USG PRESENTS

LOW-SLOPE COMMERCIAL ROOFING

ROOF COVER BOARDS PROVIDE OUTSTANDING PERFORMANCE

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Cover boards have been a standard component within roof assemblies for more than 20 years, and were developed to enhance the performance of virtually every type of roof system. The use of this relatively thin component, which is typically placed between the roof insulation and the roof membrane, enhances fire resistance, increases wind uplift performance and provides greatly improved resistance to hail and foot traffic.

The evolution of the cover board began with the inception of fluted steel decks as a roofing substrate. Early roof deck types – including wood, concrete and gypsum – are flat, providing a bonding or nailing substrate for the first layer of roofing. The base sheet, as it is called, can be nailed or adhered to the flat surface to form the first layer of the roof assembly. By contrast, a profiled steel deck is formed in a variety of configurations, with varying modules of voids or valleys, called flutes. Deck modules[1] range from 2-1/2 to 6 inches across, providing a regular pattern for attachment.

In order to attach a roof assembly on the profiled deck, some type of flat board is needed to create a bonding surface. Years ago, such boards were formed from cork. The cork boards were bonded to the top flanges of the steel deck with asphalt, over which the roof assembly could be applied. The cork provided a solid walking surface, a good bonding substrate, some thermal insulation value and could be cut to slope for drainage purposes.

Later, other cover board materials entered the market. These materials were lighter and more fire resistant, and included expanded perlite, wood fiber board, exterior-grade gypsum and fiberglass insulation.

(Continued on page 37)

Courtesy of USG Corporation.

With the introduction of foamed plastic insulation, cover boards took on a dual role – providing a fire barrier between the steel deck and the plastic insulation and serving as a suitable bonding layer above the insulation. Foamed insulations, such as urethane, extruded polystyrene and polyisocyanurate, fast became the insulation of choice due to their light weight, fairly good dimensional stability and ease of forming into a tapered material. Both foamed insulation and cover board materials were used in combination to form a slope.

Events of the 1980s

Two significant events occurred in the 1980s that further advanced the use of cover boards.

1. The determination that application of hot asphalt or coal tar directly over foamed insulation could result in blistering[2].
2. A change to Factory Mutual (recently renamed FM Global) Standard 4470 requiring that all insulation be mechanically attached to the steel deck substrate prior to the application of an FM-approved roof assembly.

Significantly, the use of mechanical fasteners and stress plates creates thermal shorts within the insulation. In colder climates, interior condensation forms when the warmer air around the metal fasteners is cooled by the colder exterior temperatures, resulting in moisture formation on the fasteners. The condensed moisture then drips into the interior and rusts the interior components of the screw.

This problem was solved in a variety of creative ways, such as recessing the screws into the stress plate hub, the use of plastic fasteners and the application of a cover board over the foamed insulation to act as a thermal break between the cold exterior and the warm interior.

As a result of these developments, cover boards became a standard component in commercial roof assemblies. In addition, competing board manufacturers began to promote the use of particular cover board types for their abilities to enhance the performance of specific roof systems.

Comprehensive rounds of wind uplift and fire testing have confirmed the claims of better performance characteristics with the use of some cover boards. Some new cover board materials, including oriented strand board (OSB) and water-resistant gypsum board, entered the market and further broadened the options of interface materials. Materials less than 1/2-inch thick also became available, some of which offer performance characteristics similar to boards with twice their thickness. These options were particularly economical when adhered with hot asphalt or cold adhesive.

Recent Cover Board Developments

In the 1990s, FM Global expanded the uplift ratings of approved roofing systems to include enhanced ratings well above the 90 psf threshold typical before that time.

Furthermore, the protocol for testing these systems was changed from the conventional 5- by 9-foot test table to a much larger 12- by 24-foot table. The larger table minimizes the contribution of the perimeter frame to the tested assembly performance and makes passing at higher pressure levels more difficult. Hence, minor components within the roof assembly, such as mechanical fasteners and cover boards, came to play a key role in advancing the performance of roof assemblies.

