PLAZA DECK DESIGN PRIMER

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Contents

INTRODUCTION

A *plaza deck* is a walking surface, which sometimes can accommodate vehicles, typically waterproofed to protect the underlying structure and/or occupied spaces below. Common surface treatments include concrete, ceramic tile, stone or other paving material, usually with a bi-level drain used to accept both surface run-off and water at the waterproofing membrane level. Structural substrates are commonly wood or concrete.

ASTM E2266, *Standard Guide for Design and Construction of Low-Rise Frame Building Wall Systems to Resist Water Intrusion*, has the following definition:

> *Protected membrane plaza deck* – a plaza deck constructed with the waterproof membrane placed directly over the structural deck surface (usually concrete or wood panel sheathing) with a separate traffic-bearing surface, such as concrete, ceramic tie, or pedestal-supported pavers placed on top of the membrane.

Because the underlying structure is vulnerable to water damage in case of leaks, design and construction should be well thought out and well executed. Repairing failed plaza decks can be expensive because of the need to remove the walking surface and associated flashings, seals, accessories and interfaces with adjoining surfaces.

Because of the cost of replacing a failed plaza deck system or a waterproof membrane that has reached the end of its useful life, good design and high quality durable materials and systems are essential. Manufacturer's warranties typically are written to provide only replacement waterproofing products in case of failure, but labor and the cost of removing and replacing the balance of the system components is not covered.

This brief Plaza Deck Design primer is intended to point out some of the key issues for designing and constructing a successful plaza deck system.

TYPICAL FAILURE ISSUES

Plaza decks can fail for endless reasons, but most failures include one or more of the following:

A. Lack of sufficient substrate slope to drain at the membrane and surface levels.
B. Improper connection of membrane to internal drain, deck edge or scupper.
C. Adhesion failures between membrane and edge or base flashings.
D. Failure to extend membrane vertically above the deck surface.
E. Failure to integrate membrane with a pan flashing at doors.
F. Membrane failures relating to adhesion or application to a damp or improperly primed surface.
G. Lack of a drainage course.
H. Poorly designed or executed penetrations.
I. Damage during construction.
J. Failure to provide explicit design details for transitions between deck and adjacent walls.
K. Selection of an inferior or inappropriate membrane.
L. Flawed specifications.
M. Poor workmanship.

DECK DESIGN

A protected membrane system with a pedestrian topping provides durability, a pleasing appearance and low maintenance requirements. It is a system with a long history of success, and its design concept and details are well documented in industry standards.

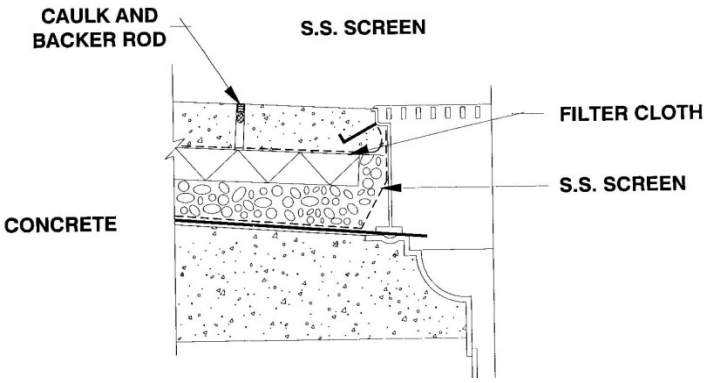


Figure 1
Protected Membrane System from D5898 Standard Guide for Standard

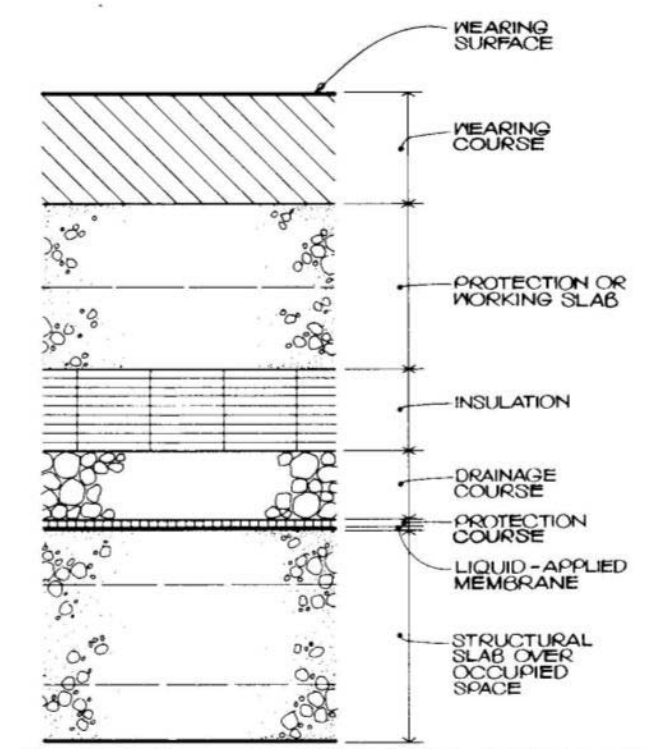


FIG. 1 Basic Components of Cold Liquid-Applied Elastomeric Membrane Waterproofing System with Separate Wearing Course

Figure 2
Components of a plaza deck (ASTM C636)

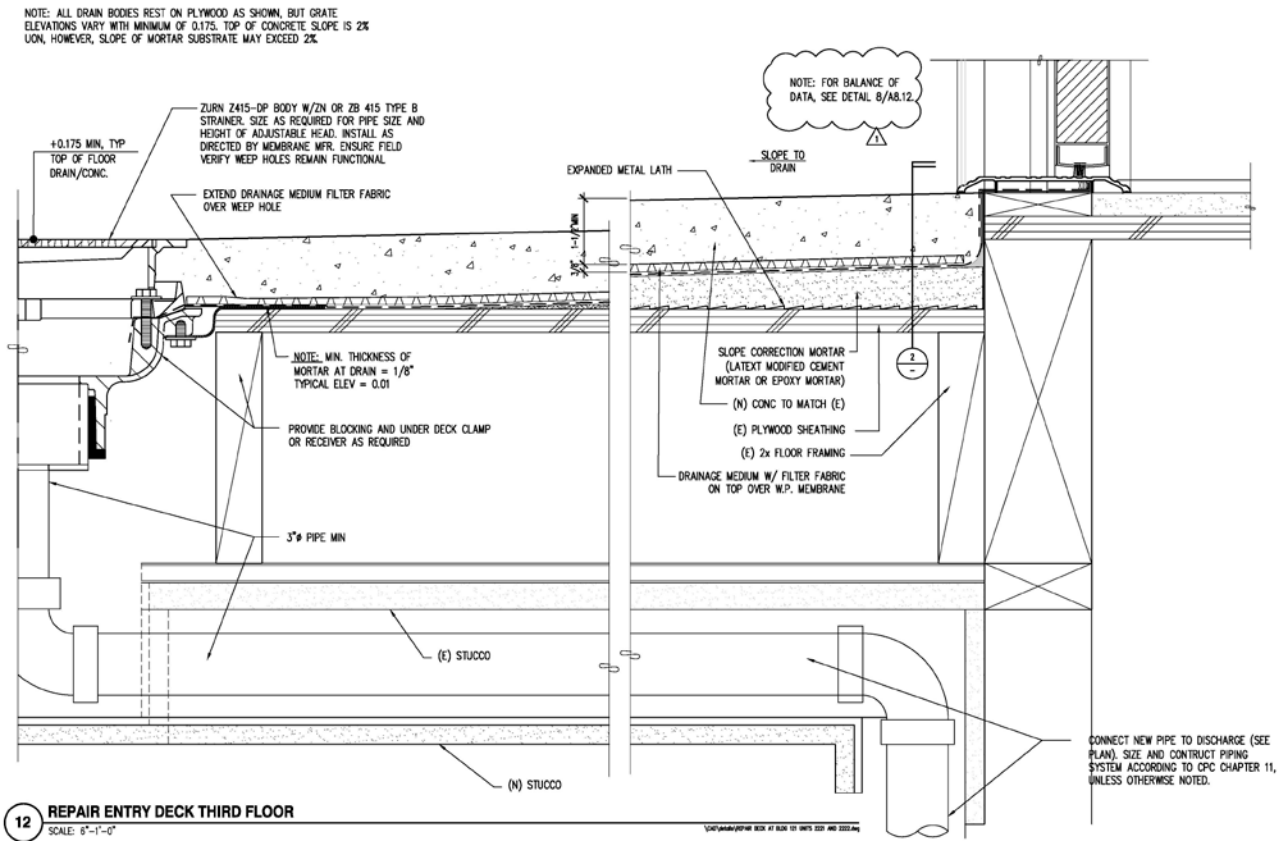
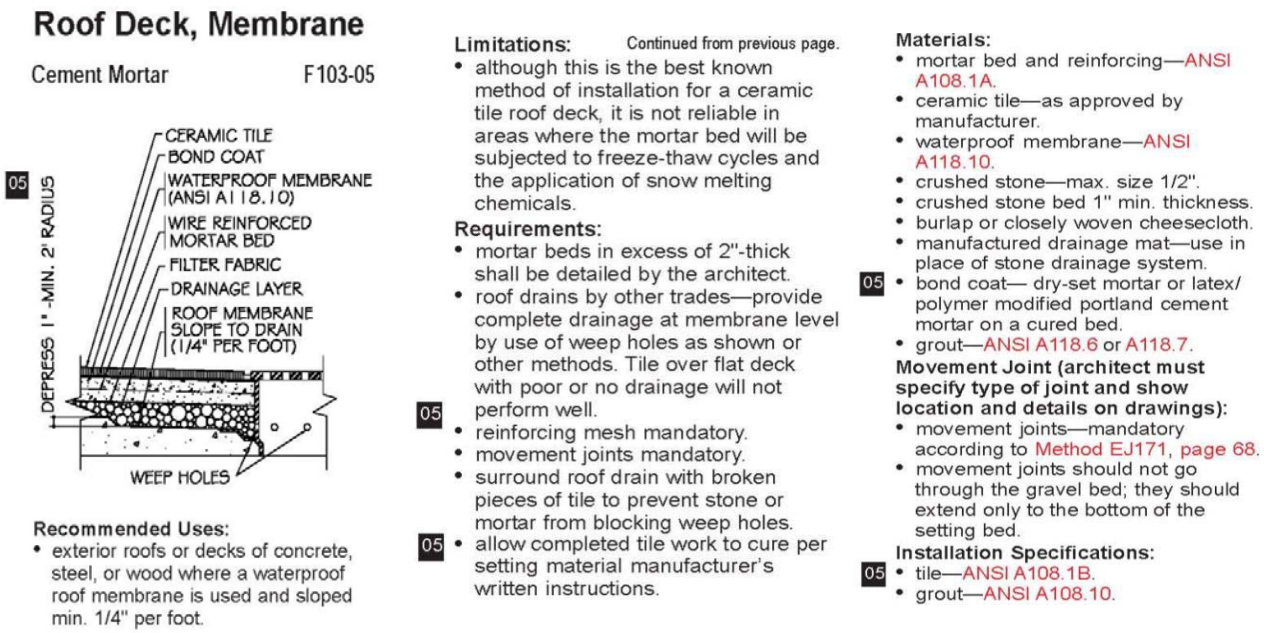


Figure 3

Typical plaza deck design for a wood substrate



Roof Deck, Membrane

Cement Mortar F103-05

Recommended Uses:
- exterior roofs or decks of concrete, steel, or wood where a waterproof roof membrane is used and sloped min. 1/4" per foot.

