Foam Sheathing Coalition™
Tech Matters
FSC — SHARING LEADING-EDGE TECHNOLOGY

Overview of Wall Sheathing Options
The Value of Foam Sheathing as a Wall Covering

June 16, 2008

Issue:

Exterior wall assemblies built in accordance with the 2006 International Residential Code (IRC), International Building Code (IBC), and International Energy Conservation Code (IECC) must be designed and built to meet or exceed minimum requirements for structural performance, energy efficiency, and moisture resistance, among other factors. These requirements appear in different sections of the code. Yet, designing a wall assembly requires an integrated approach that considers and balances all criteria appropriately, including cost-effectiveness. The choice of wall sheathing is a key step in optimizing the design and construction of wall assemblies. Unfortunately, the comparative capabilities of various wall sheathing materials and "trade-offs" are often poorly understood and sometimes misrepresented. These concepts are addressed in this *Tech Matters*.

Recommendation:

When properly specified and installed, a variety of sheathing materials can meet their specific performance capabilities for code compliance. If a high performance wall assembly is desired to cost-effectively meet energy efficiency, weather-resistance, and wind pressure requirements in building codes, foam sheathing is one of the best choices on the market. It is also commonly used to attain green building certification because of its environmental benefits. Be sure to follow the local building code, recommendations in this *Tech Matters*, and the manufacturer's requirements to achieve the best possible result when using foam sheathing.

Overview and Analysis:

Topic #1: Integrated Wall Assembly Design:

Various code-compliant sheathing products may be used, but not all products provide equal benefits or functionality to a wall assembly. Available wall sheathing products may be grossly categorized as "structural", "non-structural", or "hybrid" sheathing materials (e.g., foam sheathing and structural sheathing laminates). In reality, all sheathing products are required to have structural properties suitable to their intended conditions of use. The capabilities and trade-offs associated with two common sheathing types are discussed below.

Foam Sheathing – There are several types of code-compliant foam sheathing including Expanded Polystyrene (EPS) with properties established per ASTM C578, Extruded Polystyrene (XPS) per ASTM C578, and Polyisocyanurate (ISO) per ASTM C1289. The main capabilities of foam sheathing include:

- energy efficiency (insulative value),
- weather resistance (water resistive barrier behind siding of choice), and
- wind pressure resistance.

Wood Structural Panel Sheathing – The most common type of wood-based wall sheathing used today is oriented strand board (OSB) which is a hot pressed composite of wood strands and adhesive, with properties established by the U.S. Department of Commerce Voluntary Product Standard 2 (PS2) Performance Standard for Wood-Based Structural-Use Panels. The main capabilities of OSB include:

- wind pressure resistance, and
- wall bracing.

Both of the above sheathing products are permissible in code compliant wall assemblies and may be used separately or together. While foam sheathing provides the unique capabilities of energy efficiency (insulation) and weather resistance, OSB provides the unique capability of wall bracing. On an OSB-sheathed wall assembly, other materials must be provided to meet the energy code and weather resistance requirements efficiently (e.g., sufficient wall cavity insulation – sometimes requiring larger studs – and a building wrap). Conventional foam sheathing must be used with a separate means of wall bracing. Fortunately, various code-compliant bracing methods may be used with foam sheathing. The applications of bracing with foam sheathing are addressed in a separate document entitled *"A Guide for Builders, Designers and Plan Reviewers"* available at: www.foamsheathing.org.

Emerging are proprietary "hybrid" sheathing products that provide a combination of wall bracing, insulation and building wrap. These products are filling a key need in the market.

Topic #2: Energy Efficiency & Environment:

A minimum R2 rating is required by code to attain the status of "insulating sheathing" when used to meet energy code requirements. Sheathing products, like OSB, do not meet this requirement. Foam sheathings, depending on thickness and type, provide typical R-values ranging from R2 to more than R10. Foam sheathing encapsulates a building with a continuous thermal barrier that:

1. Eliminates thermal "leaks" common to traditional wood framing.
2. Reduces air infiltration due to tight fitting joints and the application of joint tape.
3. Reduces the potential for condensation and mold to form inside walls or on cold interior wall surfaces, when properly sized.

