



DESIGNING AMENITY ROOFTOPS: COMPLEXITY, COORDINATION, AND CONFLICT AVOIDANCE

JOHN N. KARRAS,

JOSHUA B. KIVELA,

AND

SARAH B. RENTFRO

SIMPSON GUMPERTZ & HEGER INC.

1828 L St. N.W., Ste. 950, Washington, DC 20036

Phone: 202-239-4199 • E-mail: jnkarras@sgh.com and sbrentfro@sgh.com

BUILDING ENVELOPE TECHNOLOGY SYMPOSIUM



RCI, Inc.[®]

1500 Sunday Drive • Suite 204 • Raleigh, NC 27607
800-828-1902 • 919-859-0742 • 919-859-1328 Fax • www.rci-online.org

ABSTRACT

Rooftop amenity spaces can offer building owners significant value. Successfully incorporating these spaces into the design of a rooftop requires thorough coordination, given the convergence of cross-disciplinary design requirements, complexity of amenity overburden materials (e.g., pavers, pools, vegetative roofing, etc.), and dimensional constraints associated with the roof plan and roof assembly depth. This presentation explores key roof amenity design decisions that warrant scrutiny early in the design phase, including waterproofing selection, drainage coordination, energy conservation, fire resistance, wind resistance, maintenance and fall protection, and associated building code requirements in both new and retrofit applications.

SPEAKERS

JOHN KARRAS — SIMPSON GUMPERTZ & HEGER, WALTHAM, MA



JOHN KARRAS is a professional civil engineer with more than 14 years of combined design and construction management experience with commercial projects. His expertise encompasses building enclosure design, consulting, construction phase services, and investigation services—in particular, creatively collaborating with design and construction teams to navigate roofing and waterproofing challenges.

SARAH B. RENTFRO — SIMPSON GUMPERTZ & HEGER, WASHINGTON, DC



SARAH RENTFRO received her BS from the University of Maryland and her MS from Stanford University. She has contributed to a variety of building enclosure projects in the Mid-Atlantic and Southeastern United States, including several vegetative roofing, plaza, and amenity roofing assignments. Rentfro's work includes design consultation, field investigation work, and construction administration.

NONPRESENTING COAUTHOR

JOSHUA B. KIVELA, PE — SIMPSON GUMPERTZ & HEGER INC.

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ABSTRACT

Rooftop amenity spaces can offer building occupants comfort, pleasure, and convenience of features that would otherwise require offsite travel and public environments. Often placed on otherwise underutilized real estate, these spaces can offer significant benefit for relatively limited expense. Common amenities include hardscape, vegetation, water features, swimming pools, sun decks, fire pits, and excellent views.

Successfully incorporating these spaces into the design of a rooftop (including avoidance of water leakage problems, problematic design conflicts, and risk of other moisture-related damage) requires thorough design coordination, given the convergence of:

- Multiple cross-disciplinary design requirements, including architecture, structure, landscape, plumbing, and drainage, among others
- Complexity associated with multiple deck elevations
- Dimensional constraints of the roof plan area and roof assembly depth

In this article, the authors examine key amenity rooftop design fundamentals relating to waterproofing and drainage, wind and fire resistance, energy conservation, building science, and programming. This article does not address seismic design requirements.

WATERPROOFING SYSTEM SELECTION

Selecting a waterproofing system for an amenity roof is a process that combines fundamentals from vegetative waterproofing, plaza and below-grade waterproofing, pool waterproofing, and cladding systems. These subjects, individually, have been well documented, including by the authors referenced at the end of this article. The specific context of an amenity roof, however, requires some unique considerations. Rooftop amenity spaces constructed with

pools and hot tubs are often designed so that the coping is level with the finished walking surface, like an in-ground pool. These heavy and often fully welded stainless steel or gunnite water features are not easily removed for waterproofing repairs. Depending on the location of the pool mechanical room, the plumbing and electrical lines may run through openings in a series of concrete walls below the finished walking surface (*Figure 1*). Other rooftop features, such as glass screen walls (*Figure 2*), folding glass walls, and transitions to coping and cladding systems, require the use of flexible flashing materials that can conform to unique shapes and be applied to various substrates, including building expansion joints.

Therefore, a durable waterproofing membrane with good flashing accessories is desirable. From a material perspective, several characteristics that impart durability are low water absorption, high puncture resistance, and strength. From

a system perspective, monolithic (i.e., no or few seams) membranes that are sloped to drain with membrane-level drainage are important considerations to maximize membrane durability.

For the reasons noted above, the authors often employ reinforced hot-applied rubberized asphalt and reinforced liquid-applied polymeric membranes, both in protected roof membrane assembly (PRMA) configurations, for rooftops rich with amenity features. Single-ply thermoplastic roof membranes with heat-welded seams are often used in situations where the overburden is relatively easy to remove (e.g., vegetative roof trays or wood decking). It is prudent to allow for improved membrane access with these types of membranes. Leaks can occur through poorly constructed seams and travel a significant distance from the leak source because the roof membrane is not fully bonded to the structural deck substrate.



Figure 1 – Pool and hot tub installation in progress.



Figure 2 – The glass and aluminum curtainwall projects past the roof, forming a screen wall. Hot rubberized asphalt waterproofing is applied on a sloped concrete deck.

BUILDING CODE REQUIREMENTS

Jurisdiction-specific building code review is an eclectic exercise for amenity roofs. In this section, we summarize some important provisions of model and jurisdictional codes that warrant attention in a project-specific, design-phase code review.

