IMPROVING THE FIRE PERFORMANCE OF BUILDING CONTENTS

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Reprinted from CONSTRUCTION SPECIFIER, Vol. 44, No. 2, 42-46, February 1991.

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Fire codes traditionally have regulated only the structural and finish materials used in buildings. Such regulation was intended to limit the size of the fire, first to the building of origin and later to smaller and smaller portions of that building. In response to fires in which many lives were lost, codes eventually were designed to ensure protected paths of egress and sufficient structural integrity to keep the building standing, at least until the occupants were evacuated, and hopefully long enough to allow suppression activities.

To a limited extent, these goals have been realized in modern buildings. Today, structure fires rarely spread beyond the floor of origin, much less result in total collapse of the building (though smoke and toxic gases still permeate most spaces of the building)[1]. But the fire problem has not been solved.

Has the time come to restrict what can be brought into a building?

Fire loss statistics indicate that the modern fire problem is largely one of contents rather than structure. Items such as upholstered furniture, bedding, office equipment, appliances, and stored commodities are often the first items to ignite. They also provide fuel for the fire. New fire safety regulations for building products, however, in most cases relate only to such products as plastic pipe and electric cables.

The existing system of fire safety regulation applies predominately to buildings under construction. Inspections are made at various stages in the project, culminating in a certificate of occupancy. While most jurisdictions do "regular" inspections, these often focus on obvious hazards such as locked exits or improper storage of hazardous materials. Further, because of limited resources, several years can sometimes pass

Photos courtesy the author

TB 133 restricts the heat release rate of upholstered furniture.

Advanced testing will help researchers predict products' burning behavior.

between inspections.

Regulatory authorities see themselves as able to control only those items that are present for inspection during construction. Dealing with contents, they feel, is impractical at best. How, authorities ask, would they measure the potential fire threat of a product they find in a building? And even with sufficient staff to visit certain occupancies on a regular basis, how would they be able to tell if a certain chair in daily use met some criterion for heat release or smoke contribution?

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The California Regulation

In 1988, the California Department of Consumer Affairs issued Technical Bulletin 133,[2] which places limits on the rate of heat release of upholstered furniture used in specific, "high-risk" occupancies such as nursing homes, prisons, hospitals, and group homes. To determine compliance, a furniture item is placed in the center of a 10-by-12-foot (3-by-3.7-meter) room with an 8-foot (2.4-meter) ceiling and is ignited by crumpled newspaper in a wire box placed on the seat. Pass/fail criteria include maximum temperature rises—200° F at the ceiling and 50° F four feet from the floor—and limits on smoke density, carbon monoxide release, and weight loss. Recent modifications to TB 133 alternatively allow tests to be conducted in the ASTM Standard Room Test[3] (the room is slightly smaller) or the Furniture Calorimeter (UL 1056).

As a practical matter, this limits complying furniture to a peak heat release rate of about 80 kilowatts, a level insufficient to result in flashover in nearly any habitable space. The other criteria are intended to ensure that the room of origin is safe for at least five minutes from temperature (in which time occupants would begin evacuation), and about 30 minutes from carbon monoxide toxicity.

According to the California Bureau of Home Furnishings, TB 133 has since been adopted by Illinois, Minnesota, and Massachusetts and is under consideration by a dozen other states. The bureau further states that the furniture industry is instructing its members to sell only complying items to customers in target occupancies in states that have adopted this requirement.

Other Initiatives

Several years ago the National Fire Protection Association (NFPA) formed a task group to examine the practicality of regulating building contents. They drafted a sample regulation that would limit the peak heat release rate of furniture used in non-sprinklered hotel guest rooms to about 75 kilowatts—a level that, like TB 133, would not allow flashover. This level was derived by

using a fire model to compute the maximum heat release rate that would allow survivable conditions in a hotel guest room of typical size and construction.

Based on the recommendations of the task group, a new Technical Committee on Contents and Furnishings was created. The committee will soon begin work on establishing requirements for the fire performance of products. Once established, such measures could be adopted voluntarily by manufacturers or mandated in state and local fire codes across the United States.

At the same time, UL has circulated for comment a draft standard (Subject 1895) for institutional mattresses. The draft limits the rate of heat released to 75 kilowatts, peak, during the first five minutes of burning, as measured in the Furniture Calorimeter on full-sized samples. This limit is similar to the draft requirement from the NFPA committee and is consistent with the TB 133 requirement. The intent is to classify such mattresses so that they might be required in selected occupancies by code bodies.

New Technology

In the past decade, several technical advances have allowed the development of the tests cited above, and they promise to yield further cost-effective solutions to predicting the behavior of products. These innovations include methods of measuring the burning behavior of both small samples and full-scale products as in the Cone Calorimeter, ASTM E 1354.[4] This burning rate data is then used in scientific predictive methods, such as the HAZARD I[5] software for personal computers to assess the impact of burning items on the specific building in which they are located.