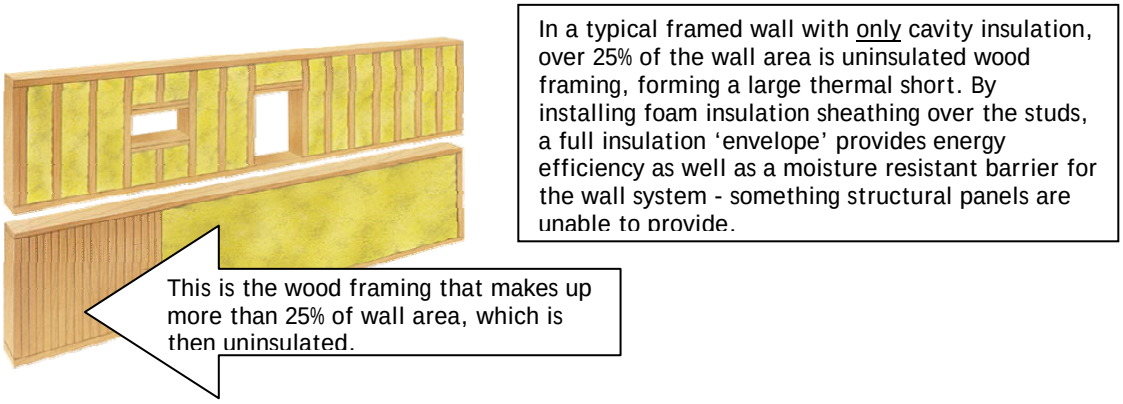

Figure 1. Illustration of thermal leaks in a wood frame wall without foam sheathing.

Many builders and designers specify foam sheathing to offer the environmental and economic benefits of "above code" energy efficiency and achieve Energy Star or green building certification. These benefits have been quantified as follows[1]:

- **Annual energy savings** for a single house using foam sheathings ranged from 3.5 (U.S.) to 11.0 (Canada) million BTU per year!
  - *If all households in the U.S were to apply foam sheathing having an R-value of ~R3, the annual energy savings is equivalent to:*
    - *70 large oil tankers per year, or*
    - *the total energy produced by 5 nuclear power plants per year (1,500 MW each)*
- **Annual greenhouse gas (GHG) savings** for a single house using foam sheathing ranged from 505 (U.S.) to 787 (Canada) lbs of CO_2
  - *If all households in the U.S were to apply foam sheathing having an R-value of ~R3, this GHG savings is equivalent to:*
    - *removal of 30 million tones of CO_2 emissions per year, or*
    - *elimination of emissions from 7 million vehicles (about 2.5 billion gallons of gasoline per year)*

Whether required by code or optional, foam sheathing is an investment that pays dividends for the life of a structure, its occupants, and the environment!

Topic #3: Weather Resistance:

Foam sheathing is a durable and water resistant sheathing product and does not rot or decay when exposed to moisture (Figure 2). In fact, approved foam sheathing materials can be used as a code-compliant "water-resistive barrier" behind any siding material, without the need or extra cost of installing a building wrap or tarred felt paper (Figure 3). Foam sheathing is cost-competitive on a first cost and monthly (operating) cost basis, through this combination of weather resistance and energy efficiency.

High performance buildings are not necessarily expensive when the right wall sheathing choice is made!

[1] Source: "Plastics Energy and Greenhouse Gas Savings Using Rigid Foam Sheathing Applied to Exterior Walls of Single Family Residential Housing in the U.S. and Canada – A Case Study". Franklin Associates, 2000. Key assumptions in this study include: (1) 1,791 sqft of opaque wall area per home based on 1997 construction data, (2) insulation value of R14 for baseline wood frame wall with batt insulation in all climates, and (3) foam sheathing with a representative R-value of about 3R (approximately 5/8" thickness) added to the baseline wall in all climates. Therefore, the data as presented should be taken as a realistic "order of magnitude" estimate of the environmental and energy-saving benefits of using foam sheathing.

