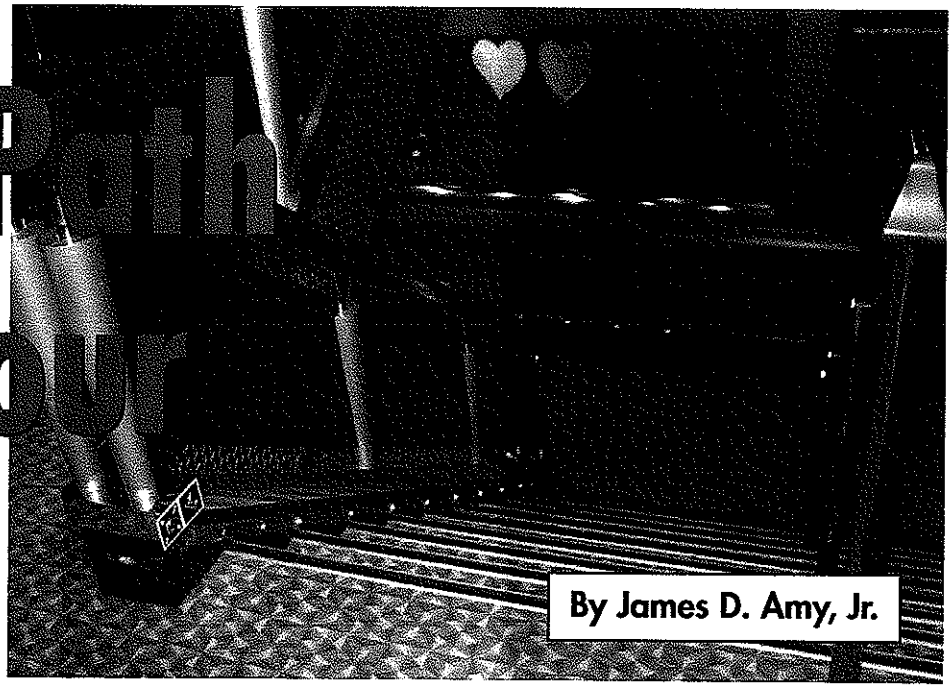
The Path At Your Feet



By James D. Amy, Jr.

Pathway marking in cruise ship stair

Pic courtesy of The RJA Group, Inc.

The Shift in Emergency Lighting

FOR THOSE IN THE field of pathway marking, predicting the shift towards emergency lighting at the floor level was logical. Experience has shown that traditional overhead lighting, both normal and emergency lighting, could become obscured by smoke during a fire, a contributing factor in many high fatality fires. Close to a fire, smoke is hot and dense and rises to the ceiling. Farther from a fire, smoke may have cooled and dispersed to the point where it fills the corridor, possibly obscuring distant exit signs. Pathway marking has been recognized as a means to maintain visibility of the egress path if smoke obscures overhead lighting and signage. Unlike emergency lighting, pathway marking provides occupants with a continuous pathway delineation at their feet about how best to egress. However, the shift has now begun from employing pathway marking to supplement emergency lighting to having it replace emergency lighting altogether.

BACKGROUND

The realization that occupants needed a continuous indicator of the egress path began in the United States with aisleway marking on commercial aircraft in the 1980s. Certain types of buildings in California were required to have pathway marking as of 1989, followed in 1993 by cruise ships and ferries. The late 1990s saw the development of pathway marking requirements for commuter trains. Recent years have seen the need for these systems more broadly in buildings, tunnels, and railway and subway platforms. Each application was associated with unfortunate tragedies where occupants were unable to find their way out. For example, the Scandinavian Star fire in 1990, which killed 158, was a turning point for the cruise line industry. Safety requirements for sprinkler systems and Low-Location Lighting, the maritime equivalent of pathway marking, were rapidly enacted subsequent to the fire.