Limitations: Continued from previous page.
- although this is the best known method of installation for a ceramic tile roof deck, it is not reliable in areas where the mortar bed will be subjected to freeze-thaw cycles and the application of snow melting chemicals.

Requirements:
- mortar beds in excess of 2"-thick shall be detailed by the architect.
- roof drains by other trades—provide complete drainage at membrane level by use of weep holes as shown or other methods. Tile over flat deck with poor or no drainage will not perform well.
- reinforcing mesh mandatory.
- movement joints mandatory.
- surround roof drain with broken pieces of tile to prevent stone or mortar from blocking weep holes.
- allow completed tile work to cure per setting material manufacturer's written instructions.

Materials:
- mortar bed and reinforcing—ANSI A108.1A.
- ceramic tile—as approved by manufacturer.
- waterproof membrane—ANSI A118.10.
- crushed stone—max. size 1/2".
- crushed stone bed 1" min. thickness.
- burlap or closely woven cheesecloth.
- manufactured drainage mat—use in place of stone drainage system.
- bond coat— dry-set mortar or latex/ polymer modified portland cement mortar on a cured bed.
- grout—ANSI A118.6 or A118.7.

Movement Joint (architect must specify type of joint and show location and details on drawings):
- movement joints—mandatory according to Method EJ171, page 68.
- movement joints should not go through the gravel bed; they should extend only to the bottom of the setting bed.

Installation Specifications:
- tile—ANSI A108.1B.
- grout—ANSI A108.10.

Figure 4

TNCA Handbook for Ceramic, Glass and Stone

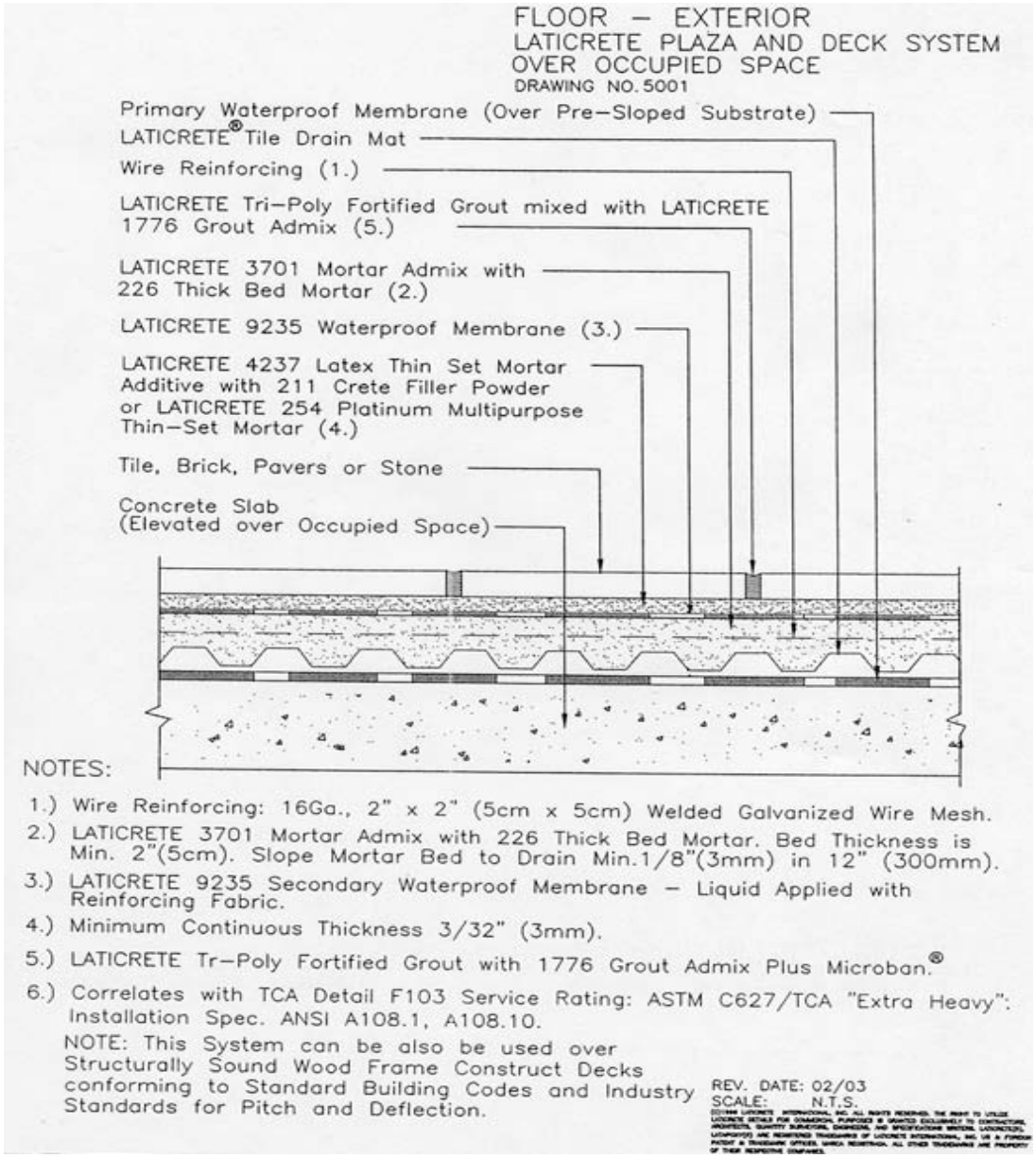


Figure 5
Proprietary Tile System with Redundant Membranes

Code Requirements

The previous edition of the *California Building Code* addressed decks in Section 1402.3:

> Waterproofing Weather-exposed Areas - Balconies, landings, exterior stairways, occupied roofs and similar surfaces exposed to the weather and sealed underneath shall be waterproofed and sloped a minimum of 1/4 unit vertical in 12 units horizontal (2% slope) for drainage.

However, the 2010 *California Building Code* dropped this requirement and does not specifically address a condition where the substrate is a membrane applied on a structural deck with a concrete wearing course. Presumably, it would be covered in Chapter 15, Roof Assemblies and Rooftop Structures, and would be "1503.1 … designed and installed in accordance with this code and the a*pproved*[1] manufacturer's instructions such that roof covering shall serve to protect the building or structure." 1503.4 Roof Drainage, requires "Design and installation of roof drainage systems shall comply with Section 1503 and the California plumbing Code."

- Assume a waterproofed deck is a "Roof Assembly" per CBC 1501.1.
- Slope requirements are in CBC Section 1507 for several generic types of roof coverings. Typical plaza deck coverings are not mentioned.
- Minimum slope is 2% for built-up roofs.
- CBC Section 1503.1 requires conformance with "approved manufacturer's instructions."
- Minimum scupper dimension is 4 inches.

Chapter 11 of the *California Plumbing Code* requires:

- Primary and secondary (emergency) roof drainage (CPC 1101.11).
- Primary roof drainage by "roof drains or gutters (CBC 1101.11.1). Scuppers not mentioned.
- Secondary drainage by roof scuppers or open side (CPC 1101.11.2.1)

For structural design of decks, CBC Table 1604.A.3, note e states:

> The above deflections do not ensure against ponding. Roofs that do not have sufficient slope or camber to assure adequate drainage shall be investigated for ponding. See Section 1611A for rain and ponding requirements and Section 1503.4 for roof drainage requirements.

CBC Section 1611: Rain Loads.

1611.1 Design rain loads. Each portion of a roof shall be designed to sustain the load of rainwater that will accumulate on it if the primary drainage system for that portion is blocked plus the uniform load caused by water that rises above the inlet of the secondary drainage system at its design flow.

Surface drainage must comply with the following:

[1] Acceptable to the code official or authority having jurisdiction (CBC 202)

- Primary drainage based on storm of 60 minutes duration and 100-year return period (CPC 1101.11.1 andTable 11-1)
- Secondary (emergency drainage) by scuppers, open side (CPC 1101.11.2.1)or secondary roof drain (1101.11.2.2).
- Scupper sizing 4" high with width equal to circumference of required roof drain.

Industry Standards

All published industry standards[2], including those of the National Roofing Contractors Association (NRCA)[3], the Tile Council of America (TCA)[4], and ASTM Standards[5] clearly require or recommend a positive slope to drain at the membrane level, usually between 1 and 2 percent.[6] Similarly, the overwhelming majority of waterproofing membrane manufacturers requires or recommends positive drainage at the membrane level. Some defenders of flat deck substrates for waterproofing have maintained that certain manufacturers recommend, authorize, or even "guarantee" their products for use on flat substrates, however, those same manufacturers typically limit their warranty to providing only waterproofing materials without any responsibility for labor or other costs of repairs.

All Protected Membrane Plaza Deck systems have common characteristics unchanged for decades[7] that include:

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[2] Although the following citations are from current publications, the references to slope have remained essentially unchanged for many years.

[3] "Ideally, the suspended structural deck should be sloped to drain. The advantages of draining the membrane surface are well-established. Recognizing the problems that arise when attempting to slope a suspended structural deck, consideration should be given to placing an adequate number of dual-level drains to reduce the accumulation of water on the waterproofing membrane surface." The *NRCA Roofing and Waterproofing Manual*, Fifth edition, Volume 3 (Rosemont, IL: National Roofing Contractor Association, 2001) 774.

