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Status of Skylight Safety

Skylights are the way to be outside in natural light while being inside a building. They bring sunlight and sunshine into a room, which, it is generally agreed, changes the human environment for the better. They brighten workers' lives and attitudes.

Skylights are often small unit panes or bubbles in the ceilings of residence kitchens, sunrooms or bedrooms while large public building skylights can be monumental with hundreds of feet of framed glass, such as the Kimmel Center in Philadelphia or Harrah's Casino swimming pool dome in Atlantic City. For flat roofs in commercial buildings, unit skylights are dominant, and their numbers are growing, especially in California for warehouse construction with the goal of cutting HVAC costs and helping produce greener buildings. Unit skylights are typically domed or bubble design.

To address the U.S.'s leading roofing problem, we must protect workers on roofs, who, in addition to employees, are typically independent contractors who may walk close to skylights.

Other types of skylights include translucent light panels contoured to the same shape as the metal decking and used in metal building roofs without a curb. Fiberglass is a common material of construction. Smoke vents are similar to domed skylights and are designed to open in a fire situation and release smoke.

The problem with skylights is that they eventually leak and degrade in strength. This gives the many trades who visit a roof for maintenance or telecommunications reason to be around skylights. Another problem is that manufacturers of skylights do not clearly mark their products with identification that permits later contact by building owners so they rarely hear of fall-through incidents involving their skylights. However, government agencies know that skylights are dangerous to roof visitors.

NIOSH issued two hazard alerts, one in 1989 and another in 2004, to warn about the continued incidence of falling through skylight material. BLS (2007) reports 36 deaths from falling through (nongovernment) building roof skylights. Safety is one of the five Ss for productivity, while fall hazard injuries and deaths are one of the seven deadly wastes in a program for lean production.

THE HAZARD

Unofficially, 60 million skylights may exist in the U.S., with up to 2 million added each year. Around 20 trades visit roofs. After interviewing hundreds of tradespeople who work on roofs, it is apparent that no trade is fully aware and many are only remotely aware that the hazard of skylights is equivalent to an open hole. People trust what they step on, and trust that what they walk past will not collapse under weight. Yet, the fact is that acrylic or fiberglass skylights will allow finger penetration with ease at some point in their lifecycle, but will not be tagged for replacement or screening. Skylights may look safe, but when impacted, they suddenly and without warning shatter, usually at the narrower end.

SOLUTION HIERARCHY TO THE RECOGNIZED HAZARD

Eliminate the hazard, provide a barrier, increase the safety factor, provide redundancy and plan reliability. The best solution is always to eliminate the hazard because that eliminates training and maintenance. That means that all parts of a roof should withstand foreseeable fall impacts onto roofing materials supported by building trusses beams and purlins. If the degradation problem cannot be addressed, then a safety factor must be added with a known long-life product, such as a metal screen that should be stainless in salt corrosion areas.

In new construction, grills add a degree of security from unauthorized entry (burglar bars). However, a fall will only test the burglar bars (rebar with approximately 4-in. square openings) by penetrating the skylight and falling onto the bars, which could be injurious.

ROOF CONSTRUCTION USING SKYLIGHTS & PERSONAL FALL PROTECTION

The Harness

According to some, the perfect solution would be if workers wore their full-body harness near roof and floor openings, skylights and smoke vents. However, this is not so simple because the hazard is not well recognized by building managers nationwide, let alone the trades. Also, the National Roofers Union has found from BLS data that 80% of U.S. occupational fall deaths are from falls involving workers wearing their harnesses but not connected. Management has not yet understood that preplanned anchorage points above shoulder height are a critical part of fall arrest protection system design. However, around skylights, which can be located within 6 in. or 6 ft of each other, where would the anchorage point go? What would its design?

A registered structural engineer experienced in fall protection system subject knowledge is required with a good knowledge of human factors and an understanding of the accepted appropriate work method. This person would most likely be a qualified person according to OSHA 1926.32, 1926 Subpart M and the ANSI/ASSE Z359 Fall Protection Code. Yet, no contract involving trades who visit roofs has ever specified that 1926.501(a)(2) be complied with for structural stability and that anchorage points

be compliant for safe work. This is assumed to be covered by the general conditions complying with all OSHA standards but is unfunded and unfair to all contractors given purchasing's desire for a low bid. Each certified anchor point may cost $3,000, and an engineered horizontal lifeline may cost $6,000 or more.