Wind Resistance for Gravel and Paver Ballast

Amenity roofs commonly utilize gravel and paver ballast as part of the overburden system above the waterproofing membrane. The International Building Code (IBC) includes provisions related to the wind resistance of these materials. Unless otherwise noted, the provisions referenced in this article are from the 2015 IBC.

The authors suggest it is sensible to begin by reviewing a “gateway” requirement associated with the use of gravel (also referred to by the IBC as aggregate, and by ANSI-SPRI as stone). Section 1504.4 requires that, for ballasted low-slope roof systems, gravel shall not be used on the roof of a building located in a hurricane-prone region or on any other building with a mean roof height exceeding that permitted by Table 1504.8 (note: The genesis of this table was examined by Jay Crandell and Michael Fischer in a paper published in the *Proceedings of the RCI 25th*

*International Convention*⁴). The basic/nominal wind speed, a primary input for Table 1504.8, is determined in accordance with Section 1609.3.1. A conversion is required between the ultimate wind speed (shown on the wind maps in Figures 1609A, 1609B, or 1609C, which differ based on the building’s risk category) and the basic/nominal wind speed.

Chapter 15 provides a guide for determining the design characteristics required for gravel (if permitted by Table 1504.8) or pavers on a roof. In this regard, Section 1504.4 requires that ballasted low-slope roof systems comply with the referenced standard ANSI/SPRI RP-4, *Wind Design Standard for Ballasted Single-ply Roofing Systems* (RP-4).¹ RP-4 provides a method of designing wind resistance for gravel or concrete pavers (including traditional precast concrete or approved interlocking, beveled, doweled, contoured-fit, or cementitious-coated lightweight-concrete pavers). Essentially, RP-4 presents a series of tables (with each table representing a range of parapet height) from which a designer can determine permissible characteristics (e.g., weight) of gravel or pavers in the field, perimeter, and corner zones of the roof.

Similar to the IBC Chapter 15 gateway requirements regarding gravel, to avoid problematic design conflicts, the RP-4

analysis should be performed early in the design phase for reasons that include the following:

- Many amenity roofs include a relatively low parapet, provided they include guardrails to limit pedestrian access away from the roof edge, and especially in jurisdictions that have building height restrictions and elevation setback requirements (e.g., Washington, DC), or when maximizing views is a primary feature of the design criteria. For buildings with a roof height taller than 45 feet, RP-4 does not permit the approach of a ballasted roof assembly if the parapet is less than 12 inches tall unless a project-specific ballast design that is approved by the Authority Having Jurisdiction (AHJ) is performed by a registered design professional. Alternatively, the design team may have to consider a conventional low-slope roofing assembly or concrete paving slab above waterproofing in a split-slab configuration, separated from the main roof by an impermeable (e.g., glass) guardrail at the roof perimeter area.
- RP-4 notes that the standard should be used in conjunction with the requirements of the manufacturer of specific products used in the ballasted roof system. One example of potential conflict here is that some manufacturers and some insurance requirements (e.g., FM Global Data Sheet 1-35) require a “vegetative-free zone” at the roof perimeter. If only RP-4 (and its sister document, a design guideline that is commonly utilized though not required by code, ANSI/SPRI RP-14, *Wind Design Standard for Vegetative Roofing Systems*)² is utilized, and the roof has a jurisdiction-specific green roof area (see “What’s Next?” below), the vegetative-free zone requirements should be considered prior to submitting the green roof area calculations, since they often compete with those requirements.
- When the building height exceeds 150 feet, the ballast design shall be determined by a registered design professional and approved by the AHJ. This process requires project resources (e.g., a component-and-

cladding wind tunnel study for irregularly shaped buildings) and time to complete. Similarly, any building not fitting one of the design tables provided shall be treated as a “special design consideration” requiring review by a licensed design professional and approval by the AHJ.

Waterproofing Slope and Drainage

Slope and drainage are two of the more important system-level features of a durable waterproofing system. The 2015 IBC Section 1507 requires a minimum 2% slope (¼ in. per foot) on new roof projects for all roof types except for coal-tar built-up roofs, which may have a 1% slope. The aforementioned reinforced hot-applied rubberized asphalt and reinforced liquid-applied polymeric membranes are typically classified as built-up roofs and liquid-applied roofs, respectively. Therefore, the 2% minimum slope requirement applies to these types of membranes. In some local jurisdictions (e.g., Washington, DC), hot-rubberized asphalt roofs are not required to meet the 2% minimum slope requirement for new roofs, but should still achieve positive slope to drain. Drain placement (with consideration to service and creep deflections) is critical on roofs that utilize this approach. Although many of these lower-slope projects have been successful, the limited slope may impact membrane durability over the long term and result in other unintended consequences associated with long-term ponding on the roof membrane (e.g., odors and/or mosquitoes at the amenity area). A tapered concrete substrate that is monolithically placed with the slab offers the most architectural design flexibility because the number of available slopes and configurations is infinite.

The 2015 IBC Section 1503.4 includes requirements related to primary and secondary (emergency overflow) roof drainage and references to the International Plumbing Code. Overflow drainage can be achieved via independently plumbed internal overflow drains or by allowing water to drain over the roof edge. Section 1504 implies that drainage over the roof edge (provided the load from ponding water on the roof deck, if all primary internal drains clog, does not exceed the design capacity of the structure) can serve as a secondary drainage path in lieu of secondary internal drains or scuppers. If the design team

pursues this approach, coordination is also required with RP-4 parapet height requirements described above.