"NRCA recommends all horizontal waterproofing systems over habitable spaces be designed and built to provide positive drainage. For horizontal waterproofing systems over habitable spaces, NRCA recommends that a drainage layer be installed to facilitate the movement of water…For horizontal waterproofing systems over habitable spaces, a designer should specify a minimum 1/8:12 (0.6 degree) slope or greater and should make provisions in the design for complete positive drainage… Primary drains and overflows are typically installed at the same level as the waterproofing membrane's surface. For all waterproofing systems, it is recommended that a protection course be installed between the waterproofing membrane and any overburden. The drainage course may also act as a protections course. For horizontal water proofing systems, the drainage course is suggested to promote the movement of water under topping slabs, wearing course, etc. to promote the movement of water to relieve hydrostatic pressure. *The NRCA Waterproofing Manual* (Rosemont, IL: National Roofing Contractor Association, 2005) 14-15.

[4] See "Roof Deck, Membrane," with note "roof membrane, slope to drain ¼" per foot," *2003-2004 Handbook for Ceramic Tile Installation*, 41st Edition (Anderson, SC: Tile Council of America, Inc., 203)14

[5] See paragraph 12.2.3, ASTM E 2266 *Standard Guide for* Design and Construction of Low-Rise Frame Building Wall Systems to Resist Water Intrusion.

[6] Other references include: C.W. Griffin and R.L. Fricklas, *Manual of Low-Slope Roof Systems*, Third Edition (New York: McGraw-Hill, 19960 393-94 – "An absolute minimum slope of 1 percent, and preferably 2 percent is recommended to assure positive drainage," and Michael T. Kubal, *Construction Waterproofing Handbook* (New York: McGraw Hill, 2000) 3.63-3.64 – "Sandwich membranes should not be installed without adequate provision for drainage at the membrane elevation; this allows water on the topping slab, as well as water that penetrates the protection layer onto the waterproof membrane, to drain…If this drainage is not allowed, water will collect on a membrane and lead to numerous problems, including freeze-thaw damage, disbanding, cracking of topping slabs and deterioration of insulation board and the waterproof membrane."

[7] See C.W. Griffin, *Manual of Built-Up Roof System, Second Edition* (McGraw-Hill, 1982), 445; Justin Henshell, *Manual of Below-Grade Waterproofing Systems* (John Wiley & Sons, Inc.: 2000) 149; *The NRCA Roofing and Waterproofing Manual*, 5th Edition, 774.

- A substrate of wood sheathing or concrete with recommended minimum slope to drain of 2%.
- A waterproof membrane.
- A drainage medium o drainage course, which may also serve as a protection course.
- A bi-level drain with a drain grate at the walking surface and weep holes at the membrane level and/or scuppers and/or edge drainage. Decks using pedestal pavers or unit pavers set in gravel may not require a drain inlet at the surface.
- A durable walking surface with minimum recommended slope of 2% to drain.

A general summary of design and construction techniques for the selected system can be found in ASTM E2266 - *Design and Construction of Low-Rise Frame Building Wall Systems to Resist Water Intrusion*.

12. Plaza Decks or Stairs with a Protected Waterproofing Membrane

12.1 *Materials*:

12.1.1 Waterproof membranes should be specifically recommended by the manufacturers for the intended use.

12.1.2 Waterproofing membranes and associated materials should conform to, Specification C 836, Specification D 6134, materials listed in Guide D 6622, or waterproofing membrane products listed in SPRI Flexible Membrane Roofing: A Professional's Guide to Specifications.

12.1.3 Deck substrate materials and fasteners should be compatible with waterproofing materials.

12.1.4 The installer should provide a written description of maintenance requirements and frequency, repair procedures, and replacement procedures.

12.2 *Design and Construction*:

12.2.1 Refer to Guide C 898, Guide C 981, Practice D 6135, Guide D 5843, Guide D 5898, Guide D 6622 and TCA

"Method F 103," where applicable. The ASTM standards anticipate installation of waterproofing over a concrete substrate. Adapt these standards when waterproofing is to be installed over wood-based deck sheathing.

12.2.2 For design of sheet metal flashings at deck perimeters and deck posts, refer to the SMACNA Residential Sheet Metal Guidelines.

12.2.3 Decks should have minimum 2 % slope to drain at the level of the membrane after any deflections due to load or material creep have occurred. Although this is the minimum necessary for drainage, greater slope should be considered where design and construction constraints allow. When pedestal-supported pavers are utilized where water can drain between the pavers, the pavers need not slope, but the substrate at the underlying deck membrane should have minimum 2 % slope to drain.

12.2.4 Overflow drainage should be provided by scuppers, deck edges, redundant drains, or overflow drains so that water will overflow into the secondary drains before rising to a level sufficiently high to overflow door thresholds.

12.2.5 Membranes should be fully supported, and turned up at the walls, sills and jambs adjacent to sills at least 200 mm (8 in.) above wearing surface of the deck.

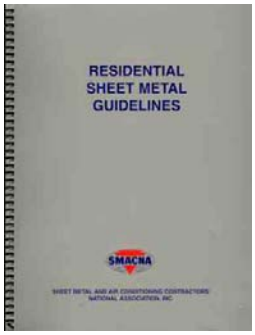
12.2.6 Ultra violet light protection cover may be required where the membrane is exposed above the wearing surface if the membrane material selected is not intended to be exposed due to potential mechanical damage and weathering, including solar radiation.

12.2.7 Where membrane decks are flashed with galvanized sheet metal at the wall base, all sheet metal embedded in or in contact with concrete or mortar bed decks should be cleaned, primed and covered with the membrane material used for the deck surface to avoid corrosion.

12.2.8 Joints of railings to walls should have saddle flashing installed.

12.2.9 Prior to installation of planters and landscaping, decks should be fully waterproofed.
12.2.10 Planter boxes and landscaping beds should have separate waterproof membranes and drain separately into drainage systems.
12.3 *Inspection and Testing*:
12.3.1 After completion of each deck, water test in accordance with Guide D 5957.

Achieving 2% slope at both the membrane level and the walking surface is generally a fundamental basis of design. Often, 2% slope at the walking level is required by for accessibility. Even when this is not a requirement, a slope lower than 2% may not provide adequate drainage, and a slope over 2% can look and feel awkward and may be a hazard. Excess of 2% slope at the membrane level may not be a problem, but it can make construction unwieldy when substrate and surface slopes are not synchronized.



References and manufacturer's instructions typically assume installation over concrete. Adaptations have to be made for frame construction and installation over wood-based sheathing

Drainage Options

Internal drains:

- Less elevation differential than scupper and edge drains.
- Integration with waterproof membrane less complex and more reliable due to mechanically secured clamping ring.
- Bi-level drainage easily handled.
- Cost and location of drain piping can be a challenge.

Edge drainage with or without gutters:

- Can be less expensive than internal drains
- Minimizes complex two-way drainage planes.
- No piping required without gutters.
- Overflow drains not required.
- Edge-to-wall interface requires complex detailing.
- Drainage at substrate (waterproofing membrane level) requires careful detailing.

Internal Drainage

The principal of bi-level drainage is described below in ASTM C898:

> 10.1 General–When the membrane waterproofing is covered over with a wearing surface, it is necessarily assumed that water can and will reach the membrane; otherwise, the membrane below the wearing surface would not be needed. Drainage should then be considered as a total system from the wearing surface down to the membrane. Since it would be undesirable to permit water to build up below the wearing surface, multilevel drains should be used, with particular emphasis on rate of flow into the drain at the membrane level.

An example of an internal drain is the Zurn Z-415 Figure 2) which is designed to collect water at both the surface and at the membrane level.

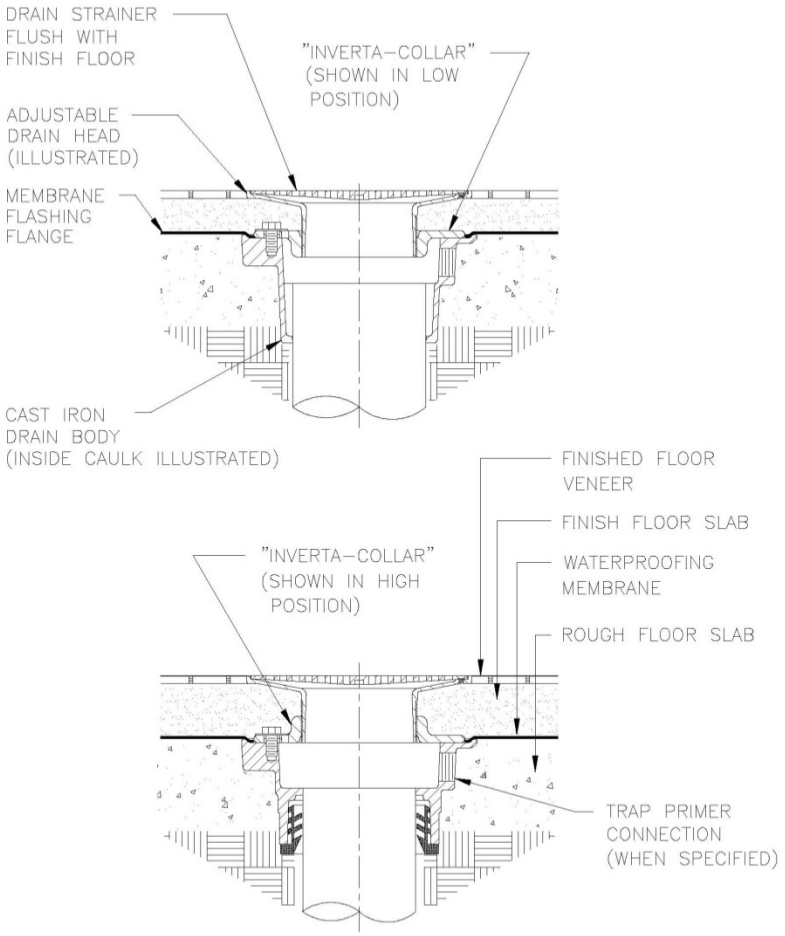
ZURN

TYPICAL INSTALLATION FOR Z-415 FLOOR DRAIN

Dimensional Data (inches and [mm]) are Subject to Manufacturing Tolerances and Change Without Notice