Another problem is with present OSHA construction skylight requirements, namely the 2:1 safety requirement for skylight design, which no manufacturer can guarantee without clarification of the noninclusion of Bobcat vehicles and similar vehicle axle loads. Yet, it is not good enough to tell the worker to put an anchorage connector cheater cable around the curb of another skylight where the hazards are now multiplied and the strength is never established. Connection is not the same as a fall arrest system. The standard, Minimum Requirements for a Comprehensive Managed Fall Protection Program (ANSI/ASSE Z359.2-2007) explains the difference between certified and noncertified anchorages.

Maintenance Firms

Maintenance firms treat skylights as sources of leaks only needing leak repair when checking an inspection checklist; they do not evaluate for critical structural weakness or degradation. Owners rely on these reports as sufficient for safety when in fact fall-through protection safety has not been evaluated. The process of using harnesses again applies for the lifetime of the building and is inadequate.

OSHA Status in General Industry

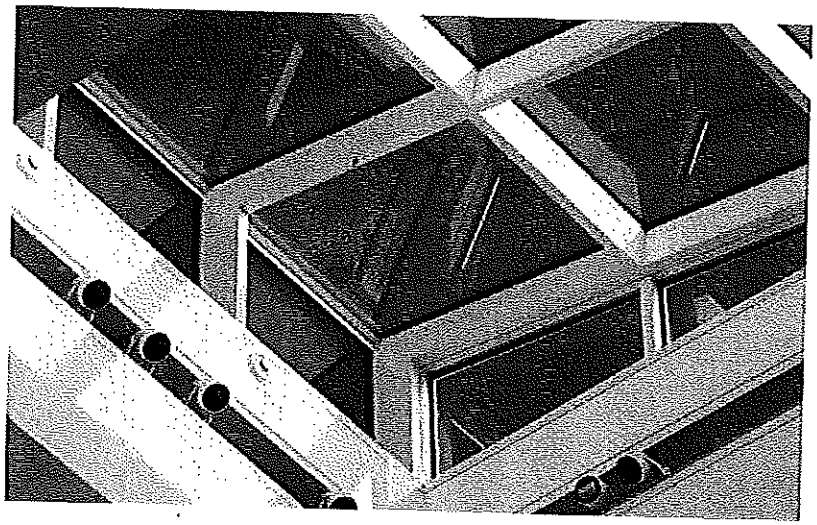
OSHA rules for skylights are clear except that a 1984 OSHA interpretation destroyed the meaning of the standard for covering skylights with screens. Instead, the manufacturer can lay a 200-lb sandbag onto the lens statically, and if it holds, then no screen is needed. This has permitted the manufacture and sale of skylights without any screen and without regard to falling impact loads of 95% human weights (presently 267 lb and rising) or sunlight degradation. This interpretation was OSHA rulemaking by interpretation and possibly illegal under the OSH Act.

Human Impact Considerations

Testing

The biggest issue has been to come up with a drop test weight, called an impactor, that represents the human body anticipated impacts. The second issue has been to address the variation in weight of persons on a roof.

The typical human impact onto a skylight from a crouched position falling forward is with wrists, which have electronically been evaluated to be 5.5 in. in diameter and produce the same result whether one or two wrists impact. The subsequent impact is with the shoulder. One other scenario is a trip from walking backward on the curb of a domed skylight and either the buttock or shoulder impacting. The study has produced a recommendation from the University of Michigan Biomechanics Lab that a 267-lb conical bag filled with lead shot and a polyurethane foam nose and intermediate vinyl lining provides the near equivalence to a human falling. The bag dimension is presently 5.5 in. nose diameter and 18 in. at its widest point. The data, including a drop distance of 37.5 in. to the skylight surface less curb height, were included in a proposal to the ASTM E06.50.25 committee for new skylights in May 2009.



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Degradation Due to Weathering

After reviewing the Dade County Miami requirements for a weather-tested skylight, it is evident that the maximum lifetime of skylight material is 5 years after undergoing a test program of 1 year. The anticipated goal is 20-year lifetime for any section of roof material, including steel decking, plywood and OSB-supported structural roof enclosures.

Solutions to Existing Skylight Fall-Through Hazards

Provide a screen on top of or a guardrail or other barrier around the skylight depending on geometry and cost. Many screen suppliers exist, including almost all manufacturers of skylights and metal buildings.