For buildings in the U.S., September 11th was the turning point. In the Pentagon, some occupants were unable to find their way out because of the massive fire that ensued after Flight 77 slammed into the building. Renovations to the Pentagon included the addition of a pathway marking system to enhance egress. In the World Trade Center, a pathway marking system had been installed subsequent to the 1993 bombing that left the stairs in complete darkness. While battery-powered emergency lights were also installed in the stairs and remained operative for much of the time prior to the building collapses on the morning of September 11th, the pathway marking assisted occupants in their movement. It identified a path to safety that was otherwise unclear to some occupants.

The United Nations, the City of New York, and several branches of the U.S. government, among others, have recognized as a result of September 11th that pathway marking systems can be a critical component to safety. New York City has proposed changes to its building code to require pathway marking systems in the stairs of all high-rise buildings. The United Nations initiated installation of a pathway marking system in all corridors and stairs in their complex two years ago. The owners of several high rise buildings in New York have voluntarily installed a pathway marking system.

REPLACING EMERGENCY LIGHTING

It should come as no surprise that pathway marking systems are increasingly being recognized as serving in part or in whole as the emergency lighting system as opposed to simply a supplemental system. This has been the case in stadiums and theaters in Australia, New Zealand and the U.S. where lighting each step with non-electric, photoluminescent material has been accepted. Photoluminescent materials are charged by ambient light and will glow in the dark should power be lost or smoke obscure overhead lighting.

Recently, New Zealand proposed changes to their building code that would allow pathway marking in lieu of emergency lighting. It is likely that other countries will follow suit in coming years. This is not to say that pathway marking systems are suitable for all applications of emergency lighting. Overhead lighting can be unavoidable, such as on a convention room floor where the path will change based on the exhibits that have been set up.

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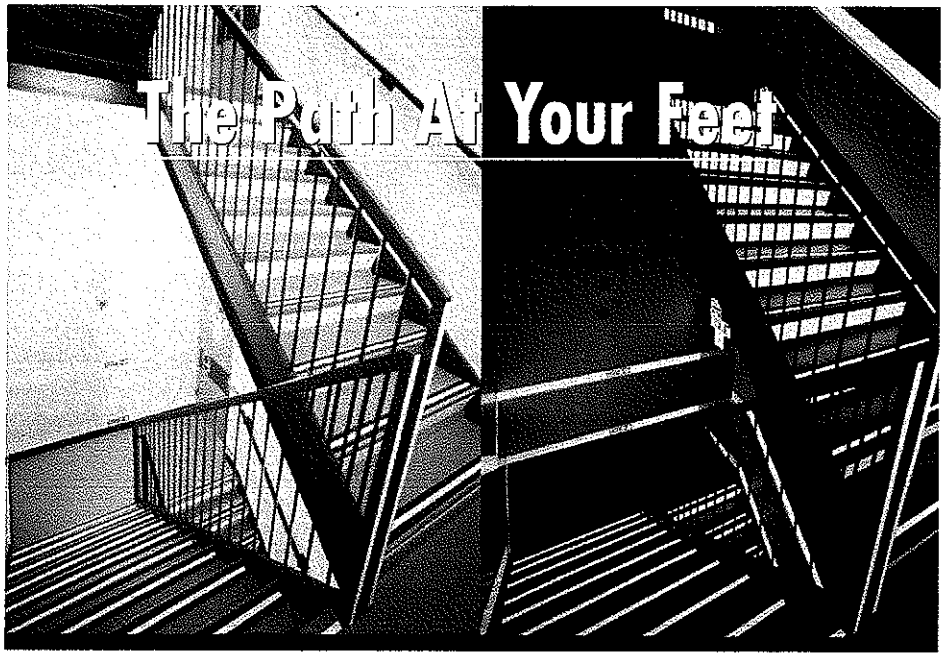

Pathway marking under normal and blackout conditions *Pic courtesy of NRC Canada*

EXIT SIGNAGE

One objection to pathway marking replacing emergency lighting has always been that pathway marking does not illuminate the means of egress as brightly as emergency lighting. There was a similar objection to photoluminescent exit signs prior to their acceptance by Underwriters Laboratories as performing equivalently to electrical exit signs. While not as bright as electrically-powered exit signs, they were bright enough to be read from the prescribed distance after 90 minutes in darkness. While objections to these signs persist, no substantiation has been provided to prove that they do not accomplish the goal of identifying the exit.