Z-415
FLOOR DRAIN

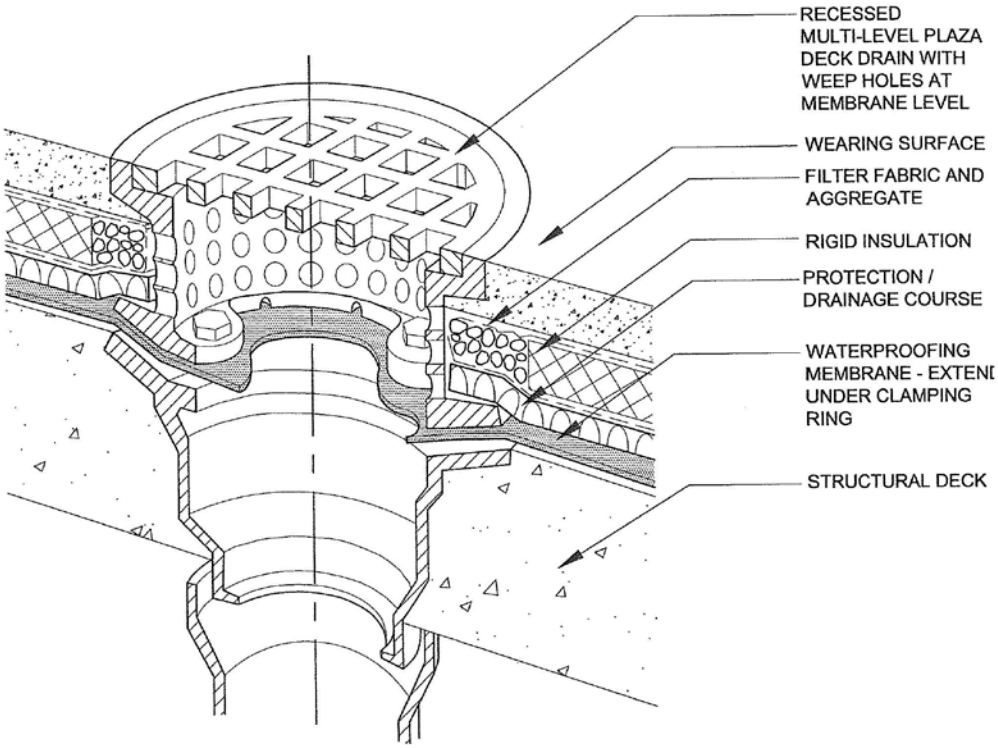
The Z-415 Zurn Floor Drain can be installed in most floor construction. The drain pipe is run to an elevation below the expected finished floor level, so that the drain top will be flush with (or slightly below) the finished floor. Dimensional data for all drain heights and outlet types are shown in the Engineering Handbook, and on Zurn Submittal Drawings. The drain body is secured to the pipe with any of four connections, Threaded, No-Hub Connector, Lead Caulk or the Zurn Neo-Loc Gasket. The type of connection should be specified upon ordering any Zurn drain. Once the drain is set in place, the initial concrete sub-floor is poured to an elevation level with the top flange of the drain body. The waterproofing membrane is then run up to and over the flange. The clamping collar is then placed on the drain and secured. The strainer is then screwed into the clamping collar and finished floor is poured to finished grade. Note the Z-415 collar can be used on either side to change the total adjustment of the head elevation (for example 1/2 [13] - 1-5/8 [41] on one side, 1-3/8 [35] - 2-3/8 [60] on the other). Also, care should be taken to protect the top finish during installation, through the use of cardboard, tape or other protective material applied by the plumber.



Form # FD15	Date: 8/5/99	C.N. No. 83044	Rev.

ZURN INDUSTRIES, INC. ♦ SPECIFICATION DRAINAGE OPERATION ♦ 1801 Pittsburgh Ave. ♦ Erie, PA 16514
Phone: 814/455-0921 ♦ Fax: 814/454-7929 ♦ World Wide Web: www.zurn.com
In Canada: ZURN INDUSTRIES LIMITED ♦ 3544 Nashua Drive ♦ Mississauga, Ontario L4V1L2 ♦ Phone: 905/405-8272 Fax: 905/405-1292

Figure 6
Zurn Z-415 product sheet showing installation with waterproof membrane



NOTES:

1. WEARING SURFACE MAY BE CAST-IN-PLACE CONCRETE OR MORTAR-SET TOPPING MATERIAL.
2. RIGID INSULATION MUST BE MOISTURE RESISTANT AND HAVE HIGH COMPRESSIVE STRENGTH (25 PSI MIN.; CONSULT ENGINEEI
3. SEE INTRODUCTION TO THE WATERPROOFING CONSTRUCTION DETAILS FOR ADDITIONAL INFORMATION.

NATIONAL ROOFING CONTRACTORS ASSOCIATION

PLAZA DECK DRAIN WITH WEARING SURFACE

2005 *NOT DRAWN TO SCALE* WP-

Figure 7
Bi-level drain detail WP-22 from NRCA Waterproofing Manual

Edge Drainage

The deck edge shown in Figure 8 provides edge drainage, but the variation shown in NRCA WP-35(Figure 6) works only if there is an interior drain. WP-35 can be improved by wrapping the waterproofing up the vertical leg of the edge metal.

If drainage is over the edge, there has to be a way for drainage to occur at the membrane level. One way is to use weepholes, which is challenging because they will have to be drilled after the concrete is installed and will puncture both the metal edge and the vertical membrane. Weepholes can also result in staining on the face of the edge metal and the face of a wall or fascia below it. Another is to allow for drainage under the edge metal as shown in Figure .

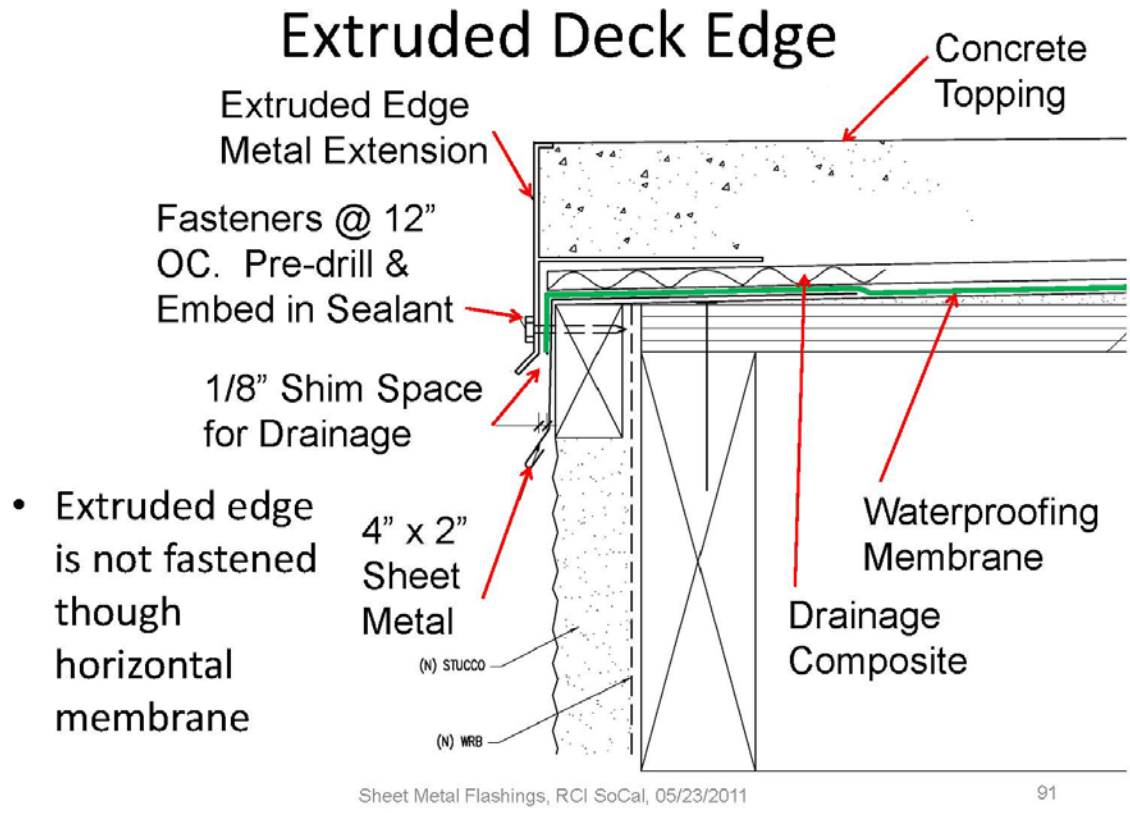
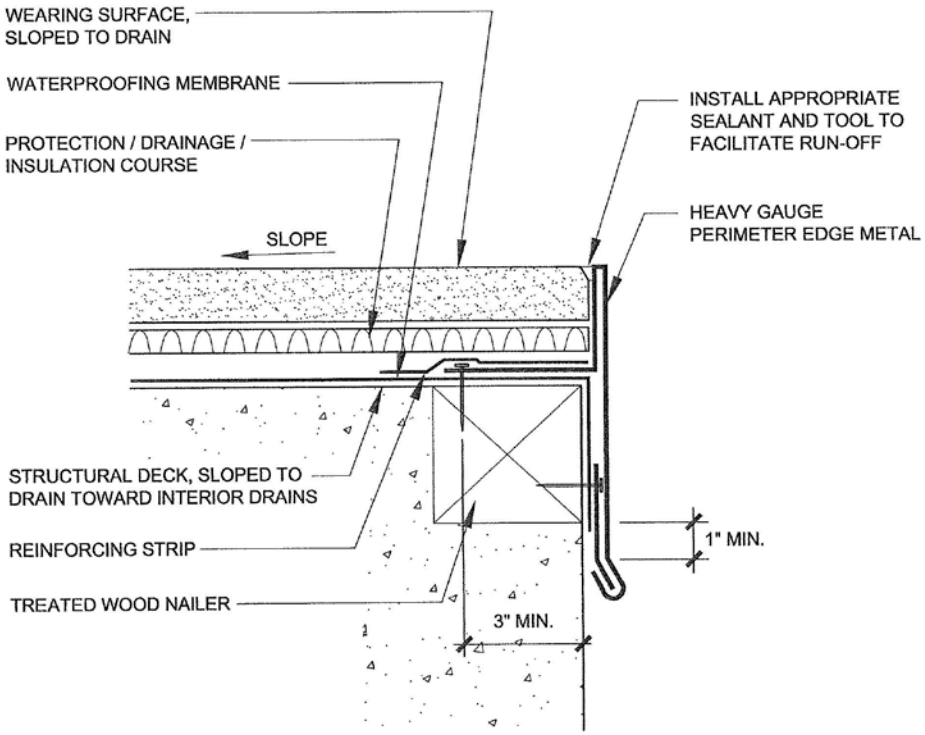


Figure 8

Example of an edge draining deck with provisions for drainage at the membrane level



NOTE:

1. SEE INTRODUCTION TO THE WATERPROOFING CONSTRUCTION DETAILS FOR ADDITIONAL INFORMATION.

NATIONAL ROOFING CONTRACTORS ASSOCIATION

OPEN EDGE PERIMETER DETAIL WITH INTERIOR DRAINAGE

2005 *NOT DRAWN TO SCALE* WP-35

Figure 9
Deck Edge with Internal Drainage Detail from NRCA Waterproofing Manual.

