



Pedestrian and Occupant Safety and Scaffolding...

SPECIFYING PROTECTION

By Chris Cronin and Hunter Gilbertson

ABSTRACT

Building owners or their specified agents are responsible for protecting pedestrians passing, entering, or simply hanging around their buildings. They are also responsible for providing egress from buildings in case of emergency, regardless of what type of work is going on outside of the building. Roofing operations above cannot block or make exits unsafe to use.

The roof consultant can and must specify protection for pedestrians to protect both their own liability and that of the building owner/manager. What choices does the consultant have when specifying protection for pedestrians and building occupants as they pass by or exit a building? What are the risks associated with each type of protection for buildings and pedestrians? This article focuses on protection of pedestrians through various types of falls and discusses code requirements that point to specifying protection for pedestrians and others who come close to roofing operations.

SPECIFYING SCAFFOLDING

The roofing profession is a very interesting trade. The people who participate are from all walks of life, all education levels, and perform very different tasks.

Roofing workers install products in the field to make them into roofing systems. They endure some of the most difficult working conditions of all the trades in construction today. Many roofing workers receive training from their employers, while others participate in multi-year apprentice programs leading to journeyman status.

Roofers' work environments are those of extremes, from the heat of 100°F summers to the brutal chill of winter. Wind, rain, and varying temperatures are part of their everyday lives. Couple that with the dangers of always working above everything else – from 10-foot heights to the tallest high-rise roofs, 100 stories in the air. Materials are heavy and often applied with heat, or mopped with bitumen at 400°F temperatures. Understanding these conditions, it's

easy to see how roofers are most likely enduring the hardest working conditions in the construction trade.

Contractor personnel manage the process from procuring work through final inspection, providing a leak-free roofing system. And, as can be expected, many of the same disciplines that are found in corporate structures – accounting, operations, purchasing, personnel, etc. – are all wrapped up in a roofing contractor firm.

Consultants must endure most of the same conditions as the roofer and contractor. Their “office” is the roof during the time they must supervise roofers' work. In the dead of winter and the heat of summer, these professionals, with varied backgrounds from former roofers, contractors, and manufacturers' representatives to engineers and architects, endure the same conditions without the heavy lifting of materials or manual labor associated with the installer.

SAFETY REDUNDANCY

All these players must find ways to protect against risks to their safety and those of the general public. Fall protection is of utmost importance to protect the health, safety, and life of each participant in the roofing industry.

Safety lines are sometimes used by roofers, contractors, and consultants. Safety fencing protects workers from the edge of the building, where fall-off risk is huge. These ropes and harness systems, tied off to structural systems, provide a stop for workers who may lose their footing and start sliding on a roof surface. The advantage of safety lines is that they perform an important function, stopping someone from falling completely off a roof. A possible failure mode might be that a “tying off” occurs onto a less-than-secure structural support, rendering the harness useless. Also, if the person exceeds the weight limit of either the harness or structural tie-off system, falling



Scaffolding secures building perimeter, allowing safe egress. Photo by GILCO.

could occur. Also, productivity may decrease if mobility is affected.

Parapet walls designed for aesthetic reasons may also serve a secondary purpose as safeguards against materials falling from higher areas, while serving as the final stop point before a fall. The advantage of a parapet wall is that it can serve as a primary or secondary support for workers. As primary protection, parapets free the worker to possibly work without a harness, increasing productivity for the worker. However, aesthetically, the parapet may not fit the design philosophy of the building.

Finally, scaffolding can play a vital role in protecting both workers on the roof and the general public entering and exiting buildings. Scaffolding can protect building visitors and occupants from falling debris, while protecting workers as a line of defense against falling from roof surfaces.

Everyone is susceptible to falling. All it takes is one mistake, large or small. Loose gravel or slippery rooftop surfaces could also cause a fall.

Regardless of whether it's new construction or re-roofing, a high-, mid-, or low-rise building, protection for roofing workers, building occupants and visitors is important to us all. Safe work practice should be ingrained into the company culture. Leading firms conduct safety seminars for all their people, office to field, so everyone "gets it."