Adequate drainage is also important to limit ponding conditions that may lead to floating insulation. Contemporary energy codes continue to require greater amounts of insulation and, in some localities, use of blue roofs and roof drain flow restrictors are encouraged to dampen peak stormwater flows. Providing adequately sized roof drainpipes and continuous membrane-level drainage will typically negate the likelihood of floating insulation in most situations, but if a blue roof or flow-restricted roof is designed, a hydrologic analysis is warranted.

Fire Resistance

The International Fire Code (IFC), which is adopted by certain U.S. jurisdictions, includes provisions related to a common amenity roof feature—the vegetative roof—that IFC refers to as a roof garden or landscaped roof. Section 317.2 requires that vegetative roof areas do not exceed 15,625 square feet without a 6-ft.-wide Class A-rated roof system providing above-deck fire-resistive separation from the adjacent roof area.

Section 317.2 includes a similar provision for long/narrow rooftop vegetative roof

areas, limiting their length to 125 feet maximum without Class A-rated separation, and for vegetative areas adjacent to combustible vertical surfaces (e.g., building superstructure, mechanical penthouses, skylights, and photovoltaic panels). For amenity roofs over noncombustible decks, design teams can consider PRMA roof systems with pavers (provided they are Class A-rated) to satisfy both these IFC requirements and the FM Global (where applicable) roofing manufacturer vegetative-free-zone requirements described above, while providing access paths for maintenance personnel or circulation paths for building occupants.

Energy Conservation

The 2015 Edition of the International Energy Conservation Code (IECC) is the applicable standard for energy code compliance in many states. The ANSI/ASHRAE/IESNA Standard 90.1-2013 (ASHRAE 90.1) may also be used as an alternative means of energy code compliance. The energy codes generally allow a prescriptive compliance approach (insulation R-value or overall U-value) or a performance-based approach. Based on our experience, regardless of the compliance path selected, designers typically try to achieve prescriptive insulation values on roofing assemblies. This may range from R-20 to R-35, depending on climate



Figure 3 – Spray-foam insulation installed on underside of prefabricated pool shell. Photo courtesy of CBT Architects.



Figure 4 – Structural penetrations for screen walls and glass rails must be considered as part of the project’s energy conservation goals. A consultant takes in the great views from the soon-to-be-completed private cabanas.

zone and building use type. An R-30 PRMA with extruded polystyrene insulation would require about 6 in. of insulation. Roofing membrane, protection, and drainage board will also add thickness to the assembly. Special consideration should be given to water features, screen walls, and other roof penetrations, and creative solutions for challenging conditions often are required. For example, spray foam can be used on the underside of pool shells (Figure 3) to achieve thermal continuity and structural thermal breaks, and/or specialized thermal analysis may be required at structural supports for screen walls and glass rails (Figure 4).

Pool Deck Surfaces

The review of building code requirements related to walking surfaces surrounding a pool—commonly referred to as the pool deck—is typically spearheaded by the architect of record with support from a specialty pool contractor. The building

enclosure consultant, however, should be aware of some code provisions that may require coordination with the amenity roof waterproofing or traffic coating design.

As with any building code review, the project team must review jurisdiction-specific requirements. This is especially true in the context of spaces surrounding a rooftop pool, since many local jurisdictions reference requirements of local health departments. With that said, the International Swimming Pool and Spa Code (ISPS), referenced by Chapter 31 of the IBC, and the Model Aquatic Health Code (MAHC), published by the Centers for Disease Control and Prevention (CDC), promulgate some requirements that represent the types of provisions that may be of interest to the building enclosure consultant:

- The MAHC requires, for certain walking surfaces adjacent the pool, a minimum dynamic coefficient of friction. This is notable in the sense that if the building enclosure consultant specifies a traffic coating or waterproofing membrane on top of the pool deck, the finished surface must meet the mandated slip resistance performance requirements.
- The ISPS requires that pool decks must be sloped such that standing water will not be deeper than 1/8 inch within 20 minutes of the addition of water to the deck. Table 306.4 in the ISPS also provides “typical minimum drainage slope” for various wearing surfaces except when an alternative drainage method is provided that prevents the accumulation of sur-

face water. As such, open-jointed overburden systems (e.g., wood tiles or pavers on pedestals) that drain freely might not require slope, if authorized by the AHJ. In contrast, the MAHC provides more general requirements based on finish type. Smooth finishes (e.g., tile or lightly broomed concrete) shall have a minimum slope of 1/8 inch per foot).

- The MAHC requires that all water that touches the pool deck shall drain effectively to either perimeter areas or to deck drains, and not towards the aquatic vessel (e.g., pool or spa).
- Both the ISPS and the MAHC require watertight isolation joints between the pool coping and surrounding deck.

INTERSTITIAL SPACE DESIGN

Rooftop pool structures and deep planters (when the design intent is for the adjacent walking surface to be flush with the top of the pool/planter wall) are commonly designed as overbuilt structures above the structural deck, resulting in an interstitial space adjacent to the planter/pool structure. The presence of multiple deck elevations creates design and construction complexities that can, without close attention, result in performance pitfalls. We address the waterproofing location and building science considerations in this section, and drainage in the following section.

