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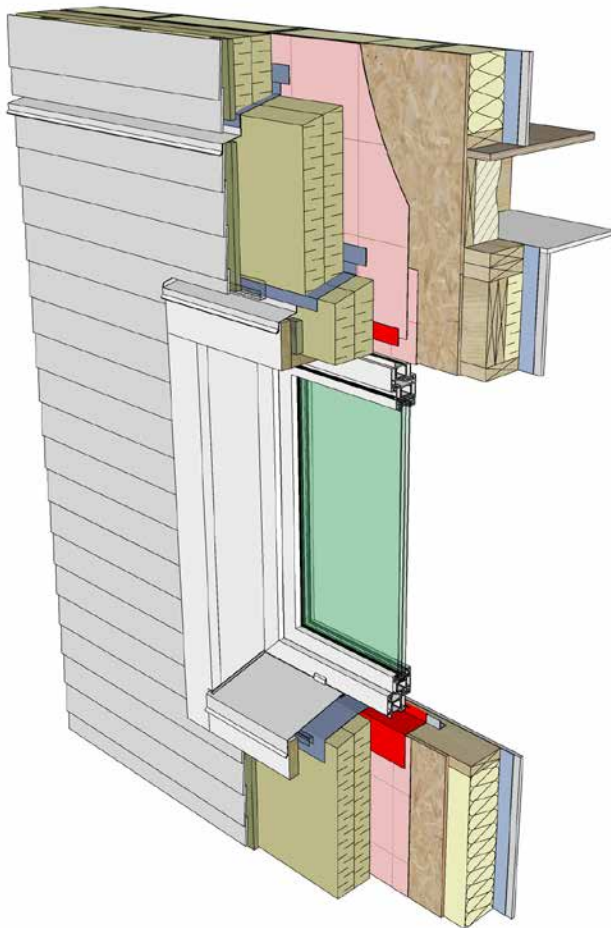
APPENDIX A: Building Material and Product Selection Guide

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Preface and Disclaimer

The National Building Code and provincial building codes including the BCBC refer to various material specification standards (e.g. CAN/ULC, CSA, ASTM etc.) as a set of minimum requirements for building materials to test against to demonstrate prescriptive compliance with the building code. These referenced material specification standards further reference additional material testing standards for individual material properties. The guidance presented in this document is not intended as a guarantee of prescriptive code-compliance or acceptance by local building authorities, but provides a basic overview of the typical building enclosure materials that can be used in the wall systems presented. The products listed provide a good selection of quality materials based on industry experience, and are not intended as a ranking or endorsement of any one brand or product.



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Material Selection Basics

While the specific code requirements referenced throughout this guide for each product type provide a good basis for the minimum performance level of the building enclosure materials used, material selection should go beyond simply the tested characteristics and also consider other factors critical to in-service performance. The following four factors should always be considered in material selection.

Durability

Durability refers to long-term performance of the material in service under expected operating conditions, and the robustness of the material as it is installed and while it is exposed during construction before being covered or protected with finishes.

Damage to materials can result from wind pressure, abrasion, heat, moisture, and ultra-violet radiation. This is significant when the material is left exposed during construction prior to the installation of exterior finishes. Exposed materials should be protected from the elements as soon as possible or be robust enough to withstand damage and degradation while exposed. Building enclosure materials with no resistance to exposure must only be installed in fully-enclosed buildings.

Compatibility

Material compatibility refers to chemical compatibility to avoid degradation of interfacing components, as well as substrate and bond compatibility to ensure proper adhesion of membranes, sealants, and tapes to the various air barrier materials.

For example, bituminous membranes are not compatible with a number of common roofing and flashing materials such as PVC membranes, asphaltic polyurethanes, and silicones. This chemical incompatibility can result in plasticizer migration, where the chemical plasticizers from one material (for example PVC) move to another material through direct contact. The result is damage to or potential failure of either or both materials.



Figure 1 Damage to a non-adhered sheathing membrane during construction due to wind.



Figure 2 Signs of plasticizer migration from a self-adhered membrane through to the urethane-based liquid-applied membrane.

Adhesion

It is difficult to establish good adhesion between silicone or urethane sealant materials and synthetic sheathing membrane materials, such as polyethylene or spun-bonded polyolefin products. Where possible, a transition membrane, such as foil-faced self-adhered membrane, or specialized sealant products designed specifically for adhesion to synthetic materials are recommended. Refer to the product manufacturer's literature for compatibility guidelines, or consider completing preliminary mock-ups or material testing to ensure chemical and adhesive compatibility before using a specific combination of materials.



Figure 3 Sealant adhesion test showing adhesive failure from a synthetic vapour-permeable self-adhered membrane.

Constructability

The performance of the building enclosure is highly dependent on the quality of the installation of its components and materials. The selection and design of materials and details is critical. This includes consideration of construction sequencing, site access, and the abilities of trades. It may help to include product representatives and trades in preliminary design discussions in order to better understand the installation process for different systems and materials.

