Using Gypsum Board as a Smoke Barrier

The Life-Saving Potential

Each year over 4,000 people die in the United States as a result of fire. Although most of these deaths happen in single family residences, an increasing proportion occur in multi-unit buildings. In 1984 for instance, there were over 9,000 hotel and motel fires reported. Each with enormous potential for tragedy.

An in-depth analysis of multiple death fire statistics over the past five years shows dramatically that the vast majority of these deaths (84.6%) resulted from inhalation of smoke and toxic products of combustion. The true percentage is probably even higher.

One of the most closely studied fires of recent times was the MGM Grand Hotel fire in Las Vegas, Nevada that occurred on November 11, 1980. Eighty-five people died as a result of this catastrophe and of those, 76 (89.4%) had no direct exposure to the flames. Smoke and poisonous gases moved upward thru unprotected openings via the “stack effect” phenomena.

In the Westchase Hilton Hotel fire in Houston, Texas on March 6, 1982, 12 persons died as a result of breathing smoke and toxic fumes. The death toll might have been much higher, but the fire was contained to the room of origin by the gypsumboard partitions. The fire was restricted, but not the smoke.

Month after month the pages of the FIRE JOURNAL are filled with tragedies of essentially the same scenario . . . the Stouffers Inn incendiary fire in Harrison, New York, 26 died of smoke inhalation and in the Ramada Inn fire in Fort Worth, Texas, five occupants died. Again, smoke not fire was the immediate and direct cause of death.

The problem becomes ever more severe than in years past with the spreading use of highly flammable plastics in furnishings and decorations. In addition to carbon monoxide, many burning synthetics generate other lethal fumes such as hydrogen chloride and hydrogen cyanide, both very deadly even in small doses.

The Standards, Building and Fire Research communities have given a
New Theories . . .

One concept now proposed and under study by some fire safety professionals has been called “defend in place.” Studies show that, contrary to popular belief, people who stayed in their rooms during structure fires in recently constructed high-rise buildings often had a better chance of survival than those who ventured out into smoke-filled escape routes.

The wall and ceiling industry should become more involved in this issue because:
(a) Products and systems that we as an industry manufacture, sell and install are an integral part of fire-safety design. Fire resistance and fire safety are some of the most basic services we provide to the construction marketplace.
(b) Enclosing the concealed spaces such as stud cavities, furred walls, chases, shafts, plenums and penetrations usually involve only wall and ceiling trades and products. These spaces often serve as circulation routes for smoke and toxic fumes.

With proper understanding of smoke-control methods, our sales and field personnel could help educate owners, designers, insurance and code enforcement staffs and open a door of opportunity to sell-up to higher quality installation and a higher percentage of construction budgets. It would also strengthen the competitive edge gypsum drywall and our industry has over other products such as combustible panel products, masonry, etc.

In approaching a subject as vital, complex and controversial as the movement of smoke within buildings one should start from agreement on certain basic definitions:
a. Smoke may be defined as the airborne products emitted when a material decomposes by smouldering (pyrolysis) or by burning (combustion). The generation and concentration of smoke will vary according to what is burning, how rapidly it is burning and the volume of space into which the smoke can disperse.
b. Smoke movement may be caused by normal convection, pressure differentials, forced-air mechanical systems, kinetic expansion or by various combinations of these phenomena.

Smoke, like air and airborne sound, follows the path of least resistance. Door openings, vents and shafts are often direct paths for smoke movement and thus are the most obvious, immediate and greatest potential hazards. For years, building and fire codes have recognized designated wall sections, doors and compartments as “smoke barriers” in certain high-risk occupancies such as health care facilities. Test procedures have been developed and are already in use to determine the effectiveness of door gaskets, duct dampers, etc. and as these come to be used more widely, more pressure, literally, will come to bear on the wall and ceiling assemblies.