Besides increased fastener densities to improve uplift performance, engineering of newer fasteners and the use of more types of cover boards created a wide variety of enhanced wind uplift systems available to the market.

The lessons of Hurricanes Hugo and Andrew that devastated the Carolina and South Florida coasts have led to more frequent specification of enhanced systems. In the case of South Florida, these enhanced systems became a requirement under the new South Florida Building Code.

Code changes have led to the current published inventory of enhanced high-wind uplift systems, which are supported by credible third-party testing. Cover boards have become a critical component in these assemblies, and quantifiable advantages of one cover board over another have been established. Cover board manufacturers invested significant money in testing to prove the threshold capabilities of their boards. Assemblies incorporating thinner boards, fewer fasteners and less adhesive were tested to maximize performance and minimize costs.

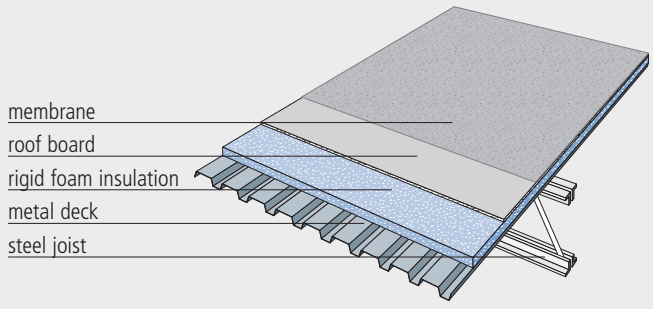
Increased use of cover boards over extended periods of time has revealed problems with some cover boards that are sensitive to moisture degradation. In some cases, minor leaks from the exterior and rising vapor from the interior would condense at the roof membrane (with a relatively low permeability) and wet the cover board materials. Rot, collapse and general deterioration of the cover board would follow, requiring the removal and replacement of the roof membrane, cover board and, in some cases, the underlying insulation.

Even some cover boards touted as water resistant experienced degradation. The water-resistant cover board materials were not necessarily waterproof, but were being used in hostile environments where the boards were destined to fail. In some cases, the water-resistant board was installed in designs where moisture would clearly be present, such as the reroofing of roofs with wet and even saturated insulation.

These experiences led to formulation changes in core materials and the development of surface coatings to limit moisture-related

Standard Cover Board Application

ROOF BOARD IS PLACED DIRECTLY BELOW THE ROOFING MEMBRANE, PROVIDING THE PRIMARY SUPPORT FOR THE MEMBRANE AND PROTECTING THE UNDERLYING INSULATION LAYER FROM DAMAGE DURING INSTALLATION AND FOR THE SERVICE LIFE OF THE ROOF.



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problems, reduce the quantities of adhesive required to apply membranes and enhance adhesion performance. The cost of cover boards increased as more features were added to improve performance levels.

As often happens in the evolution of a product, manufacturers offer enhancements or add-ons for improved performance. Competition eventually develops from products that combine the add-ons into the basic product, creating a single product that meets a variety of needs. These advancements reduce inventory for the distributor and minimize the potential of using the wrong product in the wrong application.

Besides wetting issues, some gypsum-based products were known to experience limited moisture release as a result of the application of hot asphalt, especially the Type IV asphalt used in SBS (styrene butadiene styrene) membrane applications.

The core of gypsum-based products is composed of a matrix that chemically binds water within the molecular structure of the gypsum. At elevated temperatures, the chemical process known as calcination releases the chemically bound moisture at the cover board surface. Sufficient water can cause blistering of the base membrane as it is applied directly to the cover board, especially if the base membrane is impermeable.

Newer fiber-reinforced, gypsum-based products have been developed to overcome this problem, and are now compatible with the application of Type IV asphalt, as with the installation of impermeable membrane systems directly over the cover board.

