More Than a Dozen Ways to Build a Better Balcony

By Derek A. Hodgin, PE, RBEC, CCCA, F-IIBEC

DURING MORE THAN 30 years of forensic investigations related to construction litigation, I have observed and repaired a significant number of balcony problems. These issues are less common than roof and window problems, but to put things in perspective, nearly all buildings have roofs and windows and not all buildings have balconies. Given the various modes of balcony failure and performance issues, it is clear that design professionals and contractors must be made aware of better practices for balcony construction. This article shares more than a dozen better practices that are needed to avoid the most common balcony problems.

BACKGROUND

Before better practices are discussed, it is important to review historical balcony construction requirements. While adoption of better practices is typically optional, adhering to building code requirements is not. The building code represents the bare minimum standards that need to be followed, regardless of other contract documents that may or may not be available. Until the 2018 edition of the *International Building Code* (IBC),[1] building codes lacked specificity regarding balcony construction standards. Previously, both the *International Residential Code* (IRC) and the IBC dealt with balconies as a general part of the building enclosure that is required to provide weather protection. Because of the absence of balcony-specific information in the building codes, it was important for contractors to have adequate details provided in the construction documents, such as the project plans and specifications, manufacturer's instructions, and accepted industry standards, which has been required in Chapter 1 of the IBC since the 2000 edition.[2]

The 2018 IBC was revised to include a slope requirement for the waterproofing surface installed over moisture-sensitive substrates such as wood framing. This important improvement places the slope requirement at the proper location. Before this requirement was established, it was common for balcony waterproofing to be installed over flat wood framing, with a concrete topping slab specified with minimal slope, typically no more than $^1/_8$ in./ft (10 mm/m). While it is good to slope the finished surface to direct water off of the balcony, concrete is porous, and water will migrate to the waterproofing below. Without slope on the waterproofed surface, the water will be held on top of the waterproofing for an extended period of time. If the waterproofing is

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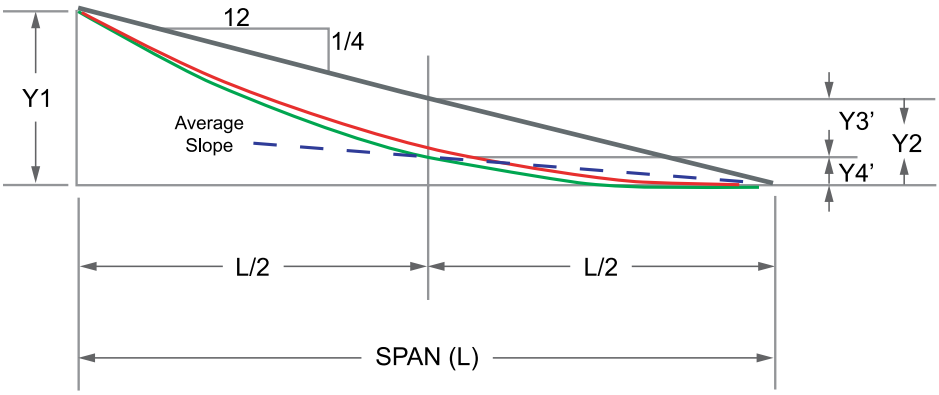

Figure 1. *Code minimum versus constructed average drainage slope.*

not perfectly installed or becomes compromised during its expected service life, the water will eventually migrate into the imperfections and cause damage, typically in the form of a water stain on the ceiling of the balcony below.

Unfortunately, the IRC[3] still lacks adequate information regarding reasonably durable balcony construction. For this reason, residential balconies remain vulnerable to water intrusion issues. This risk is a particular concern for larger-sized homes located near large bodies of water that provide an open path for wind-driven rain because they are especially vulnerable to water buildup on balcony surfaces. Balconies provide a large water shelf that can accumulate water, serving to sump the balcony door if the threshold is not elevated sufficiently. As doors age, the seal between the jambs and threshold can breakdown, providing a spillway for water at the bottom corners of the door. An elevated and waterproofed threshold, along with a sill pan flashing, provides a "belt and suspenders" form of redundancy in the protection layers.

The 90/1 principle of waterproofing suggests that 90% of water intrusion occurs at 1% of the building enclosure. Balconies are part of the 1%. It is typically advisable to spend the most attention, money, and time on the 1% of the building enclosure elements that cause nearly all of the damage. The goal should be to install your work once and not have to work again on the same area for a long time (hopefully, many years). Take your time to do the work right the first time!