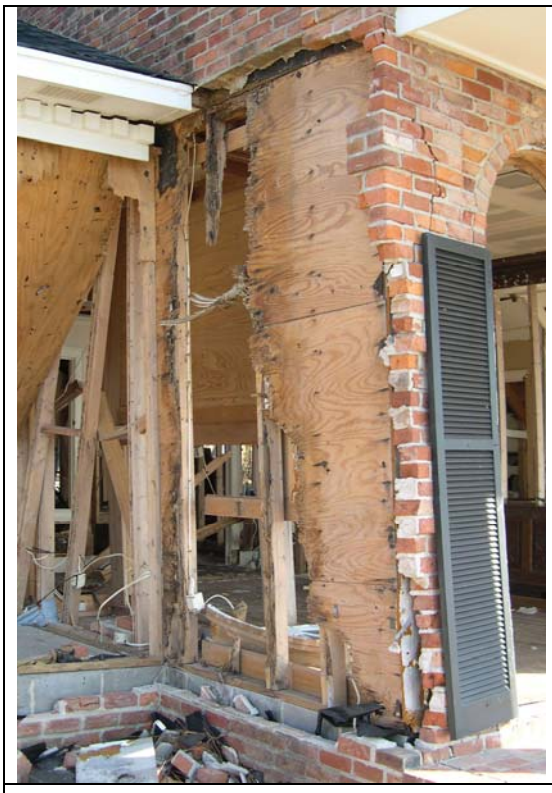

Figure 2. Damage to wood structural panel sheathing due to exposure to rain water.

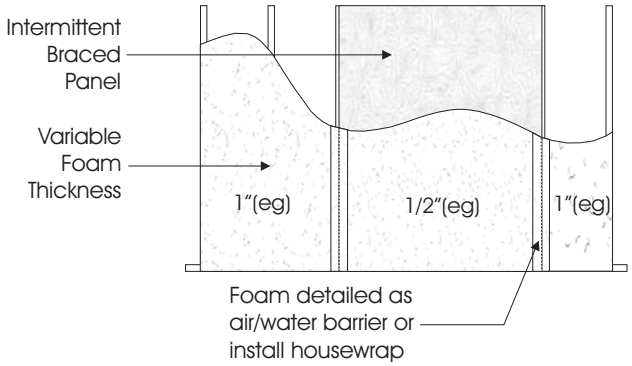

Figure 3. Example of foam sheathing applied to a wall and detailed as a water-resistive barrier to protect the building from rain water penetration.

Topic #4: Wind Pressure Resistance:

There is a great deal of misinformation about the performance of sheathing products when it comes to wind pressure resistance. In many cases, the failure of any sheathing product to perform as expected is the result of lack of code compliance or, more simply put inappropriate use.

In 1992, Hurricane Andrew caused 70% of the affected homes to lose one or more panels of traditional plywood or OSB roof sheathing, due to inadequate wind-resistant fastening requirements and installation quality[2, 3] For a variety of wall sheathing materials, similar problems have been observed in extreme wind events, especially on gable end wall framing at the attic level (see Figures 4-6).

Materials must be used correctly and properly specified to perform up to expectations. Even then, failures may still be observed in extreme events that exceed reasonable code-compliant design criteria. With proper specification and use of any sheathing product, wind pressure failures can be avoided or adequately prevented.

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[2] *Reliability of Conventional Residential Construction: An Assessment of Roof Component Performance in Hurricane Andrew and Typical Wind Regions of the United States.* U.S. Department of Housing and Urban Development, Washington, DC. 1999. (publication available through www.huduser.org)

[3] *Assessment of Damage to Single-Family Homes Caused by Hurricanes Andrew and Iniki*. U.S. Department of Housing and Urban Development, Washington, DC. 1993. (publication available through www.huduser.org)

A separate *Tech Matters* is forthcoming to address best practices for wind-resistant specification and installation of foam sheathing with various wall assembly conditions. In addition, building code requirements for various sheathing products are in the process of being updated, clarified and improved. The FSC has been instrumental in preparing public comments on both RB131 and RB195. If accepted at the Final Action Hearings in September, the wind provisions of the IRC will be much better than they are today.

Figure 4. Failure of wood structural panel sheathing due to wind pressure (Hurricane Andrew, 1992).

Figure 5. Failure of fiberboard sheathing due to wind pressure (Hurricane Katrina, 2005).

Figure 6. Failure of foam sheathing due to wind pressure (Hurricane Katrina, 2005).