Figure 10

Deck edge with completed concrete wearing surface. Note weepholes

Figure 11

Deck edge from inside. Note membrane terminates on horizontal bar. Adhesion failure will result in leaks

Substrate Slope

Substrate slope may be achieved by one of three methods, or some combination:

1. Sloping or tapered primary wood framing and sheathing. Relatively easy for one-way uniform slope using edge drainage.
2. Sloping surface of structural concrete substrate.
3. Tapered sleepers over flat wood structural framing. Difficult with compound planes .
4. Sloping mortar or concrete fill over a flat wood or concrete substrate

Figure 12
Sloping mortar substrate over wood deck sheathing

- Mortar typically varies from 1/8 inch to 1 ½ inches, or more.
- Expanded metal lath fastened to sheathing enhances bond.
- Mortar provides a more durable bond than wood.

Crickets and multi-plane substrates are a particular challenge that can be a good application for a sloping mortar. A sloping mortar fill over wood framing is typically minimum 3,500 psi compressive strength acrylic modified mortar applied over 3.4 lb. diamond mesh lath.

Membrane

Membranes come in all types, including self adhered modified bituminous, cured sheets, cold applied modified bitumens and urethanes (1 –part and 2-part), hot applied modified bitumens, and others. The cost to expose and repair or replace can far outweigh any initial system cost. Most manufacturers do not provide a material and labor warranty, so getting it right is much more important than a roof, which can come with a complete 15 or 20-year warranty.

- Adhesion to substrate is desirable. Good adhesion limits migration of any water from leaks.
- Adhesion to accessories, such as scuppers and penetrations, is critical.
- Ensure minimum thickness of liquid applied membranes.
- Laps, seals, wrinkles, fishmouths of self-adhering sheets can result in leaks.

Sheet Metal Flashings

Adhesion failures relating to integrated sheet metal flashings are common, particularly where some part of the flashing is exposed, such as a deck edge or scupper. Corrosion can cause adhesion failures, so corrosion resistant materials such as stainless steel copper and combinations of copper, tin, and zinc may be critical choices. Galvanized steel should not be considered corrosion resistant for the life of the deck system.

When using galvanized sheet metal, always specify "mill phosphatized" (also called "bonderized") galvanized sheet metal. We is an issue with respect to membrane adhesion. Unless the contractor is particularly careful to use only bonderized product, what will be provided is probably passivated, also known as "chem-treated" and hexavalent chromium treated.

Passivated galvanized sheet metal is known to result in poor adhesion. Few people at the construction level are aware of requirements related to the removal of passivation treatments. Passivation is the use of hexavalent chromium on coil galvanized stock to prevent white rust stains during storage.

The supply chain for galvanized steel sheet used for architectural applications can have numerous links, including producers who hot dip or electrogalvanize coil stock, coating applicators that may bonderize coil stock, large scale distributors, regional or local warehousers, and finally, end users that include contractors and fabrication shops.

There is a remarkable lack of understanding among individuals representing various links in this supply chain about the end use of galvanized sheet metal for architectural applications and the issue of field painting.

The only reliable way for an architect to ensure membrane adhresion is to specify a bonderized finish, which is a phosphate pretreatment. Both zinc and iron phosphate are used. Iron phosphating is less durable but also less expensive.

Bondurized galvanized sheet metal is not readily available for fabricated products like fabricated structural roof/ceiling decking panels, so it is almost certain that these will be "passivated" or "chem-treated" with a chromate solution, which inhibits paint and coating adhesion. Chromium-based pretreatments may contain both trivalent and hexavalent chromium. Although there is a drive to phase these out for environmental reasons in favor of Zinc-phosphate pretreatments, and while hexavalent chromium is banned in Europe, the US has no such requirements. Hexavalent chromium leaching from PG&E cooling towers in Hinckly, CA, is what the movie "Erin Brockovitch" was about.

There are only three effective methods to prepare passivated galvanized steel for painting:

1. Weathering for 12-18 months to oxidize sufficiently.
2. Brush off blast cleaning
3. Chemical treatment with a product such as Henkel Galvaprep SG with a scotch-brite abrasive pad (Some consider this high risk)

None of these methods is easy for typical architectural sheet metal applications. Brush off blast cleaning is messy and expensive on a finished building, and few building owners are going to accept a 12-18 month wait for a building to be painted. Chemical methods are dependent on workmanship. But one of the three has to be done unless the fabricated components can be furnished non-passivated.

Bonderized finishes are not as widely available as passivated finishes, but they are readily available for sheet metal stock such as is used for fabricated flashings. There may be 10% to 15% cost premium for bonderized finishes, but the savings in paint-related costs is probably more than that. For more information:

- GalvInfoNote 2.10 Imparting Resistance to Storage Stain, GalvInfo Center email: info@galvinfo.com 1-888-880-8802
- GalvInfoNote 2.11 Preparing Galvanize for Field painting
- GalvInfoNote 2.12 Pretreatments for Metallic Coated Sheet

Figure 13
Deck edge to wall interface is a detailing challenge

Figure 14

Scuppers:

- Require careful detailing for integration with membrane, interior and exterior parapet finishes and conductor head.
- Membrane bond to scupper is weakest link. Bond is at membrane level. Insufficient priming, corrosion, poor workmanship can lead to failures.

Left: Membrane bond failure at scupper

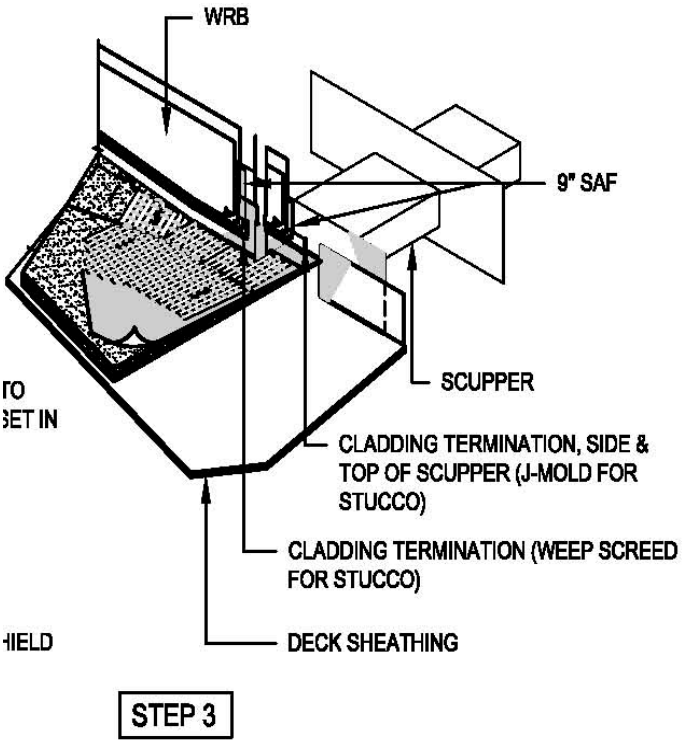
Figure 15

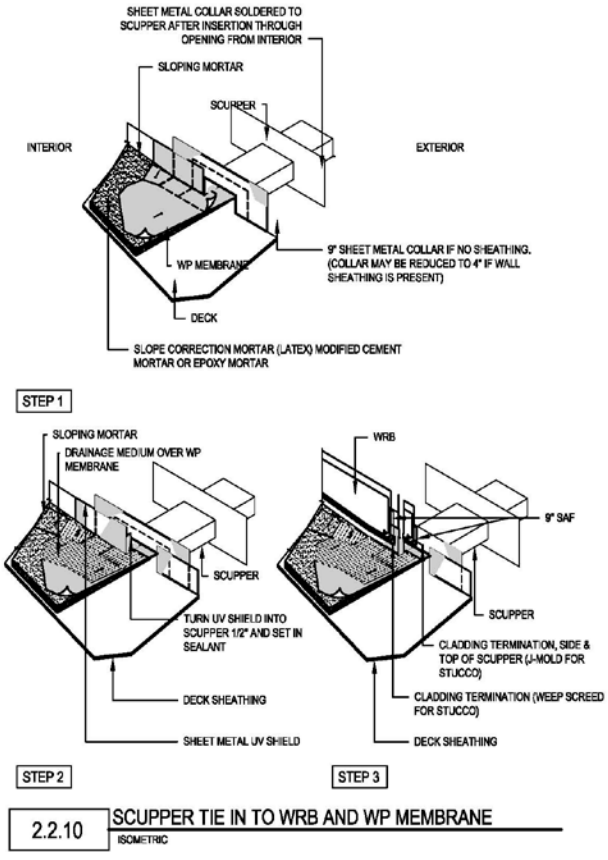
Scupper Installation Challenges

- Insure scuppers are at lowest point, are level or (better) slope outward and do not impede water flow
- Integrate properly with adjacent finishes
- If discharging into conductor head, flow line must be above water level in stopped up downspout

Left: Lower flange of scupper was lapped incorrectly with WRB

Below: Scuppers require clear detailing. Showing installation steps can help avoid misunderstandings. Must integrate with interior and exterior finishes, wall base flashing at deck and waterproof membrane