BETTER PRACTICES FOR BALCONY CONSTRUCTION

The list of better practices in this article is intended to address the most commonly observed balcony problems. There are certainly additional practices that can be employed to add redundancy, improve durability, and extend the expected service life before balcony repairs are required. Keep in mind that the practices described in this article are identified as "better" practices, not "best" practices. In general, best practices are subject to change, whereas better practices are simply practices that are better than common industry practices at a particular time. In some instances, better practices could mean simply complying with the contractor's instructions,[4] which generally consist of the applicable building codes, project plans and specifications, manufacturer's installation instructions, code evaluation reports, and accepted industry standards.

While there are no guarantees that implementing better practices will result in trouble-free performance, the use of such practices will certainly improve the durability of the balcony assembly and extend the time before a repair is needed. Some of the concepts described herein are not limited to the balcony and can also be applied to other areas of the building enclosure.

For each construction project, it would be wise to review better practices and incorporate as many as possible. The number of better practices that you incorporate may be inversely proportional to your risk of becoming a defendant in construction litigation. In other words, the more you incorporate better practices into your construction project, the less chance you have of getting sued. The recommended better practices, and the relevant takeaways for each, are shown in **bold font** for emphasis.

SLOPE TO DRAIN

Construct balconies with a positive slope to drain water away from the building. **Make sure that the waterproofing layer of the balcony–and not just the walking surface–is sloped**, particularly if the walking surface is a porous material like concrete or tile. **A minimum slope of ¼ in./ft (20 mm/m) is recommended,[1, 2, 5, 8] but a steeper slope is better**. In fact, in some assemblies, using the minimum ¼-in./ft slope will almost always cause a problem (**Fig 1**). Remember that if a balcony is located over a conditioned, habitable space, it is technically considered to be a roof and is required to have a minimum slope of ¼ in./ft for positive drainage. A balcony that is not over a conditioned, habitable space (that is, an open balcony) is not considered to be a roof and does not have to comply with code-prescribed roofing standards. Perhaps that is one reason why we have residential balcony problems?

Most accepted industry standards and waterproofing manufacturers' instructions, reference a slope of ¼ in./ft (20 mm/m), or at least reference positive drainage. In fact, if you apply the generally accepted rule of following the most stringent requirement when a conflict exists, you could argue that most balcony assemblies should be constructed with a ¼-in./ft slope, regardless of whether the code requires it or not. Specifically, if you consult the APA standard[5] for structural panels (oriented strand board and plywood), the waterproofing manufacturer's instructions, and the manufacturer's installation instructions for the door, exterior cladding, and floor covering, you will likely find that ¼-in./ft slope is required or necessary to comply with the applicable contract documents.

On larger balconies and balconies with complicated geometries, maintaining a ¼-in./ft slope may be challenging. However, the balcony should be considered to be the equivalent of a roof in terms of the need for positive drainage, which is generally understood to mean no ponded water 48 hours after a rain event. However, in many years of observations, I have found that many exceptions have been made to this requirement. Don't forget that the density of water is 62.4 lb/ft^3 (999 kg/m^3), so every inch of ponded water weighs more than 5 lb/ft^2 (22 kg/m^2). Although ponded water is all too common on large low-slope roofs, it is rare on a small balcony surface. Even so, the facts are the same: A little ponding now will lead to a leak, more ponding water later, or both leaks and ponding–it does not matter whether the ponding occurs on a balcony or a roof (**Fig. 2**). Ponding never gets better; it only gets worse. Prolonged exposure to elevated moisture is never a good thing. Do not be confused by a waterproofing manufacturer that is willing to warrant a product in the absence of a slope. You must comply with the code. **The building code requires positive drainage. Positive drainage requires adequate slope**.

Figure 2. *Ponded water on a balcony surface.*

Figure 3. *Ponded water at a balcony edge.*

Figure 4. *Framing damage from leakage below the balcony shown in Fig. 3.*

To accomplish positive drainage over a large or complicated surface typically requires a combination of internal drains and a vertical offset between the front and back of a balcony. It is not uncommon for a balcony to have a horizontal distance of 12 ft (3.7 m) or more. At a code-minimum slope of ¼ in./ft, a 3-in. (75–mm) drop would be required. On a simple, rectangular balcony, this slope may provide a code-compliant condition. However, in the presence of columns, planters, and nonlinear walls, positive drainage in all areas is difficult. These types of balconies lend themselves well to an elevated pedestal system, where the level walking surface is supported over the properly sloped drainage system. In some cases, such as a sloped concrete balcony slab with surface-applied waterproofing, the waterproofing and the walking surface can be the same. The waterproofing can be textured to offer slip resistance. There are also opportunities to apply the waterproofing in a manner to resemble a brick or tile surface if desired.