The advantage to photoluminescent exit signage is that once it is charged, it will work regardless of the conditions. There are no batteries, bulb, or electrical components that have to be maintained and can fail during an emergency. It is not uncommon to find electrically-powered exit signs inoperative. This is a function more of a lack of maintenance than a failure of a particular brand or type of sign but it highlights the weakness of the technology. Photoluminescent materials, by comparison, are more accommodating of neglect.

Another objection to photoluminescent exit signs is that they require ambient lighting in order to be charged. This is true but building owners and managers do not generally ignore burned-out overhead lighting. The locations where this argument *is* valid is in locations where overhead lighting is activated by motion sensors and only powers up when someone enters the space or where lighting levels are inadequate for charging the sign. As some new energy codes require that lighting in certain rooms be motion activated, use of photoluminescent products must be carefully coordinated with use of motion activators to avoid installing them in locations that will be normally unlit.

An interesting aside is the 2004 modification of the Environmental Protection Agency's EnergySTAR Program to include photoluminescent exit signs since they consume no power.

DEFINING THE EGRESS PATH

The aforementioned charge that pathway marking is not as bright as overhead emergency lighting bears discussing. Overhead lighting illuminates the occupant's surroundings. Pathway marking identifies only those elements of the surroundings that are necessary for egress. While pathway marking may illuminate slightly the walls and ceiling, its main objective is to identify the steps, handrails, and landing so that occupants can locate them without having to consider whether what they are seeing is a step, handrail, or landings.

It is not necessary to illuminate the entire space to identify the key elements to egress. This is why pathway marking can accomplish its goal without providing the light levels associated with overhead emergency lighting. In fact, a 1999 study by the National Research Council of Canada (NRCC) demonstrated that occupants who had never seen a pathway marking system had no difficulty descending the stairs during an unrehearsed drill and their egress speed was comparable to that in the other building stairs that were fully lit or lit by emergency lighting. The NRCC concluded the study by stating that photoluminescent pathway marking "appears to be a cost-effective addition or even a potential replacement for traditional electrical emergency lighting, since it does not consume energy, requires no wiring, needs minimum maintenance and is totally reliable, provided it is installed in locations where permanent full lighting is provided."

OCCUPANT BEHAVIOR

To fully appreciate why pathway marking is an asset to occupants, it is necessary to consider their behavior during an emergency. While panic was long ago thought to occur commonly during emergencies, it has now been recognized to be the exception rather than the rule. Instead, occupants tend to act in a rational manner, especially when they have confidence in their ability to reach the exit. Unfortunately for occupants, traditional emergency lighting does not provide any more clues as to how to egress than they have under normal conditions. If they are unfamiliar with their surroundings, the burden is on the occupants to spot the discrete exit signs that may be up to 100 feet away. Pathway marking, by comparison, is always within reach along the egress path and the psychological benefit to occupants of this feature should not be underestimated.

Walking up or down many flights of stairs is not an activity that occupants engage in on a daily basis. Occupants in high-rises use the elevators to reach their destinations. This has bred ignorance as to what to do in the case of an emergency. As they are unfamiliar with the stairs, occupants are similarly unfamiliar with even the location of the exits on their floor. In addition, some stair doors in high-rise buildings are alarmed so that

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occupants are not even provided with the opportunity to familiarize themselves with the stairs should they be so inclined.

When descending many flights of stairs under normal conditions, the monotony of the body's motion and the environment challenges an occupant's attention to details. This behavior is only amplified during an emergency when the occupant is so focused on placing one foot in front of the other and on clutching the handrail that they lose their awareness of others in the stair and of their progress towards the exit. One survivor of September 11th, Mr. Al Masetti, has recounted this "tunnel vision" during his decent from the 73rd Floor of the North Tower. Unlike many of his fellow occupants, Mr. Masetti was familiar with the stairs. He was also familiar with horizontal transfer corridors where the stairs shifted (a corridor led from where one flight ended to where the next flight began). He was also aware of the pathway marking and used it to guide him along the path. It gave him confidence to move forward as he knew it led to the exit.