Protection of the public and building occupants makes good business sense. As our economy continues to become more global, safe, unfettered access to businesses for uninterrupted operation becomes paramount. In years past, buildings could be re-roofed during shutdowns or summer breaks. With buildings in use 12 months per year for community activities, school operations, and revenue-generating business activities, more and more roofing work is taking place while the building is open for business. In new construction, developers are starting to demand that the building open lower floors for occupancy as the building is constructed above, creating more risk to the public of falling materials and debris.

With all these dynamics in mind, the design professional and building management must plan how the building will remain open during both new construction and renovation. Safe egress and passage around buildings are required by the International Building Code. Consult with the local Authority Having Jurisdiction

(AHJ) about opening buildings before all is final in the building construction. Codes and enforcement in the U.S. are "thought nationally, and acted upon locally." The local AHJ is the final say on code issues.

Certainly, with a code requirement to protect occupants from debris, workers, and objects during new construction and renovation, significantly more safety planning must take place to protect the general public from the risks of roofing installation operations taking place above entrances and exits and around the building periphery. It also makes good business sense to

protect continuity of operations through some investment in either building design and/or safety. Scaffolding can provide protection for pedestrians from the hazards of having people working above, possibly fulfill a primary code requirement for egress and passage, and provide the huge gain in worker safety that comes with scaffold protection at the perimeter of a building.

Simply put, no or low parapet walls means greater fall potential for an errant piece of material from the roof operation or to the person who loses his or her footing accidentally, or if the primary fall protection

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Scaffolding allows building operations to continue while work takes place above. Photo by Knickerbocker Roofing.

malfunctions. Scaffolding used to protect the perimeter of a structure can add safeguards against dangers to the building occupants and visitors to the structure as they pass by, enter, or exit the building.

For the building owner and manager in both new construction and re-roofing, there are some very tangible benefits to scaffold protection. First and foremost is the ability to provide a secure perimeter for the structure. This provides continuity of operations to those who own or are tenants of the building. It's also less likely there will be an injury for the building owner, manager, contractor, or consultant with a secure perime-

ter, keeping incidents and resulting insurance rates low. This, in turn, helps keep the companies in the chain of command competitive. Scaffolding also secures the perimeter of the building against debris, worker tools, and equipment or people falling into the egress or pedestrian passageways. All this means less potential liability for all.

Right and Below: Scaffolding provides safety from falling debris to those below. Photo by Knickerbocker Roofing.



SPECIFICATION ISSUES

Over the years, reasons why a consultant cannot specify a "safety item," such as scaffolding, have been raised. Questions about whether the consultant is overstepping into specifying methods and means for the contractor to complete his work. In a way, one could construe that the specifying professional is dictating which method to use for constructing the roof. However, there are valid arguments to the contrary.

There is a code requirement for building occupant egress from structures in emergency situations, while a compelling business need exists to have the structure open during roofing operations. Therefore, due diligence must be performed to provide safe egress and passage of occupants. This is the responsibility of both the design professional and building owner or manager.

In 2000, three model codes in the U.S. merged into one organization, the International Code Council (ICC). The ICC produces several codes, including the International Fire Code (IFC), International Plumbing Code (IPC), International Mechanical Code (IMC), International Building Code (IBC), International Existing Buildings Code (IEBC), and the International Property Maintenance Code (IPMC). Municipalities have been reviewing both the ICC codes and NFPA 5000, the comparable code produced by the National Fire Protection Association. Many have adapted the new ICC codes. Visit

<http://www.iccsafe.org> to learn more.

The IBC, IEBC, and IPMC have much to say, throughout several chapters, about the requirement for public safety. IBC Chapter 10 is the area that communicates "Means of Egress" requirements to various responsible parties – from building owners and

managers to architects and roof consultants.

Chapter 1002 mentions definitions for the terms used for means of egress. Since the events of September 11, 2001, it's evident that protection of the public is as important once they have exited from the building as it is exiting from the inside.

