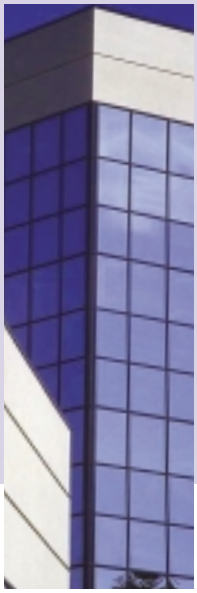
by James C. Shriver

High-rise perimeter protection systems reviewed

It happened so very quickly. In minutes, the whole world's attention was focused on the World Trade Center's twin towers. At first we marveled at the structures' ability to withstand the impacts of some of the world's largest planes. Then, in little more than an hour, we gasped as both of the structures collapsed. Suddenly, our understanding of fire's capacity to alter and weaken structural components changed. And our faith in high-rise construction turned to fear.



It is unlikely that we will see again the loss of life and total devastation of a building that we saw on September 11, 2001. Yet the event has caused us to place a higher-than-ever value on human life, and we will evaluate life safety systems differently when it comes to holding the line on construction budgets.

Life Safety

Life safety has been paramount in the construction industry since the Chicago fire of 1871. Initially, our focus was on the incombustibility of construction materials. Now, systems to provide life safety fall into three categories – detection, suppression and compartmentalization – and all three need to be included in high-rise construction.

Lessons from the Auto Industry

Motorcars were developed in the late 1800s. Crude devices, they were simply open-air platforms with wheels, propelled by an engine. It didn't take long before enclosures were added to protect the passengers.

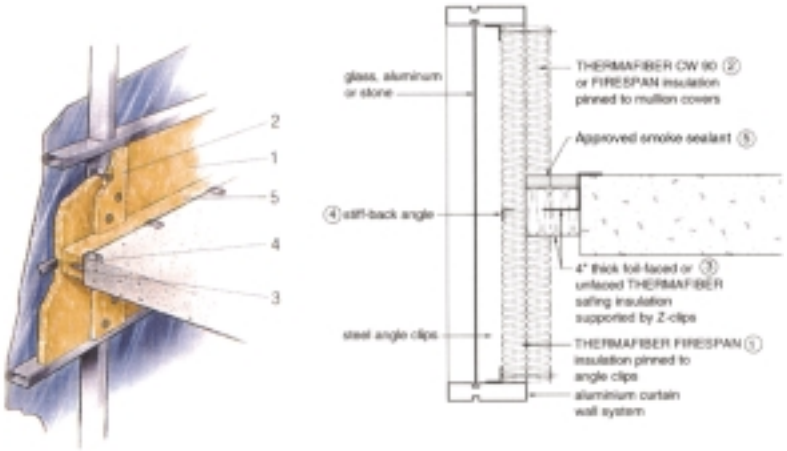
As engines became more powerful and crash risks became greater, the industry recognized the need for passive systems to protect occupants – laminated windshields, tempered sidelights, padded dashboards, collapsible steering wheels, and finally seat belts were not just available, but required in every car.

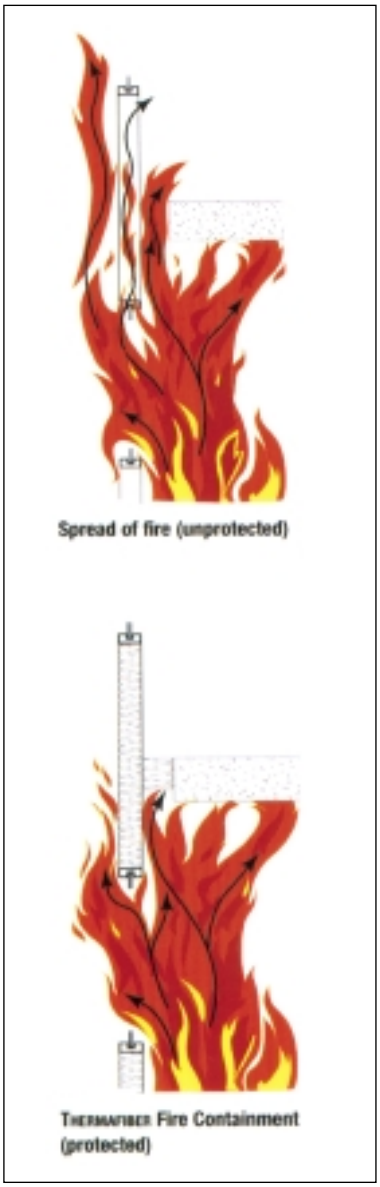
Detection systems, too, were added. Bells sound and lights flash to warn the driver and passengers when certain risks are present.

Then came the air bag, an active system that provides ultimate protection from crashes. Once activated, the air bag deploys quickly to isolate passengers.

We have learned the life safety benefits of passive, active and detection systems in the construction industry as well. Passive systems include gypsum plaster or drywall barriers and mineral fiber insulation that work to contain fire. Detection systems include alarm systems which sound off to announce the presence of fire and smoke, so that people can vacate the building. Active systems, such as sprinkler systems, suppress fire once the heat has reached the activation point.

Although the active protection of air bags in autos has continued to improve, the auto industry continues to demand the use of passive restraint systems, recognizing that the risk of air bag failure is higher than with seat belts. So too, code officials in the construction industry increasingly recognize that the risk of insulation failing to restrain fire is considerably less than the risk of sprinkler system or fire alarm mal-





Thermafiber Mineral Fiber Insulation is manufactured in a variety of formulations to meet specific fire protection and sound control needs. In addition to the Thermafiber Curtain Wall Insulation and Thermafiber Safing Insulation required to safeguard high-rise curtain walls and floor slab perimeters, the company also manufactures sound attenuation fire blankets, blowing wool and a variety of specialized insulation products. James Shriver is director of Thermafiber's technical department.

function. But the best course of action, certainly, is to require all three.

