



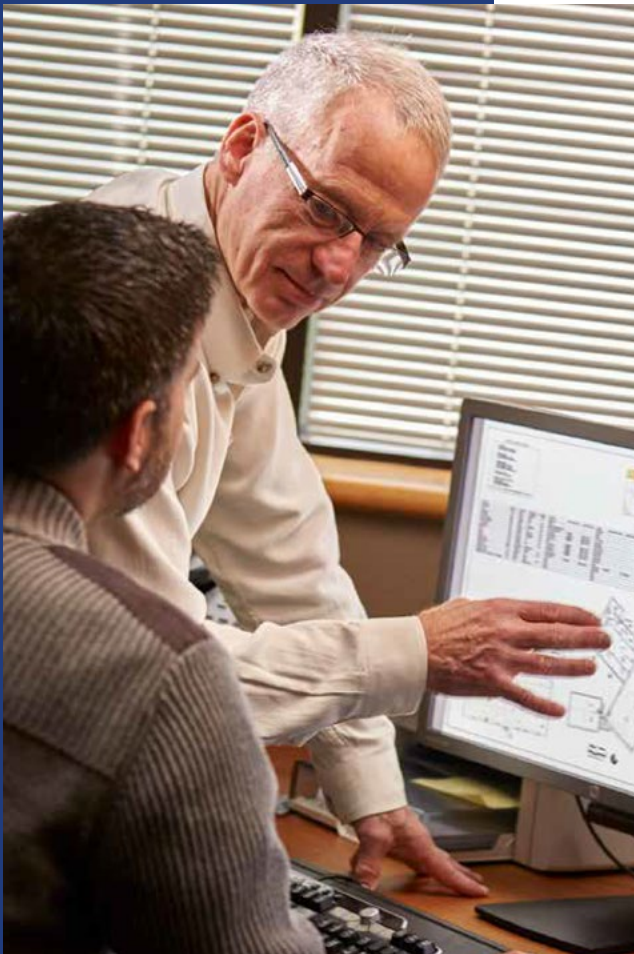
ROOF AND PAVEMENT CONSULTANTS

MAKING THE RIGHT CHOICE

ROOF SYSTEM SELECTION GUIDE

Benchmark-inc.com

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INTRODUCTION

For many roofs, there are often several roof system options that could provide long lasting service.

Before selecting a particular membrane or roof system, the project should be evaluated to determine what specific criteria or unique conditions apply to a particular roof. This evaluation should include a review of building code requirements, energy code compliance, fire resistance, hail resistance, wind uplift resistance, structural considerations, drainage, insurance carrier requirements (FM Global or Global Risk Consultants), aesthetics, rooftop equipment (mechanical, electrical, solar, etc.), roof access and maintenance, owner specific requirements, budget, and many other factors. Understanding the criteria and factors that will cause the roof system to deteriorate will allow the roof designer to weigh pros and cons of various roof membranes and systems to determine which selection is most appropriate, most “durable,” and the “best” option.

Some characteristics used to compare attributes of different roof membranes and systems are discussed throughout this guide. The characteristics can be weighted or prioritized depending on specific project criteria.



RESISTANCE TO PONDING

The ability of a roof to resist deterioration due to ponding water is a factor for all roof systems.

With few exceptions, roofs are required to be designed with positive slope to allow for drainage. A roof design should also typically include tapered crickets and saddles to promote drainage and move water toward drainage devices. Despite implementation of positive slope, crickets, and drainage devices in the design, there are often areas that pond water on a roof. Ponding water can be defined as standing water that does not drain or evaporate within 48 hours. Many manufacturer warranties specifically exclude damages caused by long-term ponding water (>48-hours).

Bodies of standing water magnify effects of the sun and ultraviolet light on a roof system. Areas of longterm ponding will often experience accelerated aging compared to dry areas of the roof. Likewise, areas of ponding may also freeze and thaw during colder weather, creating stress on the laps and seams. As water flows into the ponds, debris also accumulates in these localized areas. If the roof is subject to chemical exposure, collection of debris in the ponding areas can lead to a higher concentration of chemicals and further accelerate aging of the roof system.

Most roof systems can withstand typical and expected effects of limited short-term ponding without damage or impacting the manufacturer's warranty. However, it's worth pointing out that single-ply and liquid applied membranes demonstrate superior performance compared to many other membranes under conditions of extended standing water exposure.



SLIP RESISTANCE

All roof systems require periodic maintenance to achieve the intended service life.

Consideration should be made for anticipated work that must be accomplished on the roof, not only for roof maintenance, but also other building envelope, mechanical, and electrical systems. Many systems are extremely slippery when wet or icy, making access during rainy or cold weather impractical and dangerous. Metal roofs and white colored roof membranes can also conceal icy conditions, making it difficult to determine the level of risk. Modified bitumen membranes and built-up roofs offer more slip resistance than metal and single-ply roof systems. Walk pad material can be installed on single-ply roofs to increase slip resistance, but even these treaded path ways can become slippery when wet.