Here's what the IBC, IEBC, and IPMC codes have to say (plain text is code language; the authors' commentary is in italics):

INTERNATIONAL BUILDING CODE

Chapter 10 – MEANS OF EGRESS

• **1002 – Definitions**

- **Exit Passageway** – “an exit component that is separated from all other interior spaces of a building or structure by fire-resistance-rated construction and other opening protectives and provides for a protected path of egress travel in a horizontal direction to the exit discharge or the public way...” *Note “protected path of egress travel... to the public way.” If danger exists in the passage, there could be a code violation against requirements for passage.*
- **Exit** – That portion of a means of egress system that is separated from other interior spaces of a building or structure by fire-resistance-rated construction and opening protectives as required providing a protected path of egress travel between the exit access and the exit discharge. Exit includes exterior exit doors at ground level, exit

enclosures, exit passageways, exterior exit ramps, and horizontal exits.

- **1007.2. Continuity and Components** – Each required accessible means of egress shall be continuous to a public way and shall consist of one or more of the following components....Accessible routes complying with 1104 (Accessible routes).

Chapter 11 – ACCESSIBILITY – *Scaffolding protects the disabled from debris at the exit discharge, a key component in safe passage from a structure.*

Chapter 15 – ROOF ASSEMBLIES and ROOFTOP STRUCTURES. *In this chapter, there is no requirement for safe egress and passage from a building. This chapter is focused on roofing requirements for public safety, health, and welfare as described in the code.*

Chapter 33 – SAFEGUARDS DURING CONSTRUCTION. This chapter governs safety during the construction process.

- **3301.1 Scope** – The provisions of this chapter shall govern safety during construction and the protection of adjacent public and private properties. *High density areas means*



Scaffolding for difficult applications. Photo by Knickerbocker Roofing.

protection of more people; more risk of injury from debris means more due diligence by the building owner and design professional, as they have significant responsibility in protecting the public.

- **3302 Construction Safeguards**
 - **3302.1** – Required exits, existing structural elements, fire protection devices, and sanitary safeguards shall be maintained at all times during remodeling, alterations, repairs, or additions to any building or structure...except when the building is unoc-



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cupied, or...when adequate substitute provisions shall be made. *The Code is clear that exits must be maintained at all times during remodeling, etc. This is an important piece that means the consultant, building owner, and manager are totally responsible for safe egress from the building...and passage to safety once out of the building.*

- **3303 – Demolition** – Construction documents and schedule of demolition must be submitted when required by the building official.
 - **3303.2 Pedestrian Protection** – work of demolishing any building shall not be commenced until pedestrian protection is in place as required by this chapter.... *The building official may require scaffolding for protection, but there is no language that demands the method.*
- **3306 – Protection of Pedestrians**
 - **3306.1 – Protection Required.** Pedestrians shall be protected during construction, remodeling, and demolition activities as required by this chapter and table 3306.1. Signs shall be provided to direct pedestrian traffic. *Here, it's clear that the structure needs to provide protection to those who enter, exit, and pass.*
 - **Table 3306.1** *This table shows that when construction height is 8 feet or less, and when construction is less than 5 feet from the construction to lot line, construction railings are needed. None for greater than 5 feet. For construction over 8 feet, less than 5 feet distance from construction to lot line, a barrier and covered walkway are required. The code also dictates specific requirements for covered walkways. See the building code for construction demands.*
 - **3306.2 – Walkways** – A walkway shall be provided for pedestrian travel in front of every construction and demolition site unless the authority having jurisdiction, (AHJ) authorizes the sidewalk to be fenced or closed. *Even using this option, the building owner or manager may demand the sidewalks remain open*



Scaffolding secures residence from damage.

around the clock for various business reasons. Walkways shall be of sufficient width to accommodate the pedestrian traffic but no less than 4 feet in width. Walkways shall be provided with a durable walking surface...accessible [as in Chapter 11], support all imposed loads...no less than 150 lbs/sf.