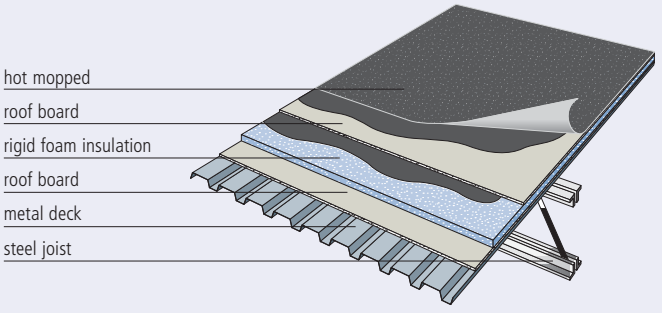
The use of a cover board has evolved from its initial function as a flat surface in a profiled metal deck to serving as an essential system component that enhances the capability of virtually every roof system in resisting wind, hail, fire and foot traffic.

Newer cover boards are being developed that will further extend their use, even in some more hostile environments. Thinner, denser boards have been created to replace older materials that required a greater thickness to provide similar or better performance levels.

Recent trends in cover boards include the creation of more water- and mold-resistant boards that provide excellent adhesion for fully bonded systems. Hot asphalt, solvent- and water-based adhesives all require a strong bond to the cover board surface. To minimize adhesive use, the surface must be dense enough to hold the adhesive out. Boards also must resist moderate levels of moisture without degradation, and surface bonding layers must not delaminate from the core (delamination reduces the bond strength). In addition, the cover board must provide maximum fire protection at virtually any insulation thickness and roof slope.

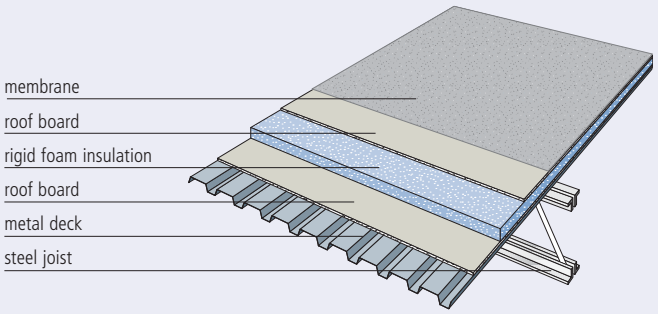
Roof Board Application - Hot Asphalt Substrate

ROOF BOARD CAN BE MECHANICALLY FASTENED, BONDED WITH MASTIC OR ADHESIVES OR HOT MOPPED TO FOAM INSULATION. ALL HOT-APPLIED ROOFING SYSTEMS CAN THEN BE MOPPED DIRECTLY ONTO THE ROOF BOARD WITHOUT CONCERN FOR BLISTERING OR DELAMINATION.



Roof Board Application - Thermal Barrier

ROOF BOARD PROVIDES A THERMAL BARRIER INSTALLED DIRECTLY TO THE METAL DECK FOR BOTH EXPANDED AND EXTRUDED POLYSTYRENE INSULATION.



More recent testing of roof assemblies for resistance to foot traffic and hail provides further evidence of the qualities cover boards can bring to high-quality roof assemblies. FM Global test protocols for hail resistance and ASTM (American Society for Testing and Materials) standards for impact and puncture resistance quantify the performance capabilities of these dense underlayments.

The Future

Cover boards will continue to play a vital role as a key component within the roof assembly. While some proposed roofing systems would eliminate the cover board, the result would compromise overall system performance levels.

The new generation of cover boards and enhancements to existing materials will make cover boards more critical, especially in more hostile environments. Similarly, fast-track construction creates numerous potentials for trapped water or residual moisture within substrate materials, including newly poured concrete and wet wood framing.

Residual moisture is a fact of construction that affects the installed, in-service materials. Consequently, cover boards become the "last stop" at the roof plane, holding residual moisture just below the roof membrane. Trapped moisture, in vapor form, passes very slowly through most roof membranes. Detail and material changes can be made to accelerate this moisture migration, but the cover board must be capable of performing during such prolonged periods of moisture without a significant loss of performance.

Furthermore, the presence of moisture must not result in the proliferation of mold within the roof assembly and the potential to cause further problems should the mold spores migrate to the building's interior. This issue is being monitored closely by building owners, tenants and insurers alike.