The building enclosure consultant should, in the schematic phase and with the architect, plumbing engineer, structural engineer, and landscape architect present, map out the path of the waterproofing membrane on a building section drawing that includes representations of the various deck levels. Figures 5, 6, and 7 show three common configurations of the waterproofing path as it relates to the interstitial space. Note that in all three cases, the waterproofing membrane extends up and over the stem walls (i.e., structural basin) immediately adjacent to the pool. This isolates the pool waterproofing system from the field of the roof, which is necessary to help contain leaks through the pool shell. The pool waterproofing should tie into the adjacent waterproofing system in a continuous manner.

Redundant Waterproofing

Redundancy in waterproofing above and below the interstitial space is prudent when the project budget allows and when the design team desires the lowest risk profile. *Figure 5* takes this approach. The waterproofing system in this configuration would include a membrane on the overbuilt deck that is contiguous with the pool waterproofing membrane. The membrane on the structural deck should share the primary characteristics of the upper waterproofing membrane, but it is not unreasonable to reduce the durability of the lower membrane because of its reduced exposure. The pool deck, if it is comprised of a paving slab, is sometimes covered with a decorative overlay, primarily for cosmetic and slip-resistance purposes. From a thermal barrier standpoint, locating the insulation above the lower waterproofing layer, particularly when the waterproofing membrane is a vapor retarder and the lower membrane is on the winter-warm side of the insulation, simplifies the hygrothermal analysis associated with this configuration.

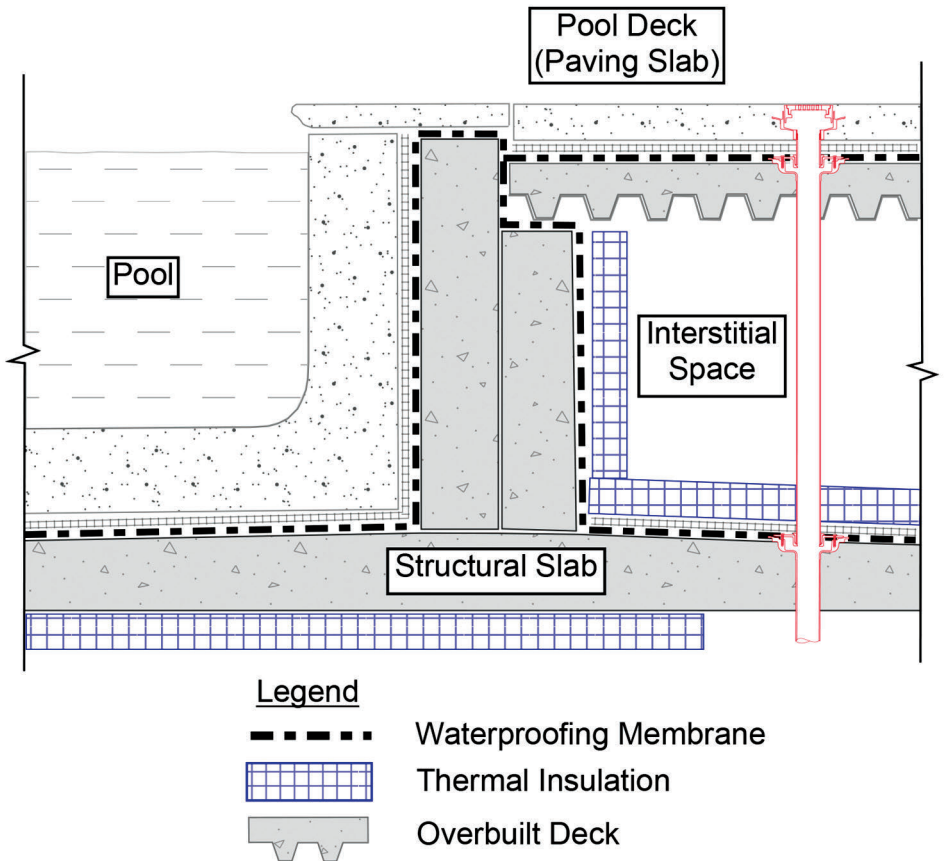


Figure 5 – Redundant waterproofing (above and below interstitial space).

Structural Deck Waterproofing

The waterproofing membrane is below the interstitial space only. This approach requires detailing the waterproofing membrane so that it can, after it passes over the walls immediately adjacent to the pool, pass under adjacent stem walls that support the elevated deck and other walls (e.g., planter walls; see *Figure 10*) that are constructed above the structural deck. From a constructability standpoint, this option (as does the lower waterproofing level of the redundant waterproofing option in *Figure 5*) has the benefit of facilitating rapid “drying-in” of the building interior, since the structural deck can be waterproofed in its entirety immediately following installation of pool waterproofing. If the interstitial space will be used to route pool plumbing lines, placing waterproofing on the structural deck also helps avoid building leakage from plumbing leaks. Since the overbuilt deck is not waterproofed and is subject to deterioration, it must be designed so that the metal deck is a sacrificial form and not part of composite deck.