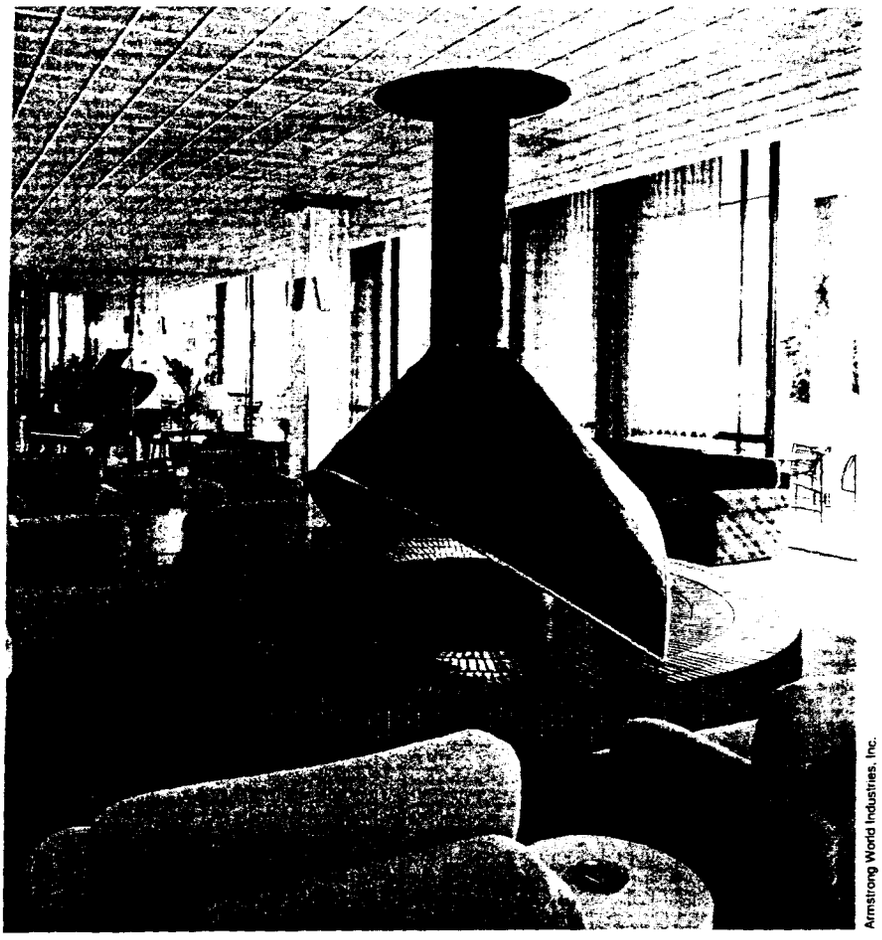
The predictive methods allow the quantitative evaluation of the impact of fires on specific buildings within the context of total building design and use. Thus, as was done by the NFPA committee, prediction methods can be used to "rate" a building space for the maximum safe burning rate of any item in it—a "safe rate" being one that does not constitute a hazard to the type of occupants expected in that building. Larger spaces or those with other, compensating fire safety features could contain items of higher heat release rates without constituting a hazard. The measurement methods can then be used to qualify objects for such use. In the future, bench-scale testing in the Cone Calorimeter used with models of fire development will replace the more expensive Furniture Calorimeter and room testing currently specified in these early regulations.

Questions remain about just how consumers or regulators can know specific products are safe. The problem of identifying tested and rated products is being addressed by approval laboratories like UL that apply markings containing the needed information to such products. But who inspects the buildings and when? Are inspections required at every change in tenancy? And what about the person who remodels an existing space or even replaces a threadbare sofa?

The solution may be a combination of education and liability: education to inform owner/occupants of their obligation under the law (i.e., their legal liability). This approach, which is being used with TB 133 in California, has worked fairly well with codes requiring the installation of residential smoke alarms in existing dwellings.

GENERAL DATA

In the long run, use of predictive models like HAZARD I to evaluate the total performance of buildings and contents should allow codes to become more performance oriented.



Armstrong World Industries, Inc.

Items such as upholstered furniture are often the first to ignite.

U.S. Gypsum

Predictive methods can be used to "rate" a building space for the maximum safe burning rate of any item in it.

The Bottom Line

The ability to control the real threat in fires should result in improved safety at reduced cost. It is always better to prevent the fire or keep it small than to try to contain an uncontrolled source of energy. Therefore, safer contents should result in safer buildings.

In the long run, use of predictive models like HAZARD I to evaluate the total performance of buildings and contents should allow codes to become more performance oriented and more responsive to alternative designs. The design and construction process will be more flexible and cost effective as a result.

The bottom line is that the new technology of product fire safety measurement and performance prediction should allow attention to be focused not on products that only marginally affect safety, but on those for which fire incident data indicate improved performance would do the most good.

What remains is development of means to ensure safe performance of products to consumers, owners, and regulators. The time to address building contents has come, and the new technology may shine light where it is needed most. □

Notes

1. According to a recent NFPA study, more firefighters die from being struck by or trapped under objects than from being burned.

2. "Flammability Test Procedure for Seating Furniture for Use in Public Occupancies," Technical Bulletin 133, Department of Consumer Affairs, State of California, Bureau of Home Furnishings and Thermal Insulation, April 1988.

3. "Proposed Method for Room Fire Test of Wall and Ceiling Materials and Assemblies," *1982 Annual Book of ASTM Standards*, Part 18, page 1618.

4. "Standard Test Method for Heat and Visible Smoke Release for Materials and Products Using an Oxygen Consumption Calorimeter," ASTM E 1354, *1990 Annual Book of ASTM Standards*, American Society of Standards and Testing and Materials.

5. R.W. Bukowski, R.D. Peacock, W.W. Jones, and C.L. Forney, "HAZARD I Fire Hazard Assessment Method, *NIST Handbook 146* (Gaithersburg, Maryland: National Institute of Standards and Technology, 1989).