The requirements for greater wind uplift performance with use of low-VOC (volatile organic compounds) adhesives, the potential for reducing asphalt applications due to possible health risks and the reduction in use of torch installations to minimize the risk of fire will all require further advancements in cover board technology. Roof system manufacturers, in conjunction with fastener, adhesive, insulation and cover board manufacturers, must meet the demands for higher performance levels within a changing market.

Specifying Cover Boards

In specifying cover boards, it is important to understand that the cover board is part of a total system. When a fire or wind uplift resistance rating is required, it is the total system, or assembly, that carries the rating. Each part of the system must be a tested component within the assembly. In most cases, a wide variety of cover boards has been tested and approved with the desired roofing system.

(Continued on page 39)

Low Slope Commercial Roofing

(Continued from page 38)

Specifiers should carefully review the specific project requirements and choose a cover board that meets the project criteria. Wind, fire, traffic, hail and impact resistance should all be considered when choosing a board. The environment in which the board will be placed is also a critical factor.

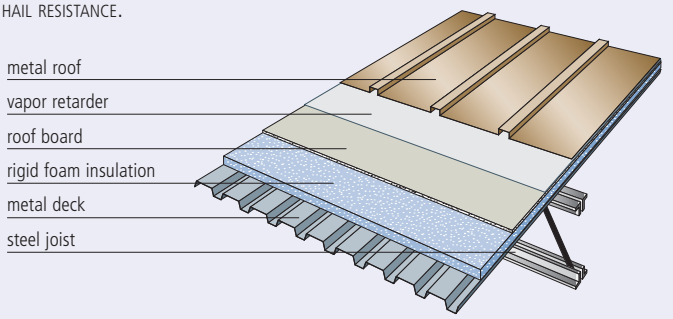
If some level of moisture can reasonably be anticipated, the design should include a means for fast moisture egress from the assembly, and the cover board should be capable of performing in this less-than-ideal environment. The wrong choice of cover board material could result in collapse and degradation, resulting in a failed roofing assembly.

Specifiers should also make certain that all components within the roof assembly are compatible with one another. Manufacturers of all the roof components should be contacted and directed to provide a letter stating that adjoining components are compatible and will remain compatible throughout the anticipated service life of the roof assembly.

Site substitutions are common as a result of availability, contractor preference or price. A substitution may result in the application of non-compatible materials or assemblies that do not provide the intended performance. Substitution may result in an assembly that does not carry the intended wind or fire rating. All substitutions should be reviewed carefully and given the same care and attention that were provided in the original choice(s).

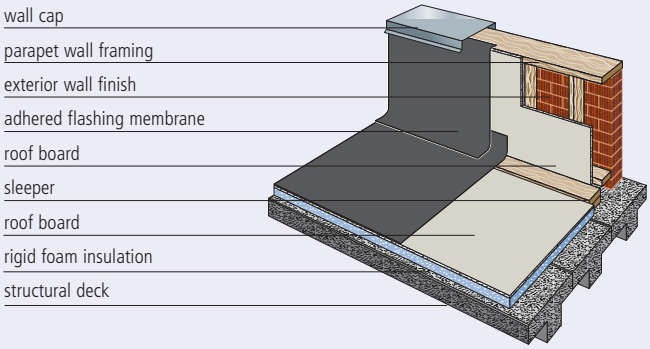
Roof Board Application - Metal or Tile Roof Thermal Barrier

ROOF BOARD PROVIDES A THERMAL BARRIER IN CONJUNCTION WITH A STANDING SEAM METAL OR TILE ROOFING SYSTEM. IT ALSO PROVIDES NOISE REDUCTION AND HAIL RESISTANCE.



Roof Board Application - Parapet Wall Substrate

ROOF BOARD IS FASTENED A MAXIMUM 89 INCHES ON CENTER TO WOOD OR METAL FRAMING ALONG THE PARAPET WALL FOR ROOFING MEMBRANE FLASHING SUPPORT.



The trend in high-performance cover boards has been the use of gypsum-based products that have been rendered water and mold resistant. Many of the products contain high levels of recycled materials, assisting in the procurement of LEED (Leadership in Energy and Environmental Design) credits. Calcination[3] issues have been overcome with some gypsum-based products, permitting application of membranes in Type IV asphalt with no blistering of the membrane.