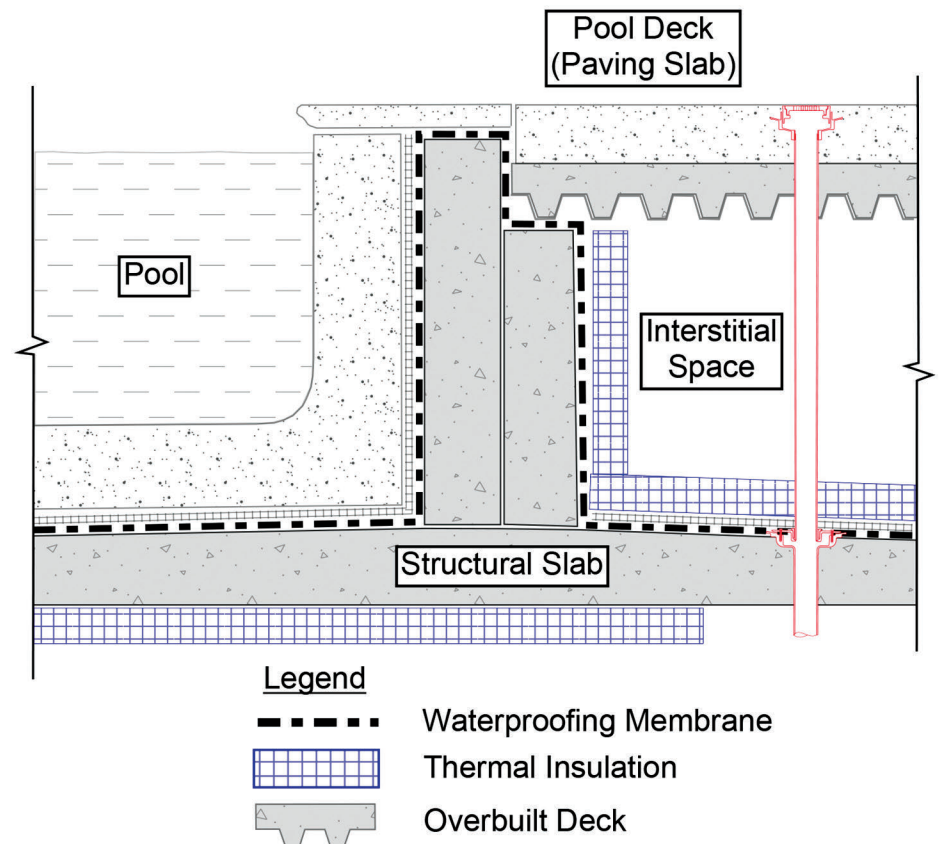


Figure 6 – Structural deck waterproofing (below interstitial space).

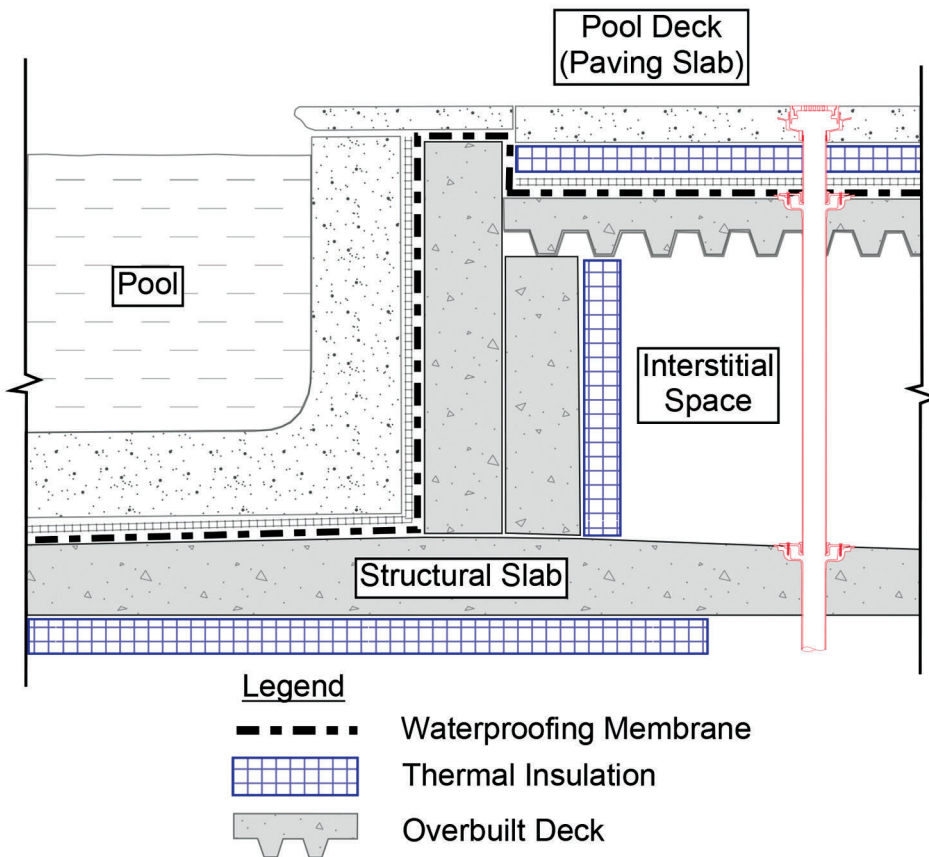


Figure 7 – Overbuilt deck waterproofing (above interstitial space).

struction (i.e., prior to waterproofing membrane installation on top of the elevated deck). Moisture entry into the interstitial space can result in a lengthy drying process that limits the construction team’s ability to install waterproofing on the elevated deck and install interior finishes below the structural deck.

