PIMA Technical Bulletin #114

Ventilated Nail Base for Commercial and Residential Sloped Roofs

About Polyiso Insulation

Polyiso is a rigid foam insulation used in more than 70% of commercial roof construction and offers a continuous insulation solution for commercial and residential wall assemblies. As one of North America's most widely used and readily available building products, Polyiso is a cost-effective insulation option for reducing building energy use and improving the overall service-life of roofs and walls.

The benefits of using Polyiso include:

- High R-value per inch of thickness
- Excellent fire test performance
- Extensive building code approvals
- Cost-effective continuous insulation (ci) solution
- Compatible with most roof and wall systems
- Dimensional stability
- Compressive strength
- Moisture resistance
- Thinner walls and roofs with shorter fasteners
- Long service life
- Preferred insurance ratings
- Virtually no global warming potential
- Zero ozone depletion potential
- Recyclable through reuse
- Recycled content (amount varies by product)
- Regional materials (nationwide production network)
- QualityMark[CM] certified LTTR-values

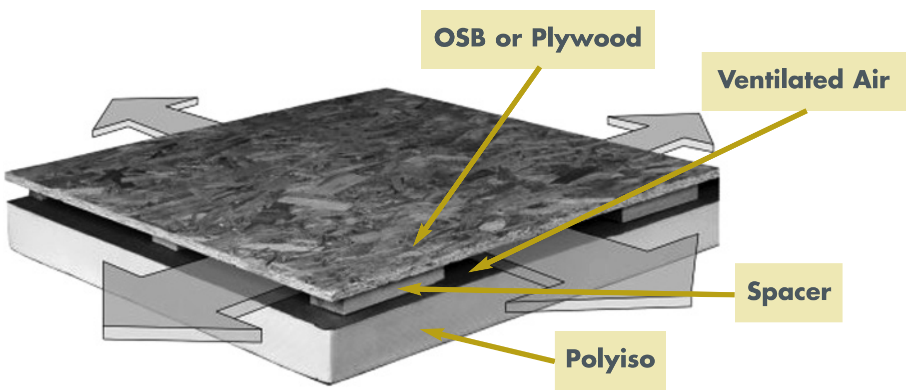
POLYISO

Surround yourself with the best.

Introduction

A number of roof coverings, notably asphalt shingles, metal and tile, perform best when the underside of the roof deck is adequately ventilated. In the absence of a non-conditioned attic, as in post and beam construction or a cathedral ceiling design, ventilation must be achieved above the roof insulation through a ventilating air space.

To address this need, the polyiso industry introduced an energy efficient solution generically called ventilated nail base (VNB). As illustrated in Figure 1, this product is composed of a layer of polyiso in thickness from 1" to 4.5", spacers, and a solid layer of OSB or plywood. This technical bulletin focuses on VNB used in commercial and residential sloped roof applications.



VNB provides several outstanding benefits:

- Excellent thermal insulating properties for the entire roof assembly;
- Effective ventilation; and
- Strong nailable base for proper attachment of asphalt shingles, tile, or metal roof coverings.

Thermal Resistance of Ventilated Nail Base

The thermal resistance value reported for VNB is the LTTR-value of the polyiso foam insulation only. Additional thermal resistance for the air space or the OSB above the air space in VNB is not considered in determining the product LTTR-value, since outside air flowing through the product creates a thermal interruption and does not, therefore, provide any appreciable thermal resistance to the product. Further, the air flowing through a properly ventilated air space eliminates the small thermal resistance provided by the 7/16-inch OSB, as well as the roofing materials and outside air film above the air space, since ambient air is flowing above and below these components.

This position is consistent with the ASHRAE Handbook *Fundamentals*, Chapter 24, Table 3, note b; and Chapter 23, "Factors Affecting Heat Transfer Across Air Spaces." This Chapter states that the thermal resistance values claimed for air spaces are applicable only when the air spaces are sealed against airflow in or out of the space.

PIMA sponsored a full-scale "hot box" test at Oak Ridge National Laboratory (ORNL) to determine whether the air space contributes to the overall thermal resistance of the VNB product. A summary of the test program and results are shown below:

OBJECTIVE: The purpose of the test program conducted at ORNL was to determine the effective R-value of the ventilation air space present in the VNB.

