story buildings complying with Section 2603.4.1.4.

2603.5.3 Potential heat.
- The potential heat of foam plastic insulation in any portion of the wall or panel shall not exceed the potential heat expressed in Btu per square feet (mJ/m²) of the foam plastic insulation contained in the wall assembly tested in accordance with Section 2603.5.5. The potential heat of the foam plastic insulation shall be determined by tests conducted in accordance with NFPA 259 and the results shall be expressed in Btu per square feet (mJ/m²).
  • Exception: One-story buildings complying with Section 2603.4.1.4.

2603.5.4 Flame spread and smoke-developed indexes.
- Foam plastic insulation, exterior coatings and facings shall be tested separately in the thickness intended for use, but not to exceed 4 inches (102 mm), and shall each have a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E 84 or UL 723.
  • Exception: Prefabricated or factory-manufactured panels having minimum 0.020-inch (0.51 mm) aluminum facings and a total thickness of 0.25 inch (6.4 mm) or less are permitted to be tested as an assembly where the foam plastic core is not exposed in the course of construction.
CBC SECTION 2603.5
EXTERIOR WALLS OF BUILDING OF ANY HEIGHT

2603.5.5 Vertical and lateral fire propagation.
   • The wall assembly shall be tested in accordance with and comply with the acceptance criteria of NFPA 285.
   • Exception: One-story buildings complying with Section 2603.4.1.4.

2603.5.6 Label required.
   • The edge or face of each piece of foam plastic insulation shall bear the label of an approved agency. The label shall contain the manufacturer’s or distributor’s identification, model number, serial number or definitive information describing the product or materials’ performance characteristics and approved agency’s identification.

2603.5.7 Ignition.
   • Exterior walls shall not exhibit sustained flaming where tested in accordance with NFPA 268. Where a material is intended to be installed in more than one thickness, tests of the minimum and maximum thickness intended for use shall be performed.
   • Exception: Assemblies protected on the outside with one of the following:
     1. A thermal barrier complying with Section 2603.4.
     2. A minimum 1 inch (25 mm) thickness of concrete or masonry.
     3. Glass-fiber-reinforced concrete panels of a minimum thickness of 0.375 inch (9.5 mm).
     4. Metal-faced panels having minimum 0.019-inch-thick (0.48 mm) aluminum or 0.016-inch-thick (0.41 mm) corrosion-resistant steel outer facings.
     5. A minimum 0.875 inch (22.2 mm) thickness of stucco complying with Section 2510.

CBC SECTION 2603.6

2603.6 Roofing. Foam plastic insulation meeting the requirements of Sections 2603.2, 2603.3 and 2603.4 shall be permitted as part of a roof-covering assembly, provided the assembly with the foam plastic insulation is a Class A, B or C roofing assembly where tested in accordance with ASTM E 108 or UL 790.
CBC SECTION 2603.7

2603.7 Interior finish in plenums. Foam plastic insulation used as interior wall or ceiling finish in plenums shall comply with one or more of the following:
1. Use thermal barrier, FSI ≤ 75, SDI ≤ 450
2. Has FSI ≤ 255, SDI ≤ 50 & meet NFPA 286 (room/corner test)
3. Cover by steel or Al & FSI ≤ 75, SDI ≤ 450

CBC SECTION 2603.8

2603.8 Interior trim in plenums. Foam plastic insulation used as interior trim in plenums shall comply with the requirements of Section 2603.7

CBC Section 2603.9

2603.8 Protection against termites. In areas where the probability of termite infestation is very heavy in accordance with Figure 2603.8, extruded and expanded polystyrene, polyisocyanurate and other foam plastics shall not be installed on the exterior face or under interior or exterior foundation walls or slab foundations located below grade. The clearance between foam plastics installed above grade and exposed earth shall be at least 6 inches (152 mm).

Exceptions:
1. Buildings where the structural members of walls, floors, ceilings and roofs are entirely of noncombustible materials or preservative-treated wood.
2. An approved method of protecting the foam plastic and structure from subterranean termite damage is provided.
3. On the interior side of basement walls.
CBC SECTION 2603.10

2603.10 Special approval. Foam plastic shall not be required to comply with the requirements of Sections 2603.4 through 2603.8, where specifically approved based on large-scale tests such as, but not limited to, FM 4880, UL 1040, NFPA 286 or UL 1715. Such testing shall be related to the actual end-use configuration and be performed on the finished manufactured foam plastic assembly in the maximum thickness intended for use. Foam plastics that are used as interior finish on the basis of special tests shall also conform to the flame spread requirements of Chapter 8. Assemblies tested shall include seams, joints and other typical details used in the installation of the assembly and shall be tested in the manner intended for use.

CBC SECTION 2603.10.1

2603.10.1 Exterior walls. Testing based on section 2603.10 shall not be used to eliminate any component of the construction of an exterior wall assembly when that component was included in the construction that has met the requirements of Section 2603.5.5.

PURPOSE OF SECTION 2603.10

- Allows alternatives to previous Sections (i.e., eliminate thermal barrier, etc.)
- Allows new/modified applications when appropriately evaluated in a full-scale test
- Use existing full-scale fire tests
- Use other tests but test shall be reflective of actual end-use & sample configuration must be reflective of actual use, thickness, geometry, seams, joint treatments, coverings, etc.
CBC SECTION 2604 - INTERIOR FINISH & TRIM

- Interior finish requires full-scale test
- Interior trim – Control density, thickness, area and FSI ≤ 75.

SUMMARY

Proper compliance with the Code requirements has shown that foam plastic insulations have an excellent fire performance history and provides an excellent basis for the safe use of foam plastic insulations.