PREVENT WATER PONDING AT THE EDGE

Be careful not to build up the outboard edge so much with flashing and waterproofing that you end up trapping water. Sometimes, it is necessary to exaggerate the slope at the outer edge to overcome the thickness of waterproofing/flashing material that could otherwise create a small dam that would serve to hold water.[6] Liquid water will go where you direct it. **If you fail to provide continuous slope all the way to the exit point, you can plan on ponding water, and dealing with the damages that result** (**Fig. 3** and **4**). Even a properly installed waterproofing membrane may have imperfections that will eventually be revealed when exposed to ponded water for an extended period of time.

PAY ATTENTION TO GUARDRAIL POSTS

If a waterproofed balcony includes guardrail posts, make sure that they do not interrupt the waterproofing. The waterproofing can typically be installed in a continuous manner below a guardrail post and/or to extend up the sides of the guardrail post. Do not penetrate the waterproofing with unsealed fasteners that will eventually leak. **Mounting guardrail posts to the vertical surface below the outboard edge of the balcony can be less problematic because of the gravity assist that moves water quickly past the fastener penetrations.**

Figure 5. *Notching one-half of a 4- × 4-in. wood guardrail post violates the building code. Note: 1 in. = 25.4 mm.*

Figure 6. *Wood deck "sleepers" installed over an ethylene propylene diene terpolymer (EPDM) membrane.*

When constructing metal guardrails, make sure to provide separation between the guardrail posts and any brittle balcony surface covering such as concrete or tile. Because the guardrail post will deflect when loaded laterally by humans, you can count on cracking a brittle floor surface that comes into contact with the base of the guardrail post. **A soft joint with a full-depth joint filler that surrounds the guardrail post is recommended**. When waterproofing is installed on the top surface of a concrete topping slab, you will typically need to install a ¾-in. (20 mm) fillet bead of sealant at the base of the guardrail post to serve as a cant, so waterproofing can extend to the sides of the post.

When constructing wooden guardrails, provide adequate connections with corrosion-resistant hardware. Do not toenail anything important such as a guardrail post, a top rail, or a bottom rail. A toenail connection will not resist a code-prescribed load. **Never notch guardrail posts below a 3½-in. (89 mm) dimension** (**Fig. 5**). That means you should *never* notch a 4- × 4-in. post, and only notch a 6- × 6-in. post by 2 in. (50 mm). It is always preferable to attach the posts to the side of solid floor framing members below the deck. **Become familiar with the American Wood Council's *Design Code Acceptance 6 (DCA-6)*,[7] which is a code-referenced guide to accepted practices**.

INSTALL COMPLETE WATERPROOFING

Waterproofing is only effective when it is continuous and uncompromised. **Installing fasteners into waterproofing should be avoided if possible**. The most common reason for installing fasteners into balcony or deck waterproofing is to attach "sleepers" (**Fig. 6**) or guardrail posts.

Liquid-applied and modified bitumen products may have some ability to seal around fasteners. However, single-ply waterproofing membranes (such as cured ethylene propylene diene terpolymer [EPDM], which is typically used as a roof membrane) have no tolerance for fastener penetration. **Check with the waterproofing manufacturer regarding the proper details for fastener penetrations**.

When repairing otherwise undamaged waterproofing membranes, it is often effective to remove the sleeper or guardrail post, install a strip of uncured, unreinforced EPDM, and reinstall the fasteners. Apply sealant at the fastener locations for good measure. **It is recommended to water test completed waterproofing before a floor covering is installed**. The type and extent of testing will be specific to each project. Testing a minimum of 10% of the balconies is recommended;[8] however, it is best to test all balconies, if possible.