As Mr. Masetti moved along one of the horizontal transfer corridors, someone ahead of him wandered off the exit path and headed towards a door that led away from the exit. Others ignored this behavior and seemed unaware that someone had strayed. Mr. Masetti redirected the man to follow the pathway marking. The man seemed a bit dazed; many of the other occupants were likely in a similar state of shock in light of the attack. To expect that occupants during an emergency will think with the same depth as they do normally is unreasonable. Providing them with simple, intuitive, and continuous direction corresponds to what they can be expected to absorb.

Thankfully, September 11th was not a typical emergency scenario. Additionally, few buildings are as tall as the Twin Towers were. However, as shown by the power outage suffered by the northeastern U.S. in August, 2003, a loss of lighting in the stairs can cripple occupant movement. Not all buildings in New York City are required to have emergency lighting. Some have generators but the generators failed. Others had battery-powered lights but the batteries died within an hour or so of the extended blackout. Some occupants were able to leave their offices in the first hour but found that they had to walk up the stairs to their apartment and into hallways in complete darkness. While a power outage does not pose the same threat to life as that posed by a fire, the increased potential for occupants to be injured as they descend an unlit stair is unacceptable and unnecessary.

TECHNOLOGY AND HISTORY

There are two major types of technology that can be used for pathway marking.

Pathway marking in World Trade Center on September 11th

The first is electrically-powered. On cruise ships, most of the electrically-powered systems are LED-based and are reportedly not burdensome to maintain. Unfortunately, there was reportedly a failure of an electrically-powered system during the 1998 *Ecstasy* fire. According to the National Transportation Safety Board, the control panel on the ship's bridge sounded a trouble alarm and could not be silenced; The Chief Electrician cut power to the system, rendering it inoperative throughout the ship. Two crewmen were unable to find their way out through the thick smoke and took refuge in a bathroom. The trapped crewmen were discovered later by a search team and rescued.

The above incident demonstrates that regardless of maintenance, an electrically-powered system can still fail. Additionally, such systems are dependent on the same source of emergency power as the emergency lighting. If emergency power fails, such as occurred in New York City during the blackout when emergency generators failed to start up, neither the overhead emergency lighting nor the pathway marking will be powered.

The other type of technology used in pathway marking systems is photoluminenscence. Photoluminescent materials absorb light under normal conditions. If power is lost or lights are obscured, the glow from photoluminescent materials becomes evident. While it is true that these materials are not as bright as LEDs, they will glow for many hours regardless of conditions during the emergency. They cannot be turned off but, as the hours pass, the glow will diminish, as the energy absorbed prior to the onset of the emergency is expended, similar in concept to a battery running through its charge. However, in the first one or two hours, high quality, safety-grade photoluminescent materials will glow brightly and enable occupants to find their way to the exit.

MOVING FORWARD

In the past twenty years, pathway marking has evolved from a concept on commercial aircraft to help passengers escape in the space of a couple of minutes to systems that are installed throughout buildings and office complexes millions of square feet in area and throughout every passageway and stairway in every cruise ship in the world. While on an airplane, this system might mark a path of one- or two-hundred feet, on a cruise ship, the numerous paths may constitute many miles of marking. Tunnels and buildings may also make use of miles of pathway marking.

Debate may continue as to the value of pathway marking but the trend has been in the direction of a broader use and of the replacement of traditional emergency lighting by pathway marking systems. Fires and other emergencies will continue to occur. Time will eventually provide enough examples of fires in occupancies fitted with pathway marking to objectively evaluate the value of these systems.

Mr. James Amy is a consultant for Rolf Jensen & Associates, Inc., based in Chicago, IL USA. To learn more about RJA and their capabilities, visit their website at www.rjainc.com