General Interstitial Space Considerations

Regardless of the waterproofing path or whether water leaks into the interstitial space during construction, it is very likely that the interstitial space will always be damp or may experience water leakage from some source. The design of the interstitial space should therefore address the following:

- Mechanical ventilation may be recommended in certain situations to reduce the likelihood of condensation within the space. For the redundant waterproofing (Figure 5) and structural deck waterproofing (Figure 6) options, since the interstitial space is outside of the air/water/thermal barrier, ventilation with outdoor air should be considered. For the overbuilt deck water-

proofing (Figure 7) option, where the interstitial space is essentially an attic space, the mechanical ventilation would be with conditioned interior air.

- Lacking dehumidification (via ventilation or other mechanical means), built-in moisture from construction (e.g., water from concrete placement and leakage) will be trapped in the materials within the interstitial space (air, concrete, formwork remnants, etc.), further increasing this risk of condensation for the first several winters after initial construction. Especially with the overbuilt deck waterproofing approach, the built-up moisture cannot readily dry to the exterior.
- Provide a means of access to the interstitial space in service for the purpose of maintaining the slab/pipes/etc. or performing repairs to the waterproofing membrane. Avoid designing stem walls that completely segregate cells of the interstitial space. If CMU or concrete stem walls are required to support the field of the elevated deck, include block-

outs large enough for communication of ventilation air and access for maintenance personnel.

- With the anticipated high humidity and constantly damp conditions predicted for the interstitial space, there is an increased risk of corrosion of mild steel components in the interstitial space (and material degradation/biological growth of any organic material that resides in that area). Biological growth and material degradation can result in an offensive odor that may manifest itself at adjacent interior and exterior spaces. Accordingly, avoid insulation materials that are sensitive to moisture, and avoid other organic materials that will remain permanently in the interstitial space.
- Even if the interstitial space is not waterproofed, providing floor drains at low points in the structural deck is prudent. Additionally, provide concrete curbs around all openings in the structural slab (e.g., duct penetrations and access hatches) to minimize the chance that the slab openings serve as paths for water leakage to the interior, should water reach the interstitial space.
- Avoid designing a composite elevated metal deck whose structural performance is reliant on the integrity of the metal deck, given the likelihood of deck corrosion in service.
- All piping within the interstitial space should be jacketed and insulated to limit the risk of sweating. All piping joinery within the interstitial space should be pressure-tested for leaks prior to activating.

DRAINAGE COORDINATION

Adequate drainage is vital to the long-term performance of an amenity roof waterproofing system, just as it is for vegetative roofs, plazas, and rooftop pools. Unique to amenity roofs, however, is the relatively complex task of coordinating the fundamentals of primary and secondary/overflow drainage with drainage off of multiple deck levels, drainage around rooftop obstructions (e.g., planter/stem walls and curbs, which are plentiful on amenity roofs), and drainage below pools/water features. We expand on these concepts below.

Slope

We discussed code provisions related to slope at the waterproofing membrane level(s) earlier in this article. Additionally, membrane-level slope and drainage layers are expounded upon by Greg Doelp and Phil Moser in their March 2009 *RCI Interface* publication.³ Apply these requirements and guidelines at each waterproofing level.

Drain Layout and Coordination with Walls/Curbs

The layout of drains on an amenity roof should endeavor to locate at least one primary drain in each zone formed by an obstruction and should provide an inverted pyramid slope configuration within each zone for maximum slope in the valleys. Include provisions for secondary drainage, such as scupper drains through planter walls and parapet walls, during the drain layout exercise (Figure 8).

Given the cost associated with independently piped internal overflow drains, many project design teams elect to utilize scuppers at the roof perimeter to evacuate secondary drainage. Additionally, though one drain in each primary zone is prudent, some amenity roofs include many small zones formed by wall/curb obstructions, rendering this approach impractical. With that said, if either primary drainage or secondary drainage must pass through wall/curb obstructions, careful attention to membrane-level drainage at the obstructions is required.

In the context of reinforced HRA and liquid-applied polymeric membranes, the building enclosure consultant has two primary options to consider with regard to coordinating drainage with wall/curb obstructions above the structural deck. With the exception of the structural basin walls of the pool (where the waterproofing should always extend up and over the pool structure, high enough to pass above the water

Figure 8 – Primary and secondary drain layout exercise.