Wall Base

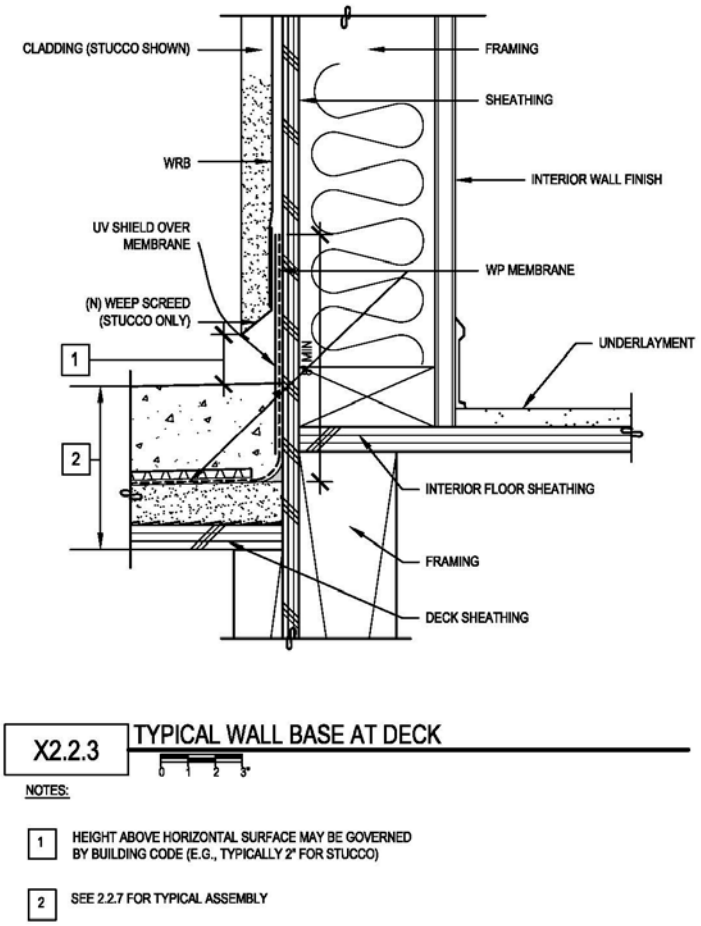


Figure 16

Typical wall Base

- Solid backing
- Separation between deck surface and cladding (CBC)
- UV Shield
- Membrane height minimum 8” above surface

Figure 17

Sheet metal “L” flashing applied over sloping mortar provides solid backing and corner reinforcement required by membrane manufacturer

Doors

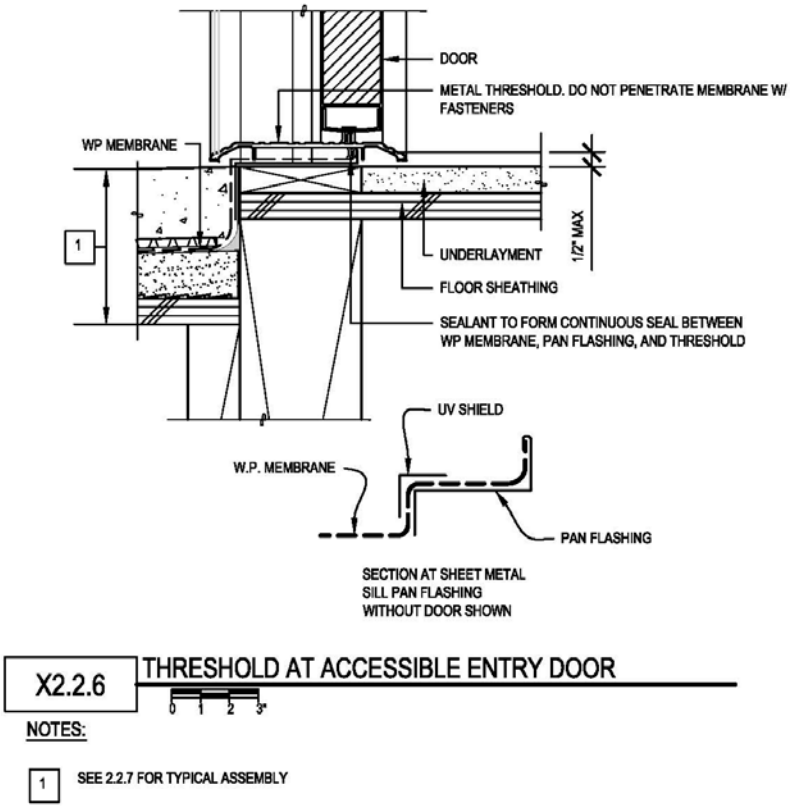


Figure 18
Door Challenges

- Door threshold should be higher than secondary drain (6' at 2% slope and ½: threshold). Difficult to achieve on small decks.
- Accessible threshold should always be protected by overhang or canopy to shield from wind blown rain.
- Membrane on top of door pan.
- Door pan sealed to threshold.

Figure 19
Door Pan

- Install door pan prior to waterproofing, door frame and door threshold.
- Make sure back leg of pan is high enough to resist wind-blown rain or is sealed to threshold assembly

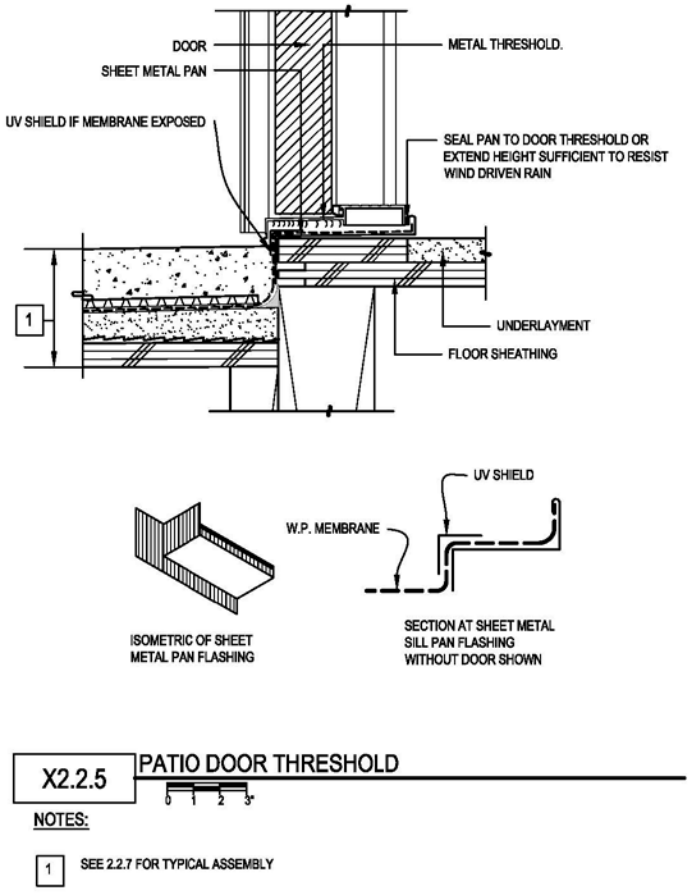


Figure 20

Patio Door Threshold

- Typically not accessible
- Membrane on top of pan
- Doors typically rated for water penetration resistance.
- Proprietary doors typically not accessible
- Elevation difference may exceed 1/2”.
- Seal pan to back of threshold or raised back leg

Penetration Flashings

Figure 21
Left, pipe has not been cleaned. Above, flashing does not extend high enough

Moisture in Substrate

Figure 22

A simple plastic sheet test on concrete substrates shows condensation, indicating conditions too moist for membrane installation.

- Consult manufacturer to obtain maximum moisture conditions of substrate and type of test required
- Test substrate (in this case, mortar) to determine moisture conditions

Figure 23

Adhesion failures can result from weak or wet substrates

Drainage Course

A typical drainage course is about 3/8 inch thick. An example would be *Miradrain 9000* or W.R. Grace *Hydroduct 660*. National Shelter Products, Inc. *Pro Cover* can be used at edges adjacent where 1/8 inch thickness is required.

Figure 24

Typical drainage course

Wearing Surface

A thin concrete wearing surface should be minimum 3,000 psi compressive strength concrete with synthetic fiber and a water cement ratio of 0.45 maximum to reduce shrinkage cracking. Minimum thickness is 1 ½ inch, and control joints could be as close as 2 to 4 feet on center to avoid random cracking.

Figure 25

Unit pavers over gravel is a popular substitute for concrete. Water drains through cracks. Surface may be flat.

For concrete wearing surfaces:

- Use control joints to direct shrinkage cracking
- Joints may be sealed or not.
- Use chopped fiber in mix for strength
- Texture for pedestrian safety

Expansion Joints

Expansion Joints

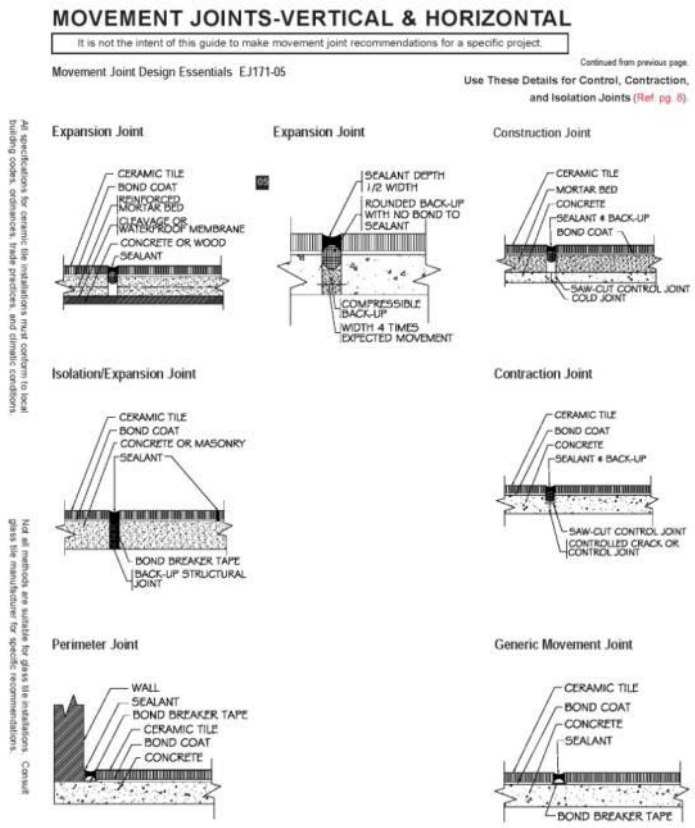


Figure 26

Ceramic tile expands post-installation as it absorbs moisture

Flood Test

Figure 27

After completion of each deck, flood test in accordance with ASTM D 5957

Warranties

Typically, manufacturers of membranes used for plaza deck waterproofing provide only material warranties. In case of a failure, they will provide only material required to repair it. That can be only a fraction of the actual cost. This is unlike roofing manufacturers, who typically offer 15 or 20-year material and labor warranties.