Today's cover boards are available in thicknesses ranging from 1/4 to 3/4 inch. Boards are fabricated from various materials and have different properties, such as fire resistance, void bridging and wind uplift resistance. Product literature and system approvals from FM Global and Underwriters Laboratories should be reviewed carefully to identify the appropriate cover board for a project.

Cover boards are compatible with a wide variety of adhesives and hot asphalt, as well as mechanical fasteners. Again, manufacturers' literature and approvals should be reviewed carefully to determine the appropriate installation methods for specific projects. ■

[1] A module is the measurement from the center of the high rib to the center of the next high rib (or flute)

[2] National Roofing Contractors Association bulletins

[3] The release of chemically bound moisture within the gypsum crystal when heated

NEW COVER BOARD OFFERS EXCEPTIONAL BOND STRENGTH

Recently, a distinctive new roof cover board option for low-slope commercial roofing applications has become available. The product's advanced fiber-reinforced technology provides superior performance benefits compared to traditional fiberglass-faced gypsum roof boards, whose face layers can delaminate over time and generate callbacks.

The new roof board is installed over the roof insulation and under the membrane, supplying protection, separation and support for the membrane. Its uniform composition enhances the strength of the membrane system by ensuring a stronger, more consistent bond.

Easy to install and handle, the roof board provides outstanding wind uplift performance. It also offers first class protection from both moisture and mold.

Tests confirm that this innovative new roof board actually enhances bond strength, while providing excellent durability and versatility. Its unique gypsum fiber technology and uniform composition also make it much less likely to delaminate.

The new roof board offers numerous product and installation advantages – all of which can contribute to a roof's long-term performance. They include the following:

• **Superior Wind Uplift Performance** – Because of its uniform composition and smooth surface with no face layers to delaminate, the roof board enhances the bond strength of membrane systems.

• **Fire Performance** – The roof board provides excellent fire performance and demonstrates exceptional surface burning characteristics.

• **Moisture and Mold Resistance** – Its integral water-resistant core ensures excellent resistance to moisture and mold. In independent lab tests, the product scored a 10 (the highest possible rating for mold resistance) on the American Society for Testing and Materials' ASTM D3273-00 *Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.*

• **Versatility** – The new roof board can be used in single-ply, fluid-applied, built-up, spray foam and modified bitumen roofing – one product for all systems.

• **Sustainability** – Made from 95 percent recycled materials, the cover board emits no VOCs during the product's life cycle and has low embodied energy. Its high recycled content makes the product an environmentally friendly option in sustainable building construction.

• **LEED Applications** – The panels are an excellent option in LEED Green Building Rating System™ applications.

The roof board is available in both 4- by 4-foot and 4- by 8-foot panel sizes, with a choice of 1/4-, 3/8-, 1/2- and 5/8-inch thicknesses.

(Continued on page 40)

ROOF COVER BOARD INSTALLATION

Roof cover boards can be installed over the insulation and under the roofing membrane. Their primary function is to protect, separate and support the roof membrane.

Roof cover board products function as a fire- and water-resistant substrate in new or reroof applications. They may be used with single-ply, fluid applied, built-up, spray foam, modified bitumen and standing seam metal roofing systems. In addition to providing protection for the insulation, a roof cover board can dramatically enhance fire, wind, and mold and moisture resistance, as well as add compressive strength to the entire roofing system.

Roof cover board products are extremely versatile and can be used in a variety of applications. Their key benefits include the following:

Protection and Support
With the roof board placed directly below the roofing membrane, it provides the primary support for the membrane and underlying insulation layer. The roof board also protects the insulation.

Substrate for Vapor Retarders
Here, the roof board is fastened directly to the deck and the membrane may be loose laid; attached with cold mastics, hot asphalt or adhesives; or mechanically fastened, depending on the system requirements.

Hot Mop
The roof board can be mechanically fastened, bonded with mastic or adhesives or hot mopped to foam insulation. All hot-applied roofing systems can then be mopped directly onto the unprimed roof board.