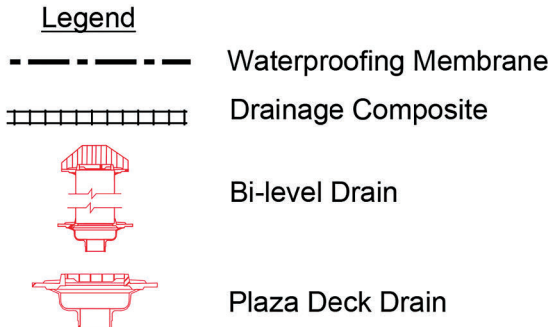
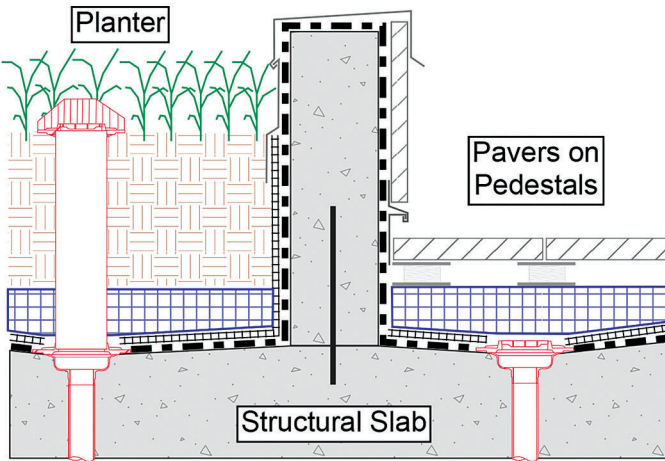
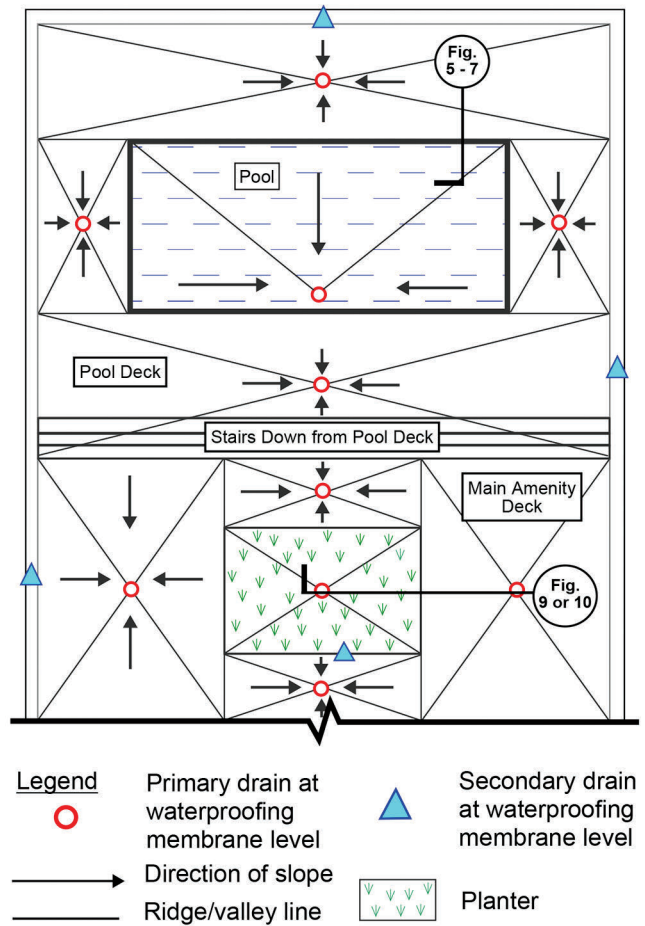


Figure 9 – Waterproofing over planter wall.

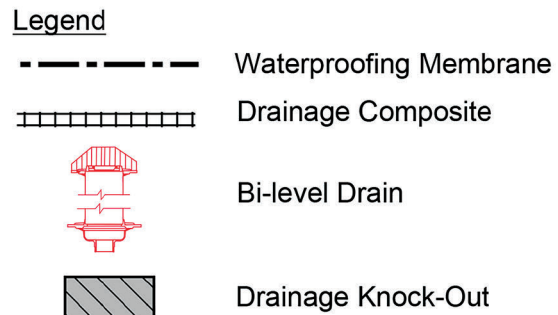
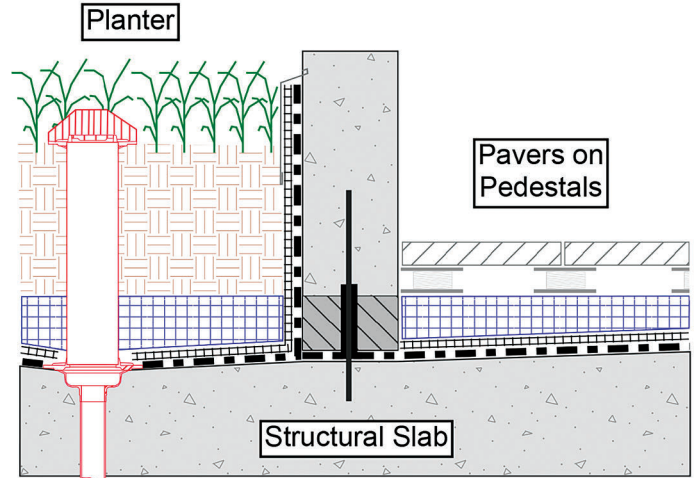


Figure 10 – Waterproofing below planter wall.



Figure 11 – Existing roof to be converted to useable space. Note the elevation of the curtainwall relative to the surface of the pavers.

line), fluid-applied waterproofing membranes can extend up and over (Figure 9) (when covered, as dictated by membrane UV resistance or durability, or for aesthetic reasons), or continuously below, wall/curb obstructions (Figure 10). The authors often prefer the Figure 10 approach for similar reasons, as described above, for the structural deck waterproofing strategy.

Within the Figure 10 approach, designers then have two options for draining water through the obstruction: Provide continuous drainage composite below the wall, or provide discrete knock-outs. In both approaches, since the waterproofing extends continuously below the wall, the vertical reinforcing steel bars that engage the wall to the structural deck must each be individually flashed. That said, the authors prefer the knock-out approach, provided the knock-outs are coordinated to avoid the rebar penetrations, since the reliability of a rebar penetration flashing encased in concrete is likely to outperform rebar penetration flashings that are in a drainage path.

Service Access to Drains

Water features and pools on amenity roofs also warrant attention in the design phase regarding placement of drains from the standpoint of maintenance access.

