

The Versatility of Protected Membrane Roof Assemblies

Multipurpose PMRA Solutions Are Green or Blue, Walkable or Occupiable, Reflective, Farmable or Solar Friendly



Figure 1 — The Dickies Arena in Fort Worth, Texas, is used for rodeo events. Partially encircling the arena, the Plaza Deck is a PMRA that is topped with walkways and a vegetative roof. Encompassing 9290 m² (100,000 sf), it serves as a practice area where handlers can warm up with their animals prior to rodeo events. Photo courtesy of Trail Drive Management Corp and Owens-Corning.

Aside from their extended service life compared to traditional low-slope commercial roofing systems, Protected Membrane Roof Assemblies offer many attractive design possibilities and installation efficiencies. Once the waterproofing membrane is installed, the building is sealed and interior work can begin immediately. The roof assemblies can be tailored to the design requirements of the locality. See Figure 1.

Some examples of roof assembly designs that are tailored to the environment are as follows:

1. Urban heat island mitigation — If the environment around the building behaves as an urban heat island, then the roof assembly can be designed to mitigate this effect. The urban heat island effect can be countered with a vegetative or landscaped roof or with the use of reflective materials for the top layers of the roof assembly.
2. Storm water retention — If water runoff from sudden downpours is a problem in the building environment then a blue roof design may be desirable. The roof itself can serve as a water detention container.
3. Water conservation — A hybrid “green & blue” stormwater management system allows water to be captured by the roof and reused as non-potable “grey water” for various suitable building needs, such as flushing toilets and watering lawns. This roof design reduces the demand from the water utility by repurposing water usage in areas where water conservation is important.
4. Occupiable roofs — There are countless designs for occupiable roofs with innovation abounding. Architects are only limited by their imagination. Occupiable roofs can be used for anything from rooftop dining and social gatherings to urban farming and recreational activities. High compressive strength extruded polystyrene (XPS) insulation competently supports occupiable roofs without compromising the performance of the roof assembly.
5. Solar power generation — Photovoltaic (PV) panel assemblies are readily installed on top of buildings with PMRAs. The structural components above the waterproofing membrane provide a foundation for the framework that supports the solar assembly. Penetrations of the membrane and deck can be avoided using a PMRA as the firm foundation for PV panels.

PMRAs require competent engineering to accommodate the dead and live loads on the insulation. Specifiers must consider the buoyancy of the insulation. (XPS insulation floats quite well in water.)

Ballast may consist of concrete pavers, aggregate, or even growth media in the case of a vegetative roof. Depending on the ballast, a fabric or other components may be installed above insulation and below the ballast. Specially designed layers also may be needed between the insulation and the membrane to provide separation for drainage as well as specialized protection (such as root barriers on vegetative roofs).

Nonetheless, a properly designed PMRA is a versatile roof, offering many advantages to a building owner. PMRA designs are continually being improved upon and are growing in popularity.

The Role of XPS in PMRA

The simplest PMRA consists of: (a) a waterproofing membrane installed on a concrete deck or other approved substrate, (b) XPS insulation boards placed on

top of the membrane, and (c) ballast loaded on top of the XPS insulation boards. See Figure 2.

The insulation in roof assemblies provides long-term energy efficiency and resists applied structural loading and moisture absorption. A properly specified roof assembly withstands compressive forces from dead loads and potential live loads and complies with fire classification requirements for the roof covering and the roof assembly. In addition to these structural requirements, the insulation must deliver thermal performance even while being exposed to moisture.

Although a variety of insulation materials could meet performance requirements when installed beneath the waterproofing membrane, XPS is uniquely qualified for PMRA applications because it delivers long-term thermal performance even when exposed to moisture. Nonetheless, proper roof drainage design will help mitigate unnecessary ponding and minimize permanent water immersion of insulation on roofs. For more examples of versatility of PMRAs and the use of XPS in these applications, please see the other Technical Insights in this series.



Figure 2 — A basic PMRA consists of a waterproofing membrane, XPS insulation, a fabric covering and aggregate for ballast. This PMRA is for a federal building in Winchester, Virginia. The distributor was Carlisle Coatings & Waterproofing. The installer was Kalkreuth Roofing & Sheet Metal. Photo Courtesy of Kingspan.