DO NOT TRAP WATER IN CORNERS

Install crickets if needed to avoid trapping water behind columns or other drainage obstructions. Some building designs, particularly Caribbean and Mediterranean styles with arches and columns, include columns placed at outside corners of the balcony. In some instances, the dimensions of these columns can become a significant interruption in the drainage plane of the balcony (**Fig. 7**). To direct water to the drainage exit point of the balcony, the installation of a cricket (or a similar slope-altering feature) to direct water away from the column is recommended. Trapping water at a column, where the waterproofing is interrupted, can result in significant damage (**Fig. 8**).

PROVIDE AN OPEN DRAINAGE PATH

Just like exterior walls, balconies need to include an unobstructed drainage path that quickly directs water away from the building. If the

Figure 7. *Large wood columns interrupt the waterproofing at a balcony edge.*

balcony surface and the waterproofing surface are the same, no additional drainage provisions are necessary–just make sure that the drainage path is unobstructed. While a significant portion of water can be directed away from the building by sloping the surface of the balcony, that strategy is insufficient if there is a concealed drainage plane below.

If the waterproofing surface is located below the balcony surface (for example, a concrete, stone, or tile surface), it is necessary to slope the surface of the waterproofing layer. Additionally, **it is recommended to "decouple" the waterproofing from the overlying balcony floor covering**, as described later.[9] This decoupling will allow the water to be directed away from the building along an open and unobstructed path. The most common ways to provide an open balcony drainage path include, but are not limited to, the installation of a drainage mat above the waterproofing membrane or decoupling an elevated floor covering supported by "sleepers" or a pedestal system. Pedestal systems can be used on balconies and roofs of all sizes (**Fig. 9**).

USE A WATERPROOFING SYSTEM WHEN POSSIBLE

Always think about construction as an assembled *system* of components (**Fig. 10**). **Ensure that the various components that are assembled together are compatible and will perform as intended**, particularly if components will be in contact and rely on each other for functionality.

Figure 8. *Significant framing damage below the balcony shown in Fig. 7.*

When possible, purchase waterproofing systems, instead of purchasing various products from different manufacturers, as products purchased individually may or may not have long-term compatibility. Some manufacturers may provide the waterproofing membrane, flashing, drainage mat, sealants, and self-adhered flashing tape, among other products.

Additionally, **a technical representative from the manufacturer should visit the site during installation of the various components**. On-site training (as needed) and the **construction and testing of a mock-up are also recommended.** Make sure that the manufacturer's representative is a technical person who is familiar with the products and installation requirements, rather than a salesperson, who may be less familiar with relevant technical issues.

Pay particular attention to waterproofing at inside and outside corners and along the outboard (drainage) edge. There are prefabricated flashing products that can be used in these areas to avoid the application of multiple layers of flashing that need to be properly integrated and sequenced (**Fig. 11**). When purchasing separate products, be sure to discuss with the design professional the assembly of components that will be used and get a written statement of acceptance. Product acceptance is typically accomplished through the architect submittal process.

LIMIT CONCRETE CRACKING AND WATER PENETRATION

Concrete balcony topping slabs are a popular design selection. While these surfaces can be durable and long lasting, **incorporating control joints in the topping slab design and limiting water penetration of the slab will serve to extend the effective service life of the entire balcony assembly**. The added service life also extends the time that passes before money must be spent on maintenance or repairs.

To limit the extent of cracking, the concrete topping slab should include the installation of control joints in accordance with general recommendations of industry standards, such as the American Concrete Institute.[10] In my experience, many design professionals and owners consider control joints in exposed concrete surfaces and stucco walls to be visually distracting, so they fail to specify or install them. Unfortunately, visible cracking is sometimes the result of these design choices. In cases where control joints are considered undesirable, it may be possible, depending on the application

Figure 9. *A pedestal system serves to separate the waterproofed surface from the pedestrian walking surface.*

Figure 10. *Consider using a balcony waterproofing system where various components are provided by one manufacturer.*

and geometry of the concrete slab, to limit cracking by modifying the concrete mixture proportions. Obviously, installing control joints (at least at critical points of predictable stress concentration) and improving the concrete mixture proportions would provide redundant protection against concrete cracking and a more robust design. Keep in mind that cracks in concrete are primarily a cosmetic issue if the waterproofing components below are properly installed; however, cracks increase the amount of water to which the waterproofing is exposed, thereby increasing the likelihood of exposing imperfections.