- **3310.2 – Maintenance of Exits** – Means of egress shall be maintained at all times during construction, demolition, remodeling, or alterations and additions to any building. *(Scaffolding can be used to maintain exit function and act as a working surface.)*

Chapter 34 – EXISTING STRUCTURES

Maintenance is the responsibility of the building owner and [his or her] agent...manager, etc. *Language in this section discusses that the safety systems must remain intact when renovating structures. In other words, safe egress must be maintained, plus safe passage of pedestrians, per section 3306 as mentioned above.*

- **3401.2 – Maintenance** – Buildings and parts thereof shall be maintained in a safe and sanitary condition. Devices or safeguards that are required by this code shall be maintained in conformance with the code edition under which [they were] installed. The owner or owners designated agent shall be responsible for the maintenance of buildings and structures. To determine compliance with this subsection, the building official shall have the authority to require a building or structure to be re-inspected. The requirement of this chapter shall not provide the basis for removal or abrogation of fire protection and safety systems and devices in exist-

ing structures. *It could be construed that the building owner/manager needs to assure safety to all, wherever they are in and around the structure. Scaffolding during roofing operations could help reduce the building owner/managers' risk exposure during maintenance or re-roofing operations.*

INTERNATIONAL EXISTING BUILDING CODE (IEBC)

For re-roofing, the requirements of the IEBC may also be invoked. The code is very clear about protecting the public, workers, or adjoining property.

Chapter 13 – CONSTRUCTION SAFEGUARDS

- **1301.1 – Scope** – The provisions of this chapter shall govern the safety during construction that is under the jurisdiction of this code and the protection of adjacent public and private properties.
- **1301.2 – Storage and Placement** – Construction equipment and materials shall be stored and placed so as not to endanger the public, the workers, or adjoining property for the duration of the construction project.
- **1301.4 – Manner of Removal** – Waste materials shall be removed in a manner that prevents injury or damage to persons, adjoining properties, and public rights-of-way. *Here, the code is not specific, but definitely states that methods of removal should be embarked upon with great due diligence.*
- **1301.6 – Protection of Pedestrians** – Pedestrians shall be protected during construction and demolition activities as required by sections 1301.6 through 1301.7 and Table 1301.6. Signs shall be provided to direct pedestrian traffic.
 - **1301.6.1 – Walkways** – ...A walkway shall be provided for pedestrian travel in front of every construction and demolition site unless the authority having jurisdiction authorizes the sidewalk to be fenced or closed. Walkways shall be of sufficient width to accommodate the pedestrian traffic, but in no case shall they be less than 4 feet in width. *In major cities, scaffolding may be used to protect the walk-*

way area. If there's one level being constructed to protect the walkway, adding height to the scaffold system may become economically attractive, as the crew is already there with materials and equipment.

- **1302.1 Protection of Adjoining Property** – Adjoining public and private property shall be protected from damage during construction and demolition work. This means that if a roof is close to another structure and potential for damage exists, it's the responsibility of the owner to protect the other structure.

INTERNATIONAL PROPERTY MAINTENANCE CODE (IPMC)

The International Property Maintenance Code governs maintenance of the structure. Section 304 addresses the exterior of the structure.

- **304.1 General** – The exterior of a structure shall be maintained in good repair, structurally sound and sanitary so as not to pose a threat to the public health, safety, and welfare. This is the catch-all warning

that someone in the construction process must have done due diligence to protect occupants, pedestrians, and the public from danger. If there's one passage in the code that shifts liability to the building owner or manager, contractor, and consultant, it's this passage. "Pose no threat to public health, safety, and welfare" is a very broad statement. This is really a catch-all that hits the design professional squarely between the eyes.

In this litigious construction environment, if pedestrians are injured, consultants may be brought into lawsuits, regardless of whether or not they "appear" to be responsible. All measures of safety should have been explored beforehand, with viable reasons for use of whichever method was chosen.