Gypsum board, the most common-
Life safety cannot be treated as an afterthought in any part of the construction process, from conception to completion.

ly used wall and ceiling surface, has all the attributes to perform properly as a functional smoke barrier; noncombustible core, minimum surface porosity, the noncontribution of additional smoke, low surface flame-spread and, it is accepted in a wide range of fire resistant systems commonly used in the design and construction of most buildings. Thoughtfully specified and properly installed, these assemblies can greatly reduce and to a significant degree “control” the movement of smoke and toxic fumes within the structure even to the extent of exhaust venting shafts.

Many details required for wall or ceiling assemblies to serve as “smoke barriers” are the same as those routinely required for fire resistance, the reduction of air leakage (whistling) and for sound isolation, such as:

1. Applying as large a gypsum panel as practical to reduce joints, gaps and cracks.
2. Seal perimeters and intersections with dissimilar materials with non-hardening fillers such as acoustical sealants.
3. Locate cabinets, outlet boxes and other penetrations in separate framing cavities between partition faces.
4. Caulk or seal carefully around plumbing, electrical or mechanical penetrations. As a general rule, holes should not be more than 1/4” larger than the penetrating element.
5. Where possible, carry partitions slab-to-slab, scribing closely to horizontal surfaces and fill the gap with joint compound or other effective sealant.
6. Install each assembly as it was tested, offsetting joints between opposite sides and between plies in multi-layered assemblies.
7. Apply the board in the direction it was tested. Most fire ratings over metal stud framing were achieved with vertical application (parallel with framing) so the joints are backed with framing members.
8. Tape and finish all exposed joints, angles and abutments with proper joint treatment or trim.
9. Shim and seal the interface between the door jambs and partitions; this is a major area of neglect and should be given additional emphasis in design, installation procedures and trades coordination.
10. Seal or “fire-tape” joints and perimeters of partitions extending above the ceilings into plenum or attic areas.

Gypsum board systems are playing an even greater role in the life-safety

NBS Plastic Pipe Penetration tests-studs flaming thru wood GWB joints.

Test to determine rate and toxic levels of Foam Plastic.
quality of both new construction and the renovation of older work. However, their contribution in this matter has become so normal and commonplace that, unfortunately, it is often taken for granted, many important details even neglected.

Identifying certain compartments, chases and area separations with higher priorities and stronger emphasis as “smoke barriers” could improve the life-protection performance of gypsum board assemblies without significant added costs. To achieve this, however, these details must become standard practice for all concerned in design, bidding and installation of such assemblies.

The key factors, of course, are communication and continuing education; filtering these perceptions and an effective understanding of how such assemblies must perform, right down to the mechanics actually doing the work.

Life safety cannot be treated as an afterthought in any part of the construction process, from conception to completion.

Putting these measures into effective use and selling our “story” is a real opportunity for the wall and ceiling industry to make a significant contribution to life-safety and to expand our opportunities in the markets we serve.

The purpose of this article is to stimulate a forum of discussion within AWCI. Your ideas, comments and views are requested and welcomed.

*Literature references
GYPSUM ASSOCIATION
2. Using Gypsum Board for Walls and Ceilings GA-201 -85
3. Recommended Specifications for the Application and Finishing of Gypsum Board GA-216-85
ASTM Standard Specifications
1. C-754 Installation of Steel Framing Members to Receive Screw-attached Gypsum Board
2. C-840 Application and Finishing of Gypsum Board

Editor’s Note: At a national conference earlier this month sponsored by the National Institute of Building Sciences (NIBS), the toxicity of building materials and furnishings in combustion were the two primary topics discussed. The August meeting was one in a series of three meetings in which NIBS plans to explore various issues surrounding assessment of fire hazards in buildings.

The meetings are sponsored in cooperation with the Center for Fire Research of the National Bureau of Standards, the National Fire Protection Association, the National Fire Administration of the Federal Emergency Management Agency, and other organizations concerned with building and fire safety.

For more information about upcoming conferences, contact Don Hill, NIBS, 1015 15th Street, NW, Washington, DC 20005, (202/347-5710).