Michael Phifer and Robert Holmer, in their article published in the October 2016 *RCI Symposium on Building Envelope Technology Proceedings*,⁸ appropriately describe the need for what they refer to as a structural vault drain (also referred to by specialty pool contractors as a condensation drain) to evacuate water from the waterproofing membrane level below the pool shell. These drains should be located to allow for access and maintenance, such as through a cleanout pipe or a maintenance

hatch. Similarly, for rooftop water features (e.g., water wall with an associated catch basin), the authors recommend avoiding locating the drain where it will be inaccessible to maintenance personnel (e.g., below an overbuilt cast-in-place concrete structure for the feature).

CONVERTING EXISTING ROOFS TO AMENITY PROGRAMMING

For repositioning projects, where designers convert existing roofs into useable space (Figures 11 and 12), greater flexibility and creativity with roofing/waterproofing design may be required. Designers must meet the building code provisions for roof deck strength, slope, and energy conservation (among other requirements) while developing a design that is durable and cost-effective. Many roof deck repositioning projects do not make it past the feasibility stage due to these challenges. The projects that do get implemented often do not incorporate all of the best practices that are readily achievable on new construction. Tapered insulation or concrete build-up at adjacent walls often limits slope, and new drains may be required to reduce this build-up. Furthermore, restrictions on the use of hot-applied or odorous membranes can drive selection of less durable systems. From our experience, diligent coordination among owners, prime designers, and subconsultants (structural engineers, code consultants, building envelope consultants, landscape architects, and HVAC consultants) is required to optimize the amenity features on these types of conversions. For example,

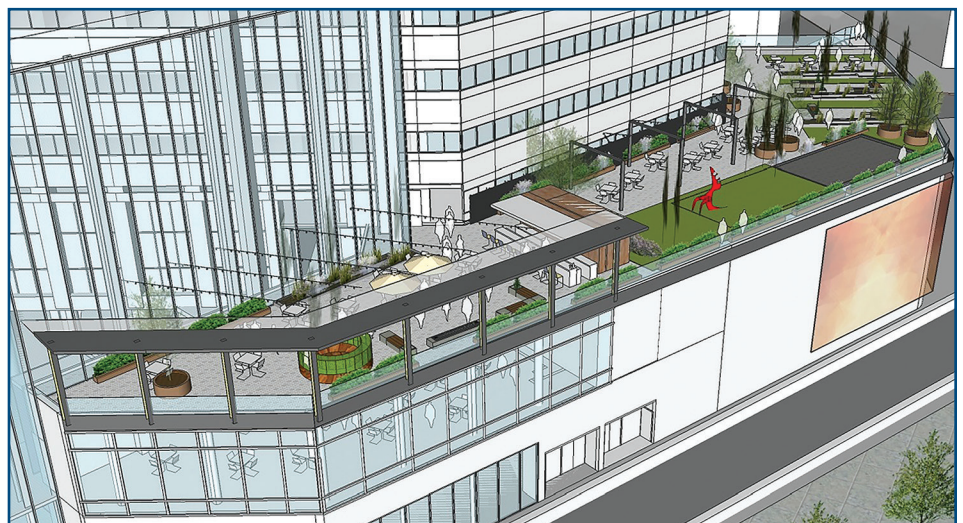


Figure 12 – Architectural rendering of reprogrammed roof space (the “cantina” scheme). Image courtesy of CBT Architects.

heavy planters are often placed directly above columns, or various tapered substrate layouts must be considered alongside overburden selection.


For these reroofing projects, where meeting the minimum slope requirements for new roofs would be overly burdensome for the owner (e.g., replacing the roof with ¼ in. per ft. slope would also require raising the elevation of adjacent windows and through-wall flashing), roofs may be designed and built with “positive drainage.” The National Roofing Contractors Association (NRCA) defines positive drainage as the drainage condition in which consideration has been made during design for all loading deflections of a deck, and additional roof slope has been provided to ensure drainage of a roof area within 48 hours following a rainfall under conditions conducive to drying. Since PRMAs used in amenity roof design are not conducive to drying, the positive drainage exception should not be used according to the NRCA’s definition. However, in concept, the positive drainage exception “holds water.” Codes require minimum slopes to compensate for finish tolerances, ponding instability, and progressive deflection. If these items can be evaluated for a particular project, there is no reason why a roof cannot drain adequately with a slope less than ¼ in. per ft.

Designers should proceed with caution when employing the positive drainage exception. Missteps during the surveying, analysis, and design process could easily lead to ponding conditions that lead

to reduced durability and leakage (and the other pitfalls associated with ponding described above). As noted by the NRCA, “providing for adequate roof drainage is the most important consideration in designing and installing quality, long-lasting, low-slope membrane roof assemblies.”

WHAT’S NEXT?

As it stands today, amenity roofing/waterproofing design is already a relatively complex endeavor requiring specific expertise in, and early/intricate collaboration among, the design team. Still, the number of relevant considerations continues to increase as some jurisdictions roll out new regulations related to stormwater retention, green roof area, and other parameters that affect amenity roof design. These relatively progressive initiatives are currently limited to select locations, but may expand to other regions, especially cities with combined storm/sewer systems. In parallel, building codes (e.g., energy conservation, plumbing drainage) continue to develop across the country, with generally increasing stringency.

The well-informed designer can remain at the forefront of these developments and continue to play a central role in successful implementation of amenity roofs. 

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