OIL (CHEMICALS/FOGS [Fats, Oils and Grease]) RESISTANCE

Commercial roofs are often subject to chemical exposure from air handling equipment, production exhaust, process debris, and other sources.

Chemicals can also be carried onto the roof from other nearby equipment, facilities or vehicles (planes, trucks, ect.). Chemical exposure can lead to accelerated deterioration of the roof system - loss of adhesion, breakdown of the reinforcement, rust, or even aggressive biological growth. Some chemical sources are easy to identify, such as jet fuel, marine salt, mechanical equipment lubricants, cooking oils, while others are more difficult. If chemical exposure is a known factor for the roof, the roof membrane or system should be selected to provide the most resistance to anticipated exposure. In some cases, this could involve special treatment around mechanical equipment or source areas. In other cases, chemical exposure may become the primary criteria for selection of the membrane or system.

Depending on anticipated conditions, PVC, KEE, PMMA, and metal roof systems provide the highest level of resistance to chemical degradation. Other membranes may be a consideration if special protection can be provided for the roof system. The system should be reviewed with select roof system manufacturers during the planning and design phase.



REFLECTIVITY

With the increase in energy code requirements and environmental consciousness, the industry has moved toward promoting roof systems that provide greater reflectivity than traditional black or gray builtup roofs in southern climate zones. A reflective roof surface provides energy savings in sunny climates by reducing heat gain by the roof system. In urban settings, this reduction in heat load

helps reduce the overall heat island effect caused by cities that are dense with pavement and dark roofed buildings. The Cool Roof Rating Council (CRRC) developed a testing and rating protocol to evaluate different roof systems to determine both their initial and aged solar reflectance. In some areas of the country, roofs are required by building code to provide a certain level of solar reflectance.



In designing a reflective “cool” roof system, the designer must consider vapor drive and potential for condensation within the roof assembly. Although, white single-ply roof membranes are commonly considered reflective membranes, spray polyurethane foam (SPF), metal roofs, and some modified bitumen roofs with reflective granules also meet the requirements for solar reflectance.



SERVICE LIFE (YEARS)

Low slope roof systems can provide anywhere from 10 years to more than 30 years of service, depending on system components, installation, and maintenance.

The expected service life of the roof system should be evaluated during the planning stage and the system selected to match the owner's expectation and capital planning. Accessories and other components should be selected to meet or exceed anticipated service life of the roof system so one component does not cause early failure of the entire system. Typical expected service life spans noted below assume that preventive maintenance is completed as recommended by the manufacturer.

Typical Expected Service Life:

- **Single-ply Membranes** – 15 to 20 years
- **PVC, KEE, and EPDM Membranes** – 20 to 25+ years
- **Modified Bitumen Membranes** – 20 to 25+ years
- **Standing Seam Metal Roofs** – 30+ years
- **Built-up Roofs (BUR)** – 20+ years



EASE OF REPAIRS AND PREVENTATIVE MAINTENANCE

All roof systems require some degree of maintenance to achieve the expected service life.

If a roof system is easy to access and repair and maintain, it is more likely to reach or exceed its expected service life. For roofs with limited or difficult access, a robust membrane or system should be selected that can withstand the elements and require less maintenance.

Understanding the site and owner constraints for roof access is a primary factor in evaluating ease of repairs and maintenance. Many of these systems require specialized tools and training that not all contractors possess. Built-up, ballasted, and concealed roof systems are the most difficult and costly to repair, partially due to the removal of the ballast or other overburden necessary before repairs can be accomplished.



EXPANSION AND CONTRACTION

Building structural systems are designed to accommodate a certain amount of movement.

Whether due to temperature causing thermal expansion and contraction, wind, or seismic events, the stress caused by this movement must be taken into consideration over the life of the building. Structural movement may also change slightly as the building ages and circumstances change. The roof system must be selected to perform with the anticipated movement of the building. Incorporating different elements in the roof assembly design can mitigate some of the stress, such as incorporating a rigid thermal barrier over a light gauge steel deck to reduce the degree of movement the polyester reinforced membrane must accommodate. Without

proper consideration, building movement in excess of the roof system capability will lead to significant stress of the system and components, and potentially catastrophic failure of the roof system.

Roof membranes are tested by the manufacturer to determine their tolerance for typical stresses such as temperature variations, thermal expansion and contraction, tensile strength, elongation, deflection, and puncture resistance. Many single-ply membranes are extremely flexible and can accommodate a wide range of stress; however, even the most flexible membranes have limitations.



The design must incorporate a roof membrane or system that has a proven record of performance with the anticipated stress, along with transitions and flashings to allow for movement without damage to the building or roofing systems.



EASE OF INSTALLATION

The roofing workforce is ever evolving and often short-staffed.

Built-up and modified bitumen roof systems (most common installations fifty years ago) have been steadily overshadowed by single-ply membrane roof systems. With the high quality of goods produced in factories, wider rolls, and easier installation techniques, single-ply membranes are the easiest to install and have the largest pool of local skilled labor. Easier installation and a readily available work force can lead to lower project costs, faster project schedules, and more work accomplished during the roofing season.

Site constraints should also be considered when considering the ease of installation.