Metal or Tile Roof Thermal Barrier
The roof board provides a thermal barrier in conjunction with a standing seam metal or tile roofing system. It also provides noise reduction and hail resistance.

Roof Recover Board
The roof board is placed over the existing membrane surface, where it functions as a separator and a support layer between the old roof and the new roofing membrane.

Thermal Barrier
When installed directly to a metal deck, the roof board provides a thermal barrier for both expanded and extruded polystyrene insulation.

Fire Barrier Underlayment
The roof board can be used as a barrier board underlayment below optional rigid foam insulation on a combustible deck to achieve a Class A, B or C fire-resistance rating.

USG

USG Corporation is a Fortune 500 company with subsidiaries that are market leaders in their key product groups: gypsum wallboard, joint compound and related gypsum products; cement board; gypsum fiber panels; ceiling panels and grid; and building products distribution.

United States Gypsum Company, a subsidiary of USG Corporation, has recently introduced SECUROCK™ Brand Roof Board. The company also manufactures SHEETROCK® Brand Gypsum Panels, the leading and best-known brand of drywall in the United States, along with a wide variety of joint treatment products. In addition, U.S. GYPSUM makes a variety of plaster and veneer plaster products, as well as DUROCK®, Brand Cement Board and FIBEROCK® Brand Gypsum Fiber Panels.

USG Interiors, Inc., another subsidiary of USG Corporation, is a leading manufacturer of acoustical ceiling panels, specialty ceilings and suspension systems.

For technical advise about roof cover boards, contact USG at 125 S. Franklin St., chicago, IL 60606-4678, call USG's Architectural Services Department at 800-USG-4YOU or visit the company's Web site at www.usg.com.

800-USG-4YOU
www.USG.com

TYPICAL COVER BOARD OPTIONS

There are a variety of different cover board material types available. These are some of the most popular cover board options and their specific benefits.

Fiber Board
One of the most widely used cover board materials, this board is often made from wood fiber or bagasi (sugar cane). Fiber board has a porous nature, good compressive and flexural strength, and an affinity for moisture, making it a popular choice under many membrane systems. However, fiber board is susceptible to moisture absorption, which leads to strength loss, decay or rot when it is exposed to moisture for extended periods of time.

Perlite Roof Board
This roof board is composed of expanded perlite ore, cellulose fibers, asphalt and starch binders. Traditionally, it has been coated on the top side surface with an emulsion to inhibit excessive absorption of the mopping asphalt. This roof board provides a dimensionally stable and thermally resistant surface for the application of hot-applied roofing membranes. It exhibits excellent flame spread characteristics, which may be important in the design and installation of some roof assemblies. Like fiber board, perlite cover board is sensitive to moisture.

Glass/Mineral Fiber Board
Glass and mineral fiber board is made from fiberized glass or basalt rock bonded with resinous binders and compressed to various densities. To prevent absorption of adhesives or asphalt into the porous core, a facer is applied at the factory. Some manufacturers provide boards with special facers designed for the direct application of torched-on modified bitumen membranes. The product is dimensionally stable and has a high degree of heat resistance. While generally unaffected by moisture, glass and mineral fiber insulation can lose its structural integrity if it remains wet for long periods of time. In addition, the facers may be adversely affected by exposure to moisture. Due to the inherent absorptive nature of its bottom surface, it cannot be back-mopped with hot asphalt for securement over heat-sensitive insulations.

Asphaltic Core Boards
Developed in recent years, this type of cover board is often fabricated with an ashphaltic core sandwiched between a glass fiber reinforcement. Asphaltic cover boards are designed for use primarily with hot-applied asphalt membranes and torch-on systems. Highly resistant to moisture, they are compatible with all asphaltic systems. However, the asphalt content makes the board unsuitable for use under single-ply membranes, which are affected adversely by contact with asphalt.

Glass Mat-Faced Gypsum Board
This type of board employs glass mat facings front and back that are embedded into a water-resistant treated core, providing moisture and fire resistance.

