

*From Canadian Architect*

### **Wrapping it Up: Building Paper and Housewraps**

Building paper and housewraps (collectively called sheathing membranes, vapour permeable sheathing membranes, or weather resistive barriers) are widely specified to control moisture movement in walls and roofs. Fundamentally, these products act as capillary breaks and drainage planes, not as waterproofing. They are used to shed liquid water that may penetrate siding or roofing, to prevent liquid water from wicking through them, while remaining sufficiently vapour permeable (breathable") for outward drying. Other products can perform the same function as housewraps and building papers, for example.

There are three basic types of vapour permeable sheathing membranes available: asphalt-saturated felt, building paper, and plastic housewrap.

**Asphalt-saturated felt.** The oldest of the three types is felt, which has been in use for over a hundred years. Originally felt was made from recycled rag but today felts are made of recycled paper products (typically cardboard) and sawdust. The most common felt product is the so-called #15 felt. Before the oil crisis felt weighed about 15 pounds per square (one square = 100 square feet) and hence the asphalt-impregnated felt was called "15#" or "15 pound felt". Modern felts no longer weigh 0.73 kg/m<sup>2</sup>, and to reflect this fact the new felts are called "#15" asphalt felt. In fact, #15 felts can weigh from 7.5 to 12.5 pounds/sq ft depending on the manufacturer and the standard to which felt is made (i.e., CGSB, ASTM, or none). Thirty pound felt, of 30# felt, is now #30 felt, and actually usually weighs between 16 and 27 pounds per square. Hence, to get a product similar to a 15# felt of old, one could specify a modern #30 felt.

**Grade D building paper** (the Grade D designation derives from a US federal specification) is widely used in the west. Building paper is manufactured from virgin kraft paper, unlike felts, and then impregnated with asphalt. The longer fibres in the kraft paper allow for a lighter weight product with similar and often better mechanical properties than felt. Grade papers are rated in minutes -- the amount of time it takes for a moisture sensitive chemical indicator to change colour when a small boat-like sample is floated on water. Common grades include 10, 20, 30, and 60 minute. The higher the rating the more moisture resistant and the heavier. A typical 20 minute paper will weigh about 3.3 pds per square, a 30 minute paper 3.75, and a 60 minute paper about six. The

smaller volume of material however does tend to make these papers less resistant to moisture than heavier felts.

**Plastic housewraps**, generally made from polyethylene or polypropylene, have now been available for over 20 years. Non-perforated wraps, like Dupont's Tyvek, are woven from fabrics in such a way that water vapour molecules can pass through the very small spaces between the fibres. Perforated wraps are manufactured from films that are then punctured with pin holes at close spacings. Non-perforated wraps tend to have higher liquid water resistance because the holes between plastic fibres are very small. These products are significantly thinner and lighter than felts or papers, but are usually stronger, especially when wet.

### **Comparisons**

None of the products discussed above is truly waterproof. Under long-term or extreme exposure, water will penetrate. Truly watertight sheathing membranes, like peel-and-stick and torch-applied membranes, are essentially vapour impermeable and hence they must be used close to the inside of an enclosure assembly. However, for many applications in which a relatively small amount of water is intended to drain, felts, building papers and housewraps perform well.

Field testing conducted on a test house with vinyl and stucco cladding has demonstrated that drainage behind these claddings is dramatically improved by the use of two separate layers of sheathing membranes. Two layers provides much more than twice the performance. The two layers offer increased resistance to leakage at fasteners, allow the installer to stagger lap joints, and provide a drainage space between the two individual layers. The use of two layers was once common, and is required in some jurisdictions, and can be highly recommended behind stucco or other contact sidings.

Heavier felts and papers offer the advantage that they tend to seal around nails and staple openings. The heavier products also seem to be more able to resist surfactant effects through sacrificing some of their volume. Felts and papers have some disadvantages too. The paper-based nature of the product means that they will rot if they are wet enough, long enough while they are warm. Hence, they may not be appropriate for flashing (on which water can stand), directly behind highly exposed stucco in warm and rainy climates, etc.

Housewraps come in large sheets, often story-height, and thus can be quickly applied with a minimum of laps and joints. They are also completely resistant to rot. The thin

sheets however make them more susceptible to leaks at fastenings, but this can be partially solved by specifying plastic capped nails, or solved by taping over the fasteners.

Breather type sheathing membranes are all vapour permeable to allow for outward drying. Although this type of product should have a vapour permeance of more than about 250 ng/Pa/s/m<sup>2</sup> (5 US perms), there is little advantage to products with very high permeances and resistance to liquid water should be a higher priority in most applications. It should be noted that almost all building papers and felts exhibit variable vapour permeance properties. When they are wet or exposed to high humidity (i.e., when they need to allow drying), their permeance is well over 1000 metric perms and may be several times higher. Most vapour permeance tests are conducted at low humidities and falsely imply a lower vapour permeance than is likely in service. All plastic housewraps have an almost constant and high vapour permeance.

Some housewraps are sold as part of an air barrier system. While a few (not all) can perform this function, this use requires special care to structural support the non-adhered membrane in the form of plastic-headed nails, taped or otherwise sealed at a spacing of about 150 by 400 mm or strapping, or other support. All joints must be taped in a structurally sound manner. Because wind loads tend to be higher on commercial structures, the use of housewraps is not usually recommended as the primary plane of airtightness for these types of buildings. Stiff or fully-supported membranes should be used as the air barrier in these cases. However, in all cases, housewraps, felts and papers will help to control or even eliminate the cooling effect of wind blowing through batt insulation.

Finally, installation is key if any sheathing membrane is to fulfill its intended function. The sheets must be lapped, especially over and around windows, doors and other penetrations. Fasteners must be of the approved type, spaced closely enough to provide the required support.

### **Summary**

It is difficult to give a definitive recommendation for the best type of vapour permeable sheathing membranes for a particular application. All of the products have their strengths and weaknesses which must be judged on a project specific basis.