Curtain Wall Fire Containment

One of the least understood areas where fire can spread is at the building perimeter, where curtain walls and floor slabs serve as barriers. Some say that there is no reason to insulate the curtain wall or around the floor slab, believing that the fire and associated heat will simply escape the building once the windows break out. Fire tests and photographed control burns indicate otherwise.

There are three specific ways in which fire spreads quickly to floors above the source of ignition. The first is through penetrations, where poke-through openings for plumbing or electrical conduit may not be protected by high temperature-resistant mineral fiber insulation, or where cracks or holes in the slab or perimeter/curtain wall abutment offer opportunities for licks of flame to engage combustibles on the floor above.

The second influence for spreading fire is the chimney effect. Heat provides a thermal air mass and movement which draws smoke and flame to it. We see that happen most around campfires, where smoke is drawn to the people who surround the fire, simply because their body heat is creating chimneys of air above them. For high rise buildings, this means that the intense heat of fire is accelerated through any openings or shafts by the effect of heated air. This is particularly true of uninsulated areas that may exist between the curtain wall and the floor slab perimeter.

The third influence is what is called the leapfrog effect. Just as the chimney effect draws heat and smoke, the heated floor slab above the fire source creates a thermal void in the room above the room of origin that tends to draw fire back into the building. The ability of flames to come back into the building is enhanced when curtain wall spandrel panels give way, leaving a smaller barrier between the floor of origin and the floor above it. So the longer the spandrel panels remain intact, the better the barrier and the less likely it is for flames to engage combustibles on the floor above.

The Time Factor

Neither system – detection, active or passive – has the proven capacity to extinguish fires. Even sprinkler systems provide no assurance that fires can be put completely out and, of course, sprinklers only work after the fire already has reached the room. The most that these systems can do is to contain or suppress the fire until firefighters can strike the blaze.

What these systems do have in common, however, is that they are designed to add precious time, so that building occupants can leave the building safely and so that firefighters have an opportunity to reach the fire while it is still manageable. To maximize that escape and firefighter deployment time, no reasonable fire protection system should be overlooked.

Insulation Systems are Not All Alike

Curtain wall insulation systems are not all alike, either in terms of the insulating material or in terms of their installation. Both of these are critical for ensuring system integrity and safeguarding escape time.

Material is important because each insulating material has a different point of failure. Cellulose burns at about 460 degrees Fahrenheit. Glass fiber insulation melts at about 1050 degrees. Aluminum disintegrates at 1220 degrees and plate glass holds out until 1510 degrees. By contrast, mineral fiber insulation has been proved to maintain its integrity for more that 5 hours at 2080 degrees Fahrenheit.

Mineral fiber insulation itself maintains its integrity well beyond 2000 degrees, but it is completely effective only if it is correctly installed, so that it fully protects the structural components, curtain wall spandrel panels and perimeter openings it is designed to safeguard. This means that each system must be installed exactly as it was designed, tested and approved. Any alterations or substitutions can lead to early system failure, and compromise the safety of the building and its occupants.

Over the years, manufactures of fireproofing materials, smoke sealant compounds and the like have tested and proved more than 245 systems. Testing and assurance principally have been handled by Underwriters Laboratory and Omega Point Laboratories and, since the mid 1990's, a special focus has been on the floor slab/perimeter joint (ul.com, Certifications, Fire Resistive Assemblies and Systems/opl.com, Listing and Labeling, Directory). Assemblies tested include glass, metal or precast panels. In each case, materials and assembly techniques are prescribed. And in each case impaling pins or other attachment devices, framing mechanisms and other essential structural components are completely concealed by the insulation to assure continued integrity of the structural assembly. Finally, safing insulation is friction fit between the curtain wall insulation and the slab perimeter, and the abutments are sealed with an approved smoke-sealing material to unify the system. (See illustration below.)

Sources of System Failure

Any protection system can fail. We know that. But a mineral fiber curtain wall and safing system for perimeter protection, properly installed and inspected at the time of installation, offers the best first line of defense against the spread of fire. Why? Because a passive system is not subject to the subsequent problems that can compromise system performance as are active and detective systems..

Warning systems require fully operational sensing devices and electrical power to perform. A power failure, bad battery or even misapplied paint can keep such a system from performing.

Sprinkler systems, too, can fail if only a small amount of sediment clogs the spray port at the time it is required to perform. Even a rigorous and meticulous maintenance regimen cannot assure that the system will remain free of such problems.

Perimeter protection in the form of carefully installed curtain wall and safing insulation, on the other hand, assures its expected performance so long as it remains undisturbed. It provides building owners and occupants with the best overall assurance that a fire in a room at the perimeter of the building can be contained until the firefighters put it out.

While the September 11 attacks were devastating and destructive, we know that as a nation our risks from any fire are extraordinarily high. A recent FEMA study reported that America has the highest fire loss in terms of both frequency and total losses of any modern technological society. Once out of control, any fire can result in metal fatigue and building collapse, and even on a smaller scale will risk human life. And how much is each life worth? Certainly it is worth the investment in mineral fiber curtain wall insulation systems that have proved their ability to contain fire to the area of origin.