New Skylights

The architect of record should comply with OSHA and industry standards and not just with building code requirements. Architects should take responsibility for ordering the proper safety components of all buildings that owners will need to comply with OSHA 1910.23 and other standards, such as Safety Requirements for Workplace Walking/Working Surfaces and Their Access; Workplace Floor, Wall and Roof Openings; Stairs and Guardrails Systems (ANSI/ASSE A1264.1-2007). Purchasers of metal buildings should insist in their written orders to contractors that all OSHA construction standards 1926.500-503 and recognized voluntary stan-

dards, such as Safety Requirements for Temporary Roof and Floor Holes, Wall Openings, Stairways and Other Unprotected Edges in Construction and Demolition Operations (ANSI/ASSE A10.18-2007) be complied with before the building is turned over to the owner and the equivalent in general industry standards so as not to embarrass the owner when the C/O is issued.

Existing Skylights

Building owners must budget for skylight protection now, probably using metal screens for unit skylights. There should be no objection to adding screens because of the low profile surface view from outside and fiberglass hiding the screen view from the inside. There may be some objection to natural light skylights if the screen can be seen through the skylight from below, but from my experience, the effect is small from the inside and is not noticeable from the parking lot.

Solutions to Construction Industry Skylight-Related Falls

a) Falls through skylight or HVAC opening. Use temporary frames and nets to place over the openings and be secured.

b) Falls through temporary covered openings. Use single-piece ¾-in plywood secured adequately.

c) Falls through skylight material. Cover with plywood box or screen installed at the same time as the skylight frame and secure adequately.

d) Color differences and wording "HOLE" "DO NOT REMOVE" in fluorescent spray paint with large 6-in. capital lettering help provide attention and notice. Use a template if necessary for clarity.

e) Address worker falls only and not vehicle impacts (suggest use of tracks and not wheeled Bobcats to distribute loads).

f) Provide two means of fall protection for roof or floor opening to accommodate the work trades that must legitimately remove a cover before filling with ducting or piping.

Conclusion

To address the U.S.'s leading roofing problem, we must protect workers on roofs, who, in addition to employees, are typically independent contractors who may walk close to skylights. Building owners should immediately develop programs for skylight screening instead of waiting for a fatality to act. This investigator is always gloved when he handles the full-body harness of a worker who is found on the inside floor of the building where the fall occurred. It occurs several times each year with unfailing regularity. It is time to stop the passive killer—roof skylights whose danger is never recognized until it is too late. ○

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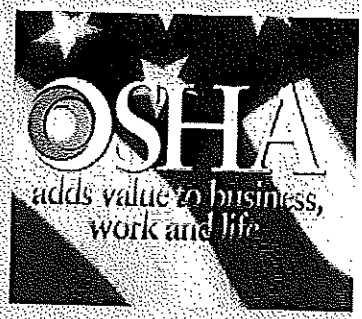
Safety & Health Issues in Aging Workforce

continued from page 14

Howard also discussed the myths of the older worker, such as slower mental cognition and recall, citing a study that found while this may be true in some cases, older workers actually have greater retention, higher learning achievement and are more likely to complete a new field of study than younger workers. He said it is essential for the employer to create flexibility by matching the ability of any worker with the job requirements, such as matching a younger worker with a job that requires heavy lifting.

Every suggestion that Howard made for accommodating older workers would also be helpful for any worker, a point that all three presentations addressed. Howard stated that while older workers have fewer injuries, their injuries tend to be more severe and take longer healing times. He stressed the need for more research on this subject.



Cohn presented on the multigenerational workforce that is in place now and the challenges it creates for employers. She outlined the four generations that currently make up the U.S. workforce: The World War II Generation (up to 1945), The Baby Boomers (1946-1964), Gen X (1965-1980) and Gen Y (1980-2000). Each group provides different responses to workplace dynamics and challenges to employers.

Cohn discussed redesigning the workplace as a means of adapting to an older workforce, which segued into Stutts' presentation as an employer that created a patient-lifting workgroup so that nurses would be relieved of that responsibility. They discovered it made a dramatic difference in the early retirement rates of their nurses: when they did not have to lift patients at any time during a 12-hour shift, nurses were less likely to leave their jobs.

Cohn recommended that employers use the workforce assessment tool on AARP's website. The tool allows an employer to enter demographics by age and position in the company to project what future needs may be for the company in terms of replacement of workers. ○