SUMMARY: The test program was conducted during February and March 2005 at the Buildings Technology Center (BTC) at ORNL. The tests were conducted in the BTC's Large Scale Climate Simulator (LSCS) and were in general conformance with ASTM C 1363, Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus. Results were obtained for both "winter" and "summer" conditions.

PROCEDURE: The VNB product, consisting of nominal 1.0" polyiso, 1" ventilated air space, and 7/16" oriented strand board (OSB), was installed on a 4:12 slope metal deck. The top surface of the OSB was covered by standard roofing felt. The test deck was installed in the LSCS, properly instrumented and insulated to prevent thermal bridges at the test deck extremities. The test deck was then subjected to testing at both "winter" and "summer" conditions with various levels of measured air circulation in the air space.

RESULTS: Effective R-value of the air space is affected by the air circulation. The amount of outside air circulating through the air space determines the effective R-value. The effective R-value of the air space is at a maximum with no air circulation. However, since air circulation is a major feature of the VNB product, the effective R-value at various levels of air circulation was determined.

The effective R-value of a 7/8" ventilation air space decreases as the air circulation increases in both the "winter" and "summer" conditions. The R-value of the air space at both winter and summer conditions at zero ventilation agrees with the ASHRAE Handbook Fundamentals values for these spaces. At ventilation rates corresponding to a 5 mph wind speed, the R-value of the ventilated air space drops off slightly but is close to the R-value at the zero ventilation rate. However, at increased circulation rates, the R-value of the air space drops off quickly.

Because each installation of VNB will likely be subjected to varying wind speeds and temperatures, the effective R-value is impossible to predict. Therefore, PIMA members have chosen to discount any potential contribution of the air space to the overall thermal performance of the product.

Effective Ventilation

VNB insulation is available in many different configurations and air space dimensions, depending upon the polyiso manufacturer. However, a standard method to calculate the expected ventilation rate of a particular product is available. The Net Free Area of Ventilation Per Linear Foot (NFA/LF) is derived by multiplying the air space in inches by the length in inches of the VNB (less the area of the spacers) and then dividing by the length in feet of the VNB panel. The ventilating capabilities of the soffit and ridge vents should be matched to the NFA of the ventilated nail base product.

Installation of Ventilated Nail Base

VNB panels shall be installed in accordance with the manufacturer's installation instructions. In general, ventilated nail base insulation is installed over a solid roof deck with the 8 ft. dimension parallel to the eave.

Use of a Vapor Retarder

Moisture vapor tends to migrate from warmer to cooler areas. In building construction, vapor retarders are used to inhibit or block the passage of moisture into walls or roofing assemblies. Sealed vapor retarders also serve as air barriers to limit the movement of moisture-laden air from the interior to the exterior. To determine whether a vapor retarder is necessary, calculations based on interior relative humidity, interior temperature, and outside design temperature must be performed. Excessive moisture migration will potentially damage the roof system and cause unwanted condensation. Consult the NRCA Roofing and Waterproofing Manual (Fifth Edition) for more information regarding vapor retarders and dew point calculations. VNB is not intended to substitute for a vapor retarder. The decision to use a vapor retarder is the responsibility of the architect or designer.

Conclusion

It is easy to specify polyiso insulation by referring to product standard ASTM C1289 (in United States) or CAN/ULC-S704 (in Canada). Polyiso manufacturers provide experienced personnel to consult and educate the specifying community on the selection of the proper ASTM C 1289 or CAN/ULC-S704 type for the job. With all these benefits and tools available, it is easy to see why specifiers and roofing contractors consider polyiso their product of choice.

PIMA

For more than 30 years, PIMA (Polyisocyanurate Insulation Manufacturers Association) has served as the unified voice of the rigid polyiso industry proactively advocating for safe, cost-effective, sustainable and energy-efficient construction. PIMA's membership includes manufacturers of polyiso insulation and suppliers to the industry. The products of PIMA's members comprise the majority of the polyiso produced in North America.

PIMA produces technical bulletins to address frequently asked questions about polyiso insulation. These publications update and inform architects, specifiers, and contractors about and build consensus on the performance characteristics of polyiso insulation. Individual companies can provide specific information about their respective polyiso products.

For more information on polyisocyanurate insulation, visit www.polyiso.org

PIMA
POLYISOCYANURATE INSULATION MANUFACTURERS ASSOCIATION

www.polyiso.org • pima@pima.org
1220 North Fillmore Street, Suite 400
Arlington, VA 22201
Phone: 703.258.0093