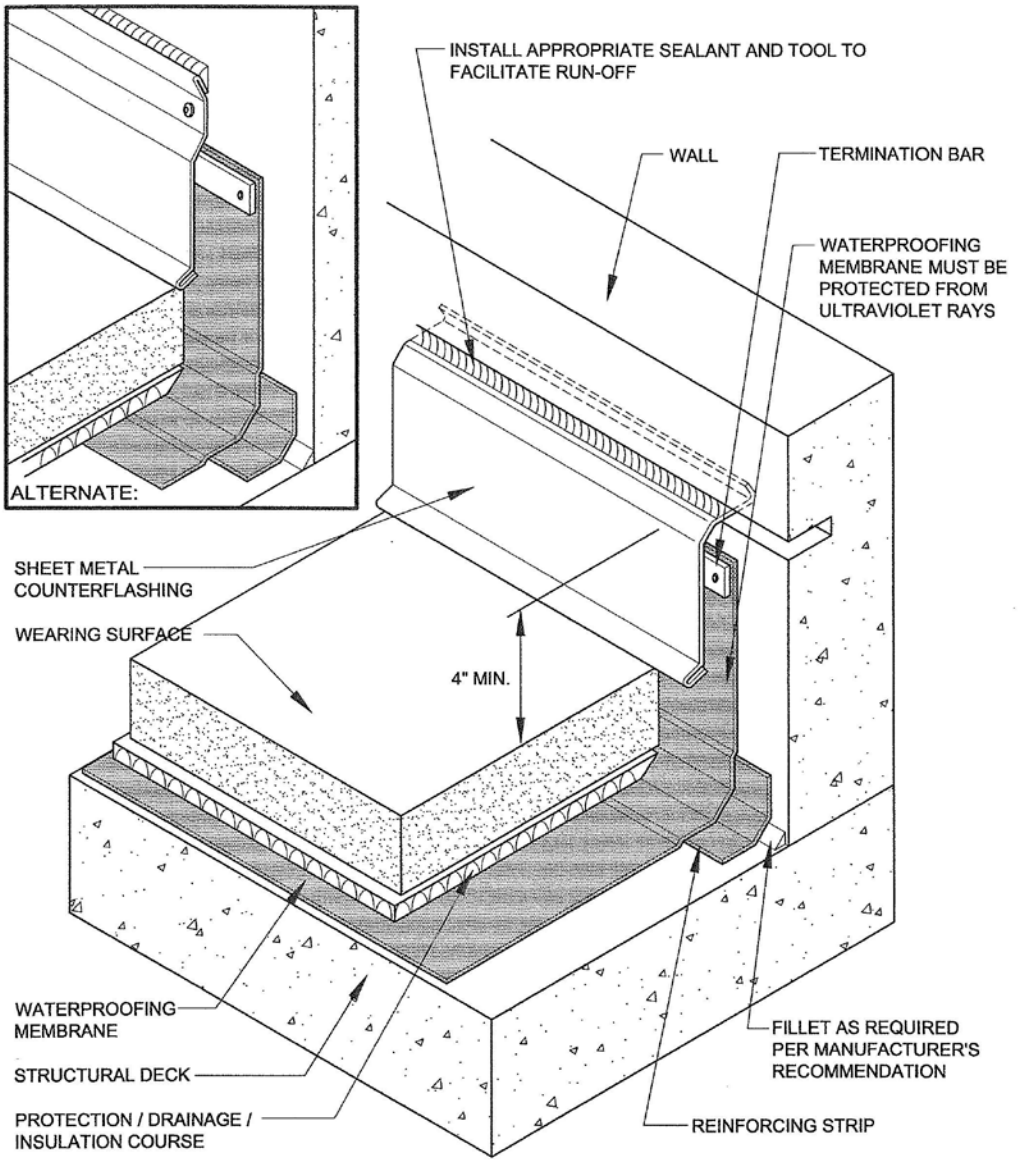
The warranty required from the general contractor and manufacturer can be written to cover anything that can be negotiated, including extent of coverage and time period. It will be strongest if written to include both the general contractor and the waterproofing subcontractor and should include the entire system, including integrated flashings, drains, penetrations, etc. the warranty be good only as long as the entities remain in business and have the capacity to honor it.

There is a 5-year membrane warranty from W.R. Grace on the *Bituthane* membrane that expires September 22, 2011 (Substantial Completion was September 22, 2006). There is also a 5-year manufacturer's warranty for the *P-Tuff* system on Building 131 that may still be in effect. The installer's warranty was for two years and has expired.

RECOMMENDATIONS

1. Provide larger scale plans of each typical deck type, clearly indicating relative elevations, crickets, inside and outside access doors, at corners, at edges, drains and scuppers. Show typical detail cuts at doors, wall bases, edges, scuppers, drains and edge terminations at walls.
2. Details should be full size to clearly show relationships of all components.
3. Provide draft specifications for all components of each deck type.
4. Incorporate a drainage course/medium into all deck assemblies.
5. Turn membranes up vertical surfaces at least 4 inches above the surface of the concrete wearing surface. Cover with a sheet metal UV shield where otherwise exposed.
6. Consider a removable expansion joint filler at the deck perimeter that can be sealed after the concrete has cured to reduce water penetration to the membrane level. Similarly, consider removable fillers at control joints (“zip-strips”) that can be removed and sealed.

OTHER NRCA DETAILS



NOTES:

1. MEMBRANE TERMINATION MAY NEED TO EXCEED 4" ABOVE TOP OF WEARING SLAB UNDER CERTAIN CLIMATIC CONDITIONS (E.G., SNOW).
2. SEE INTRODUCTION TO THE WATERPROOFING CONSTRUCTION DETAILS FOR ADDITIONAL INFORMATION.

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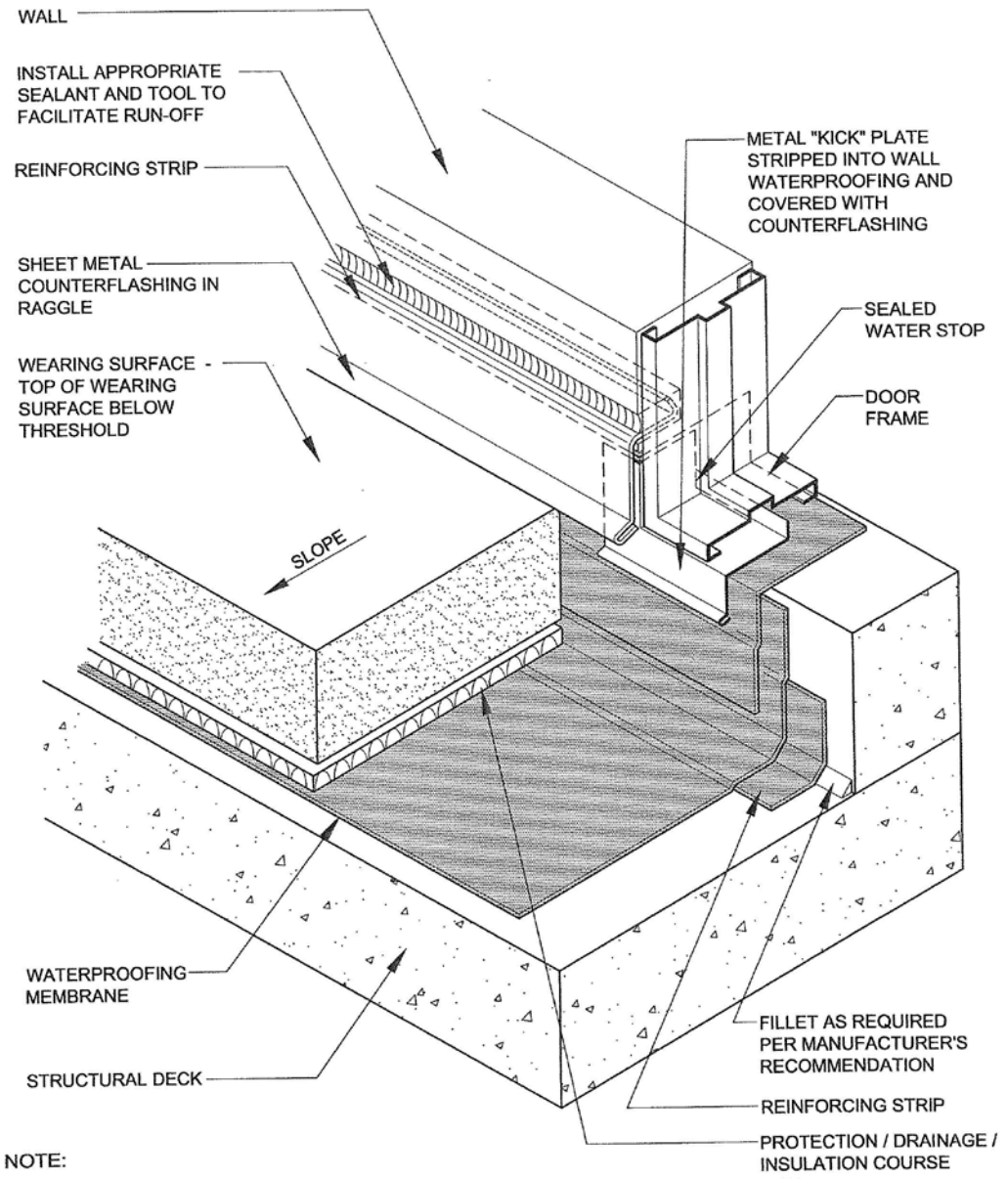
PLAZA DECK-TO-WALL TERMINATION ABOVE WEARING SURFACE

2005 *NOT DRAWN TO SCALE* WP-27



NOTE:

1. SEE INTRODUCTION TO THE WATERPROOFING CONSTRUCTION DETAILS FOR ADDITIONAL INFORMATION.

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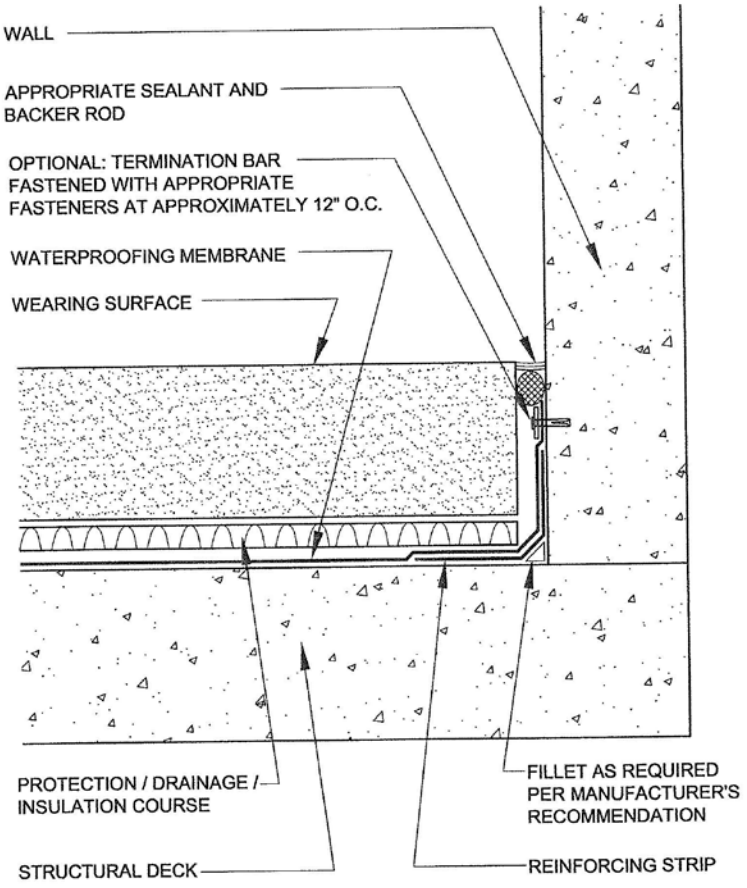
PLAZA DOOR THRESHOLD

2005 *NOT DRAWN TO SCALE* WP-29



NOTES:

1. PENETRATIONS TO BE SPACED 12" MIN. APART AND 12" MIN. FROM WALLS AND CURBS.
2. THIS DETAIL IS ONLY USED WHERE IT IS NOT POSSIBLE OR PRACTICAL TO TERMINATE THE WATERPROOFING MEMBRANE ABOVE THE FINISHED WEARING SURFACE.
3. SEE INTRODUCTION TO THE WATERPROOFING CONSTRUCTION DETAILS FOR ADDITIONAL INFORMATION.

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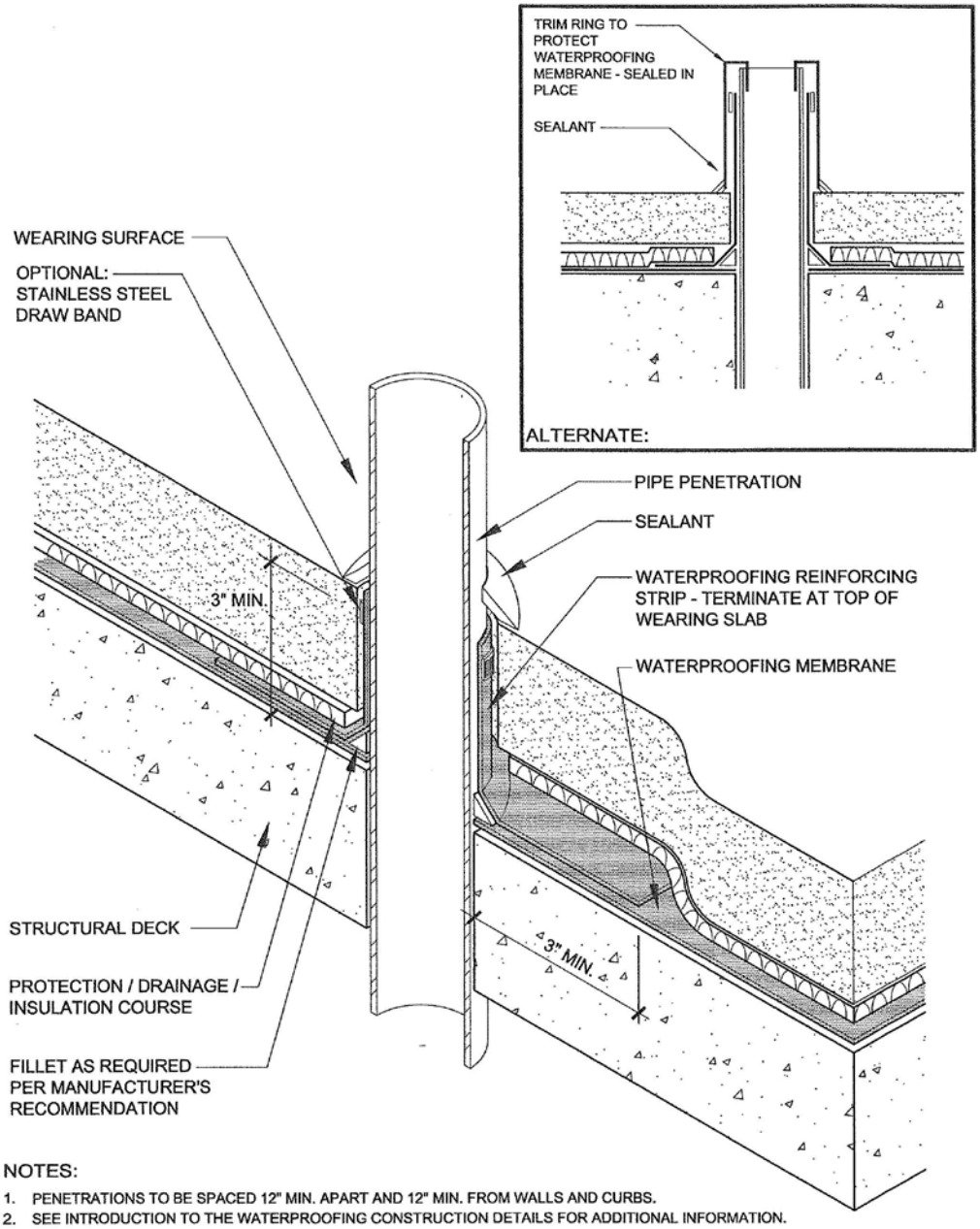
PLAZA DECK-TO-WALL TERMINATION AT WEARING SURFACE

2005 *NOT DRAWN TO SCALE* WP-28



NOTES:

1. PENETRATIONS TO BE SPACED 12" MIN. APART AND 12" MIN. FROM WALLS AND CURBS.
2. SEE INTRODUCTION TO THE WATERPROOFING CONSTRUCTION DETAILS FOR ADDITIONAL INFORMATION.

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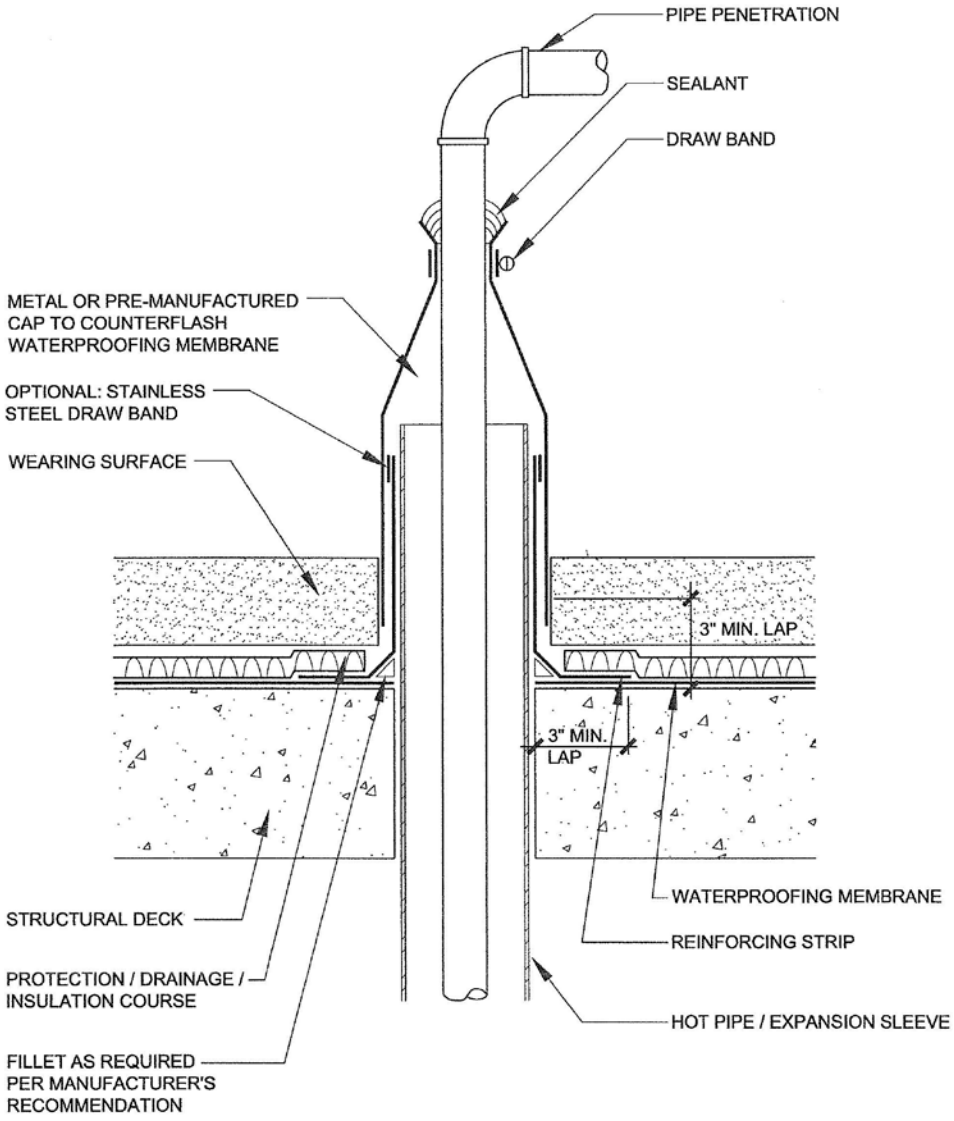
PIPE PENETRATION THROUGH PLAZA DECK

2005 *NOT DRAWN TO SCALE* WP-25



NOTES:

1. PENETRATIONS TO BE SPACED 12" MIN. APART AND 12" MIN. FROM WALLS AND CURBS.
2. SEE INTRODUCTION TO THE WATERPROOFING CONSTRUCTION DETAILS FOR ADDITIONAL INFORMATION.

NATIONAL ROOFING CONTRACTORS ASSOCIATION

HOT PIPE / EXPANSION SLEEVE PENETRATION THROUGH PLAZA DECK

2005 *NOT DRAWN TO SCALE* WP-24