Fiber-Reinforced Gypsum Panels
This innovative new type of fiber-reinforced gypsum panel incorporates the latest cover board technology. The cover board provides exceptional resistance to both mold and moisture, along with outstanding fire performance. This high-performance product is manufactured with no face layers, providing excellent wind uplift properties. The product also features a high compressive strength (up to 20 times greater than wood fiber board or perlite), enabling it to protect the roofing system from potential damage from foot traffic or hail. It is also made from 95 percent recycled materials.

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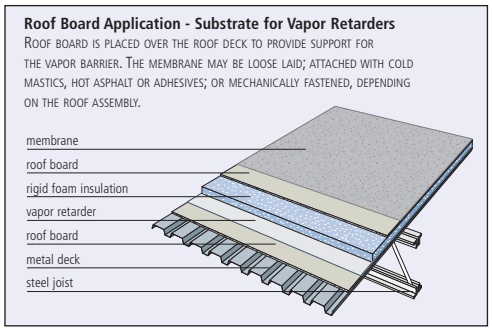

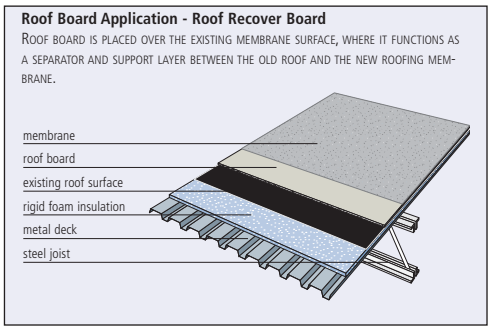

ALA Continuing Education Questionnaire - Low Slope Commercial Roofing

Program Title:
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ALA/CEP Credit: This article qualifies for 1.0 LU's (health, safety, and welfare) of State Required Learning Units and may qualify for other LU requirements. (Valid through February 2009.)

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1. In high-wind situations, when uplift in roofing assemblies is critical, minor components, such as mechanical fasteners and cover boards, have enhanced wind uplift performance systems significantly.
☐ True ☐ False

2. Changes in cover board core materials and the development of more surface coating features were designed to do all but which of the following:
☐ Limit moisture-related problems.
☐ Reduce the quantities of adhesive required to apply membranes.
☐ Enhance adhesion performance.
☐ Reduce unit costs as more features were added to improve performance levels.

3. Calcination refers to which of the following:
☐ The white powdery substance that appears on brick and masonry walls.
☐ A chemical process that occurs at high temperatures, releasing chemically bound moisture.
☐ Calcium deposits within natural materials.

4. Cover boards are an essential roofing system component designed to enhance most roofing systems against all of the following except:
☐ Wind ☐ Hail ☐ Fire
☐ Earthquakes ☐ Foot traffic.

5. Cover boards must resist moderate levels of moisture without degradation and surface bonding layers must not delaminate from the core because delamination does which of the following:
☐ Causes calcinations.
☐ Increases uplift performance.
☐ Reduces the bond strength.

6. Industry testing groups have performed tests for cover board roof assemblies relating to all but which of the following criteria?
☐ Hail ☐ Impact
☐ Snow loads ☐ Puncture resistance.

7. The presence of moisture in cover boards may result in mold within the roof assembly and mold spores migrating to the building interiors.
☐ True ☐ False

8. Typical cover board options include all but which of the following:
☐ Fiber board and perlite roof board.
☐ Calcinated mineral materials and recycled phosphate board.
☐ Glass/mineral board and asphaltic core boards.
☐ Glass mat-faced gypsum board and fiber-reinforced gypsum panels.

9. When specifying cover boards as part of a roof assembly or system, all but which of the following are true?
☐ If a fire or wind uplift resistance rating is required, only the cover board carries the rating, not the roofing assembly.
☐ Each part of the system must be a tested component within the assembly.
☐ The climate and environmental characteristics of where the board will be placed must be considered.
☐ Roof collapse or roofing assembly failure may occur if moisture cannot be anticipated in the roofing system.

10. The primry function of cover boards is to protect, separate and support the roof membrane.
☐ True ☐ False

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