To reduce the extent of water penetration through the concrete slab, consider the addition of an integral water-resistant product, such as an admixture or silicate treatment installed at the time of construction. These products significantly reduce the extent of water penetration through the concrete slab, making the role of the underlying waterproofing less critical. While the workmanship of all construction tradespeople is important, efforts to make our designs more forgiving to imperfection are good for everyone.

When dealing with existing balcony problems, a liquid-applied waterproofing could be installed to reduce the amount of water to which the waterproofing is exposed. Routing and filling of any cracks in concrete substrates can be performed prior to application. Be aware that water trapped in a concrete slab may cause blisters or delamination of the waterproofing. Check with the manufacturer for proper product selection and installation requirements. While this repair scenario would be sufficient to address water intrusion issues, it would be associated with a limited service life (approximately five years) before maintenance would be required. The time before maintenance is dependent on the quality of the installation and the exposure of the waterproofing to ultraviolet radiation and severe weather conditions.

INTEGRATE WATERPROOFING WITH WALLS

Install waterproofing in a complete and continuous manner. Make sure that the waterproofing extends up the adjacent walls a minimum of 6 in. (150 mm) above the finished floor surface **and is lapped by a weather-resistant barrier (WRB) or similar moisture protection layer installed on the exterior walls for a minimum of 2 in. (50 mm)**. Also make sure that any drainage wall cladding (such as stucco or brick veneer) can drain on top of the balcony surface or drain to the waterproofing surface below.

This recommendation can be difficult to implement in the face of sequencing issues. In some construction projects, the contractor allows wall components to be installed before the waterproofing. When that happens, it is impossible to integrate the moisture protection layers of the wall and balcony without destroying the base of the wall. It may be possible to terminate the waterproofing on the surface of the wall, if the termination is detailed properly. However, depending on the waterproofing termination detail, a termination on the wall surface will become a maintenance item that requires owner attention.

EXTEND WATERPROOFING INTO DOOR OPENINGS

Balcony doors represent a significant area of potential water intrusion. These areas are vulnerable because the door threshold is located proximate to a relatively large surface area that can collect water. **If possible, try to install the balcony door at a step-up or curb that raises the door threshold over the adjacent balcony floor surface**. An elevation difference of 1 to 2 in. (25 to 50 mm) is recommended as a personal preference. Make sure that your better design practice does not violate any accessibility rules or other standards that may apply to this transition. It is never a good idea to install a balcony door at or below the surface of the balcony floor surface (**Fig. 12**).

This is another better practice that is sequence dependent. **Ideally, the balcony waterproofing is installed before the balcony doors and the exterior cladding are installed**. This sequence allows the waterproofing to be installed onto all adjacent surfaces in an

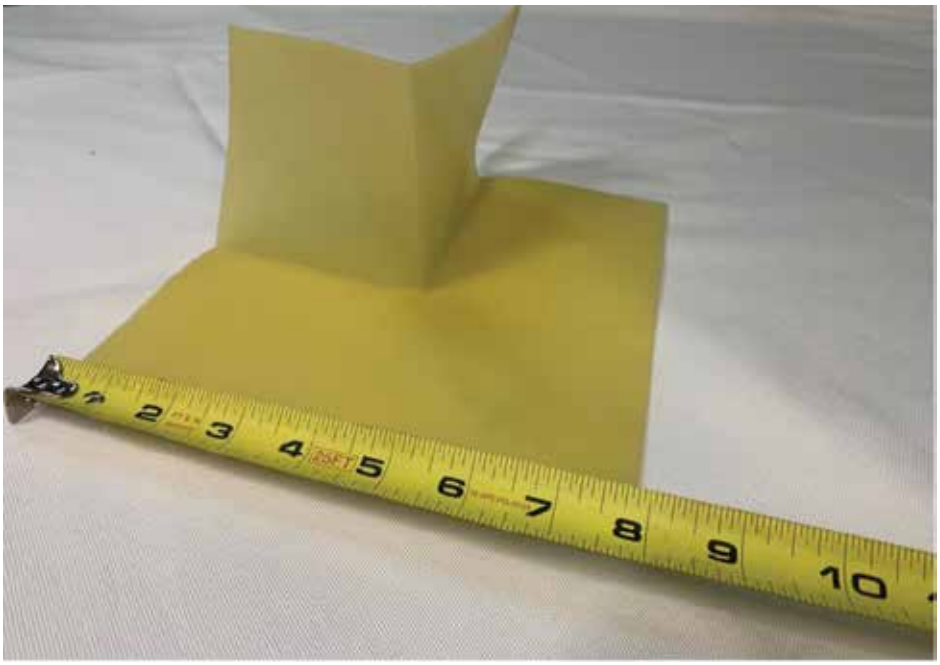

Figure 11. *Consider using prefabricated inside and outside corners. Note: 1 in. = 25.4 mm.*