Design professionals may be deemed to be in violation of code when exits become impassable due to operations above if passageway protection was not specified. Most important, the building owners and managers are expecting continuity of their tenants' business operations during construc-

ROOF KNOWLEDGE ASSESSMENT

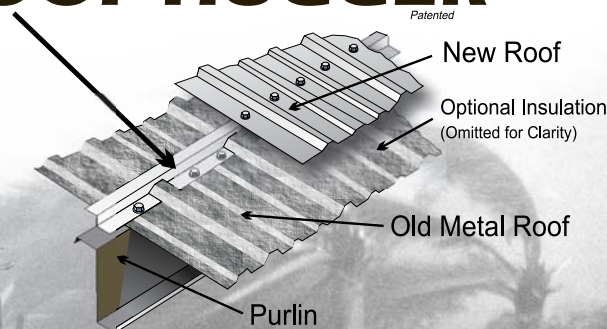
Test your knowledge of roofing with the following questions, developed by Donald E. Bush Sr., RRC, FRCI, PE, chairman of the RRC Examination Development Subcommittee.

1. When considering a ballasted roof system, what three techniques are considered in the basic wind design strategy against aggregate or ballast blowoff? Chapter 7
2. How does the size of the stone on a ballasted roof system assist in resisting wind load? Chapter 7
3. How do parapets assist in resisting wind loads on loose-laid gravel? Chapter 7
4. What are the basic principles of flashing design? Chapter 14
5. What are the four major design factors for a structural roof deck? Chapter 11

Reference: *Manual of Low Slope Roof Systems*, Chapters 7, 11, and 14

Answers on page 28

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ROOF KNOWLEDGE ASSESSMENT

Answers to questions on page 27:

1.
 - a. Increasing stone size.
 - b. Increasing parapet height.
 - c. Substituting concrete pavers for gravel.
2. Increased stone size increases the aerodynamic force required to move or lift the loose stones. Through a complex interaction of forces, upward deflection of a rolling stone combined with increased aerodynamic wind force, faster wind speed can blow some stones off the roof. The aerodynamic lifting force is a function of wind velocity squared (V^2) and diameter of stone squared (d^2).

$$\frac{V^2 d^2}{d^3} = \frac{V^2}{d}$$
3. Parapets shield the stones from the wind; increased parapet height reduces aerodynamic forces on the stones by elevating the vortices, thus reducing rooftop suctions.
4.
 - a. Eliminate as many roof penetrations as practical.
 - b. Consolidate as many roof openings as possible into a smaller number of larger openings.
 - c. Locate flashed joints above the highest water level anticipated on the roof and provide positive drainage away from the flashed joints.
 - d. Allow for differential movement between base and cap flashings.
 - e. Contour flashed surfaces to avoid sharp bends (45° maximum) in bituminous base flashings.
 - f. Anchor flashings securely to supports.
5.
 - a. Deflection
 - b. Component anchorage
 - c. Dimensional stability
 - d. Fire resistance

tion. Scaffolding provides this in a very complete way when installed, inspected, and maintained appropriately.

Scaffolding is an important component in securing the building perimeter for pedestrian passing, egress of occupants for general entry/exit, and emergency evacuation of a structure without potential for injury from objects above.


If the structure is to receive scaffolding for protection of occupants and pedestrians, here are a few recommendations for the design professional and contractor.

- Decide early in the re-roofing project planning and budgeting process to allow for scaffolding, as it may provide the best possible protection to the public health, safety, and welfare.
- Specify qualified contractors who are members of associations where scaffold firms are educated, trained, and committed to the industry.
- Determine if there are any special certifications or accreditation programs against which to judge roofing or scaffolding firms. Are they manufacturer-sponsored? Are they code organization sponsored?
- Ensure that education is available and implemented for both office and field personnel.
- Make sure the firm is reputable and has credible references.
- Determine if the contractors' employees are trained and licensed to erect or work on scaffolding.



Scaffolding keeps retailers open.

CONCLUSIONS

Whether it's a church with a steep slope or a low- or mid-rise building, there are times to use scaffolding. Economics, protecting public safety during passage and egress, and providing the building owner and manager continuity of operations for their tenants' businesses are key reasons that scaffolding makes sense. Early discussions between the building owner and roof consultant about these important code requirements is important. Consultants who are looking out for their clients' business and liability issues can separate themselves from the pack if they look at scaffolding requirements as both a method to provide safe egress and passage as well as a benefit to protect the safety of those working on the roof. 

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