An apparent straight-forward installation can become challenging if the materials cannot be loaded onto the roof or if a single component of the system cannot be used on the project (i.e., hot asphalt or solvent based adhesive).



WIND RESISTANCE

The roof is part of a building's structural system and is one of the primary wind force resisting components.

Building code requirements dictate minimum wind resistance that must be met for the specific project location and conditions. If the project is covered by Factory Mutual Global insurance, the insurance carrier also outlines specific wind resistance requirements for roofing systems. Roofing manufacturers provide data for tested roof assemblies documenting performance capabilities of their membranes/systems and components. The assemblies are tested and rated to withstand different wind pressures. By selecting a tested assembly that meets or exceeds the code and insurance requirements for the project, the owner can be confident that the roof system will stay in place through expected weather events.

Most membranes provide excellent wind resistance for typical wind pressures experienced throughout North America. Membrane wind resistance can be increased with different fastener patterns or by mechanically fastening components to the building structure. Available membrane options may be narrowed due to increased wind resistance requirements in coastal regions, hurricane zones, or unique site conditions.



EASE OF DETAILING

Roof systems must incorporate many types of penetration flashings and terminations to create a complete waterproofing system.

The complexity of penetrations and flashing solutions can be a deciding factor in selection of the roof system. Ideally, flashings incorporate components that will provide equal service to the system. Sealant dependent flashing should be avoided where possible, as sealant becomes a maintenance item that requires replacement several times throughout the life of the roof.

TPO, PVC, KEE, liquid applied, and single-ply membranes provide the most flexibility and options for detailing penetrations and flashings. Many single-ply and modified bitumen manufacturers offer liquid flashing options that decrease the amount of sealant dependent flashings.



PUNCTURE RESISTANCE (DURING AND POST CONSTRUCTION)

Roof system punctures occur most often due to foot traffic, trade work, maintenance, and wind-borne debris.

Punctures are often small and may go unnoticed and, without repair, can lead to water intrusion and saturated insulation. All roof systems are vulnerable to punctures during construction and installation of the roof. Ballasted and protected roof membranes, metal roof systems, and multi-ply modified bitumen roof systems offer the best puncture resistance post construction.

In planning for a roof project, increased puncture resistance should be considered for projects with anticipated heavy foot traffic or extremely low leak tolerance in the space below.



RECYCLABLE

Sustainable roof design and recyclable components should be considered in project planning for all projects, not just LEED or landfill zero projects.

Wherever possible, roofing systems should be designed to maximize service life of components and extend wherever possible to reduce waste. During a roof replacement project, recycling as much of the debris as possible minimizes burden on the environment and reduces the project's carbon footprint.

Metal components, packaging, and some construction debris is recyclable and can be diverted

from the landfill. Single-ply and metal roofing panels are often recyclable with minimal cost to the owner. Some insulation materials may be re-used in the new roofing system or removed and recycled into other construction industry products. Global stewardship should be part of roof system planning and construction as we share the earth's valuable and limited resources.



LOW ODOR

Roof membranes, adhesives, and sealants include chemicals that create odors during installation.

Even low volatile organic compounds (VOC) products create odors that can be unpleasant. For some industries and project locations, odors can taint products, create health hazards that impact workers, or even cause facility shutdowns. Odor impacts can sometimes be mitigated through careful planning and coordination with facilities management. Strategies for odor mitigation may include filtering air intakes, re-routing air intake, or temporarily relocating occupants.

Metal roof, mechanically fastened, induction welded and SPF roof systems typically produce the lowest odor during installation. Understanding specific site and owner expectations regarding odor tolerance is critical in planning for a roof project and selecting a roof membrane.



HAIL RESISTANCE

Each year hail events cause damage to roofing systems across North America.

Many manufacturers have developed membranes and systems to provide resistance to various levels of hail impact. Some regional building codes and FM Global require hail rated assemblies to be applied to new and replacement roofs.

Depending on the system components, most single ply, built-up, and modified bitumen membranes are capable of resisting damage from moderate to very severe hail impacts. Severe hail rated assemblies will require incorporation of a rigid coverboard beneath the roof membrane to prevent damage at impact sites.

COLOR OPTIONS AVAILABLE

For some projects, aesthetics of the roof become a primary factor in selection of a roof system.

Colored options are often used to maintain a certain look or historic element, mimic a previous roofing system, or to spell out a team name or logo on a stadium. Colors may also be considered when the roof is in direct line of sight to office space or other occupied areas. Colored system options are available in PVC, KEE, SPF, liquid applied, and metal roof panels. Modified bitumen membranes also offer a limited variety of colored quartz and aggregate surfacing options.



SUMMARY

There are numerous considerations that must be taken when selecting a roof system for your next project. Depending on your circumstance, any one of these considerations may be of highest importance to you or have no impact to your project. Every project needs to be carefully examined to determine which roof system will perform best for your situation.

For professional, unbiased recommendations and advice, contact the experts at Benchmark. Over 30 years of specialized roof consulting experience, combined with our dedication and responsiveness, have made us one of the nation's leading roof management and consulting firms.

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