Figure 12. *Setting the balcony door threshold below the concrete balcony surface is asking for trouble.*

uninterrupted manner. At the bottom of the rough opening, it is always recommended to slope the waterproofed framing away from the building, essentially telling the water where to go if or when the door unit leaks. The waterproofing should extend up the jambs of the rough opening a minimum of 6 in. (150 mm) and terminate at a back dam or step-up located behind the door frame.

If the contractor allows the balcony doors to be set before the waterproofing is installed, it will be impossible to extend the waterproofing into the door opening. However, if the rough opening flashing, including self-adhered flashing and a sill pan, is installed at the time of door installation, sufficient material must be left in place for the waterproofing to be properly integrated. Be sure to check the compatibility between the waterproofing products installed in the rough opening with those used on the adjacent wall surfaces. When the moisture protection of the rough opening is not integrated with the balcony waterproofing, a point of concentrated water penetration can develop at each end of the door threshold.[11]

AVOID DISSIMILAR SUBSTRATES

Beware of installing balcony waterproofing over more than one type of substrate. Occasionally, balconies include both concrete and wood framing as a waterproofing substrate, or they may include framing that is oriented in different directions. These areas of discontinuity should be considered in the waterproofing design. Specifically, **the design professional should consider the dissimilar movement of the adjacent substrates and select a waterproofing product or system that can accommodate the anticipated stress**. If reinforcing or additional preparation in these transition areas is not specified in the construction documents, contractors should ask the design professional questions about what is needed to properly install waterproofing at these locations.

BEWARE OF WOOD SHRINKAGE AND COMPRESSION

A portion of this better practice has actually been required by the IBC[1, 2] for wood structures over three stories (such as mid-rise wood-frame apartments or student housing) for two decades; however, the requirement is not always considered or enforced.[12] The vertical movement associated with wood shrinkage must be analyzed "to the satisfaction of the building official."[1,2] Vertical movement associated with wood shrinkage is in addition to the vertical movement associated with frame compression. As the building advances in completeness during the construction phase, the dead loads (framing, drywall finishes, flooring, cabinets, mechanical, electrical, and plumbing equipment, and so on) serve to compress the imperfect wood framing, closing gaps at framing joints. **Cumulatively, shrinkage and compression can cause as much as ¼ to ½ in. (6 to 13 mm) of vertical movement per floor**, depending on the moisture content of the wood framing, the framing design, and the quality of the construction. The vertical movement is cumulative, with the greatest displacement at the top floor. Given the magnitude of these movements, a balcony could be constructed with a ¼-in./ft (20 mm/m) slope away from the building, only to have a similar (or greater) slope toward the building after just a year or two in service.

Once the balcony and flashing slopes have been reversed, the balcony will serve to collect water and the flashing that was supposed to protect the building from water will direct water against the exterior wall. Some contractors have attempted, with limited success, to install retrofit drains in the balcony floor (**Fig. 13**). Unless the

Figure 13. *A retrofit drain installed in a balcony with slope/drainage issues will have limited success unless water is directed to it via proper design and construction.*

balcony assembly is designed and constructed to direct water to the drain, the effectiveness of the drain will be limited. Even "code-compliant" structures will be overwhelmed with water when subjected to concentrated areas of infiltration. For these reasons, **it is recommended to consider shrinkage/compression movements in the balcony design**. Improvements to flashing details may be needed to avoid water intrusion problems.

CONCLUSION

It may be difficult to incorporate all the better practices described by this article. However, I recommend that you review your next balcony project and see what works for you. Meeting the minimum requirements set forth in the building code does not always result in durable or leak-free balcony construction. The saying in the construction industry has always been, "You get what you *inspect,* not what you *expect*," and there are typically no code inspections for balconies. Successful (safe and long-lasting) balcony construction is in the hands of the design professional, the contractor, and the owner, and it is imperative that this team provides a proper design, selects good materials, installs them properly, and maintains them in service. The better practices discussed in this article are intended to assist in this process.

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