Sheathing Membranes

All wall assemblies presented in guide series use sheathing membranes that are permeable to water vapour and used as the exterior air barrier. Sheathing membrane products are typically either sheet-applied or self-adhered, but may also be liquid-applied.

The Canadian standard CAN/CGSB-51.32-M requires "breather type" permeable membranes to have minimum permeability rating in the order of $170 \text{ ng/Pa}\cdot\text{s}\cdot\text{m}^2$. Note however that this standard has been withdrawn from service, and alternative specification standards are more suitable to reference to demonstrate an acceptable level of performance. The ASTM E2556/E2556M, "Standard Specification for Vapour Permeable Flexible Sheet Water-Resistive Barriers Intended for Mechanical Attachment" and the International Code Council's Evaluation Services Acceptance Criteria 38, "Acceptance Criteria for Water-Resistive Barriers" (ICC-ES AC38) are therefore used as the primary reference material specification standards for this evaluation.

CAN/ULC-S741 requires the air barrier membrane have less than $0.02 \text{ L/s}\cdot\text{m}^2$ air leakage when tested at 75 Pa pressure difference.

Note also the Canadian Construction Materials Centre (CCMC) offers testing and review services to assess product compliance with building codes.

Sheathing membranes must also resist degradation from ultraviolet (UV) light exposure. Since the membrane is often installed on the building well before the cladding and finishes, it can be exposed to UV light from the sun for an extended period of time, which can both cause discoloration and degrade the strength of the membrane. In general, the UV resistance of each membrane will be provided by the manufacturer and can help determine the allowable exposure time. This is usually in the range of six to 12 months though may be less. Construction scheduling should be adjusted to allow as little exposure time as possible for the sheathing membrane.

As with all products, consult the manufacturer's instructions for products, and consult with appropriate design professionals and building authorities regarding issues of material selection and code compliance.

Non-Adhered Sheet Membranes

Care must be taken when using non-adhered sheathing membranes as air barriers, to ensure that they can accommodate the expected wind loads over the long-term without damage, and that the air sealing accessories are compatible. Woven, spun-bonded, and trilaminate poly membranes are typically the best material for non-adhered membranes because they are durable and allow air sealing with compatible tapes and sealants.

Example products (trademark symbols omitted throughout this Appendix for ease of viewing):

- › DuPont Tyvek HomeWrap/CommercialWrap
- › DuPont Tyvek DrainWrap
- › VaproShield WrapShield
- › Dorken DELTA-VENT S
- › SIGA Majvest
- › SRP AirOutshield WALL
- › TYPAR HouseWrap and Metrowrap
- › NovaWrap GP Building Wrap

Adhered Sheet Membranes

Trilaminate poly membranes with continuous acrylic adhesive backing are typically the best material for adhered membranes because they are durable and permeable without requiring perforations in the facer or intermittent glue patterns. The product should achieve good adhesion to the substrate and at laps, which can be difficult for some products with acrylic adhesive and so this should be carefully reviewed. Some products require the use of primer on the substrate and at laps to promote adhesion, which may pose a sequencing and constructability challenge.

Example products:

- › Soprema Sopraseal Stick VP
- › VaproShield WrapShield SA
- › Dorken DELTA-VENT SA
- › Siga Majvest 500
- › SRP AirOutshield SA 280
- › 3M 3015VP
- › Henry Blueskin VP160
- › Resisto VP SA

Liquid-Applied Membranes

Liquid-applied sheathing membranes can be effective once cured and in service, but are often very sensitive to moisture during installation and cannot be easily installed during wet and cold weather. They also typically must be used with compatible membrane tapes or sealants as part of a product system. During installation, it is important to check the thickness of the membrane to ensure that it is adequate. If the cured membrane is too thin it will not resist water infiltration sufficiently, and if it is too thick the breathability will be reduced. Silicone, silicone hybrid, silyl terminated polyether/polyurethane (STPe/STPu), and acrylic-based liquid-applied products are all typically used as part of sheathing membrane product offerings from various manufacturers.

Example products:

- › GE Elemax 2600 AWB
- › DOWSIL DEFENDAIR 200
- › DOW LIQUIDARMOUR CM and LT
- › Tremco ExoAir 220 and 230
- › DuPont Tyvek Fluid Applied WB+
- › Prosoco Cat 5

Flashing Membranes and Tapes

Air and water control membrane systems rely on suitable accessories to achieve their water and air tightness. These accessory components play an important role in the systems' performance at details and penetrations. Materials include butyl- and rubber-based self-adhered membranes, as well as various acrylic tapes. Canadian building codes do not state acceptable solutions or reference prescriptive standards for flashing membranes and tapes. However, in general for products to comply with various code requirements they must demonstrate that they fulfill the objectives outlined in associated articles, clauses, and sentences of the building codes related to water and air barrier systems. While various sheathing membrane systems may require the use of approved or compatible accessory products, there are two important characteristics to consider with all systems:

- › **Adhesion:** The ability of the flashing membrane and tape product to stick well to the substrate is one of the most important characteristics to consider. Products that aggressively adhere even in non-ideal conditions such as wet and cold substrates, without requiring careful or specialized application approaches (see Workability below) are ideal. Primers should always be considered to optimize the adhesion, but installation is simpler if it is not needed. How well materials stick to it is also important to consider. For example, low-energy surfaces such as plastic and polyolefin can be difficult for sealants to adhere to, so they should be carefully selected and tested before use (through on-site mockups if possible).
- › **Workability:** Accessory products that can be installed without complex installation approaches or specialized tools are preferred, to reduce the risk of workmanship errors in the field. Self-adhered membranes with easily-removable release-films and that retain their shape while being installed are ideal. Strong and flexible tapes that provide immediate bond without introducing wrinkles or fish-mouths are preferred on site.

Self-Adhered Flashing Membranes

Butyl and rubberized asphalt membrane products with polyethylene films are commonly used for rough-opening preparation, as through-wall flashing membranes, for roof-to-wall transitions and for above-grade to below-grade transitions. They offer durable surfaces for high-water load areas and for shedding moisture out of the wall assembly, and can provide a transition material for other adhered products like coatings and sealants.

Example products:

- › Henry Blueskin Weather Barrier and Blueskin Metal Clad
- › Protecto Wrap Protecto Seal 45
- › Grace Ice & Water Shield
- › Soprema Sporaseal Stick 1100 TC

Tapes

Durable building tapes with high-quality acrylic adhesive should be used. Some products come with a silicone release film to unrolling the spool easier and allow for potentially longer continuous tape seals since the film protects the adhesive until it is set in place. Note that most sheathing tapes are not considered permeable unless explicitly noted by the manufacturer.

Example products:

- › Tuck Tape Construction Grade Sheathing Tape
- › 3M All Weather Flashing Tap
- › DuPont Tyvek Seam Tape
- › Owens Corning JointSealR Foam Joint Tape
- › Dow Weathermate Construction Tape
- › Soprema Sopraseal Stick Flashpro HT
- › SIGA Wigluv, Rissan, and Fentrim
- › Rothoblaas "Band" product line

Sealant

The recommended sealant types that should be used in typical wood frame wall construction are: neutral and acetoxycure silicone, polyurethane, thermoplastic "hybrid", and acoustical. Other consumer-grade products like acrylic latex are not suitable for exterior enclosure purposes. There are three important challenges with all types of sealant used in construction:

Adhesion: This is best determined through sealant mock-ups in the field, along with pull testing, as specified by the manufacturer. Adhesion characteristics can also be found in product literature and lab test reports. Good adhesion is considered to be achieved when the sealant splits or cracks through the profile (cohesive failure, see Figure 4) before it detaches from the substrate (adhesive failure, see Figure 5) as it is pulled away from the substrate. Synthetic sheathing membranes and self-adhered membranes have shown that many common sealants, especially neutral cure silicones, have trouble achieving good adhesion to these substrates. In these cases, either a specialized sealant type may be required, or an aluminum foil-faced self-adhered membrane strip is used to transition to the sealant joint.

Tooling: Sealant tooling is an important part of the installation in order to form a proper joint design. Most sealants allow at least some amount of tooling after they are initially placed to smooth the profile, and ensure the substrate is fully coated for the depth and width of the sealant joint. The sealant gun tip can also be used to tool the sealant if appropriate (see Figure 6). Ease of tooling can be reduced by the use of cold sealant, incorrect tools, and incorrect sealant types for the type of use. Refer to the manufacturer’s literature for correct installation procedures and operating temperatures.

Compatibility: Sealant compatibility is an important consideration over the lifetime of the sealant joint. Chemical incompatibility between the sealant and the substrate is a common cause of sealant joint failure as buildings age.



Figure 4 Example of cohesive failure of the sealant bead.



Figure 5 Example of adhesive failure of the sealant bead.



Figure 6 Example of correct installation and simultaneous tooling of sealant at window perimeter interface.

Silicone Sealant

Silicone sealant, specifically neutral cure, is generally appropriate for exterior seals where movement is expected and correct joint design and tooling is important. Silicone comes in many formulations to suit the installation, tooling, adhesion, and movement requirements. Note also that many liquid-applied sheathing membrane systems are paired with matching silicone sealants for joints and details.

Example silicone sealant products:

- › DOWSIL: 795, 791, 790, 758, Contractors Weatherproofing Sealant, Neutral Plus Silicone Sealant
- › Tremco Spectrum 1,2, and 3, Tremsil 200, and Tremsil 400
- › GE SCS2000 SilPruf
- › Vaproshield Vaprobond

Polyurethane and Hybrid Sealants

Polyurethanes and hybrid products have many of the same uses as silicone, but may achieve greater adhesion on some substrates and can be formulated to allow better workability and greater durability in exposed conditions. They can also provide a paintable surface. Hybrids include modified silicone-based sealants like silyl-terminated polymer (STPe)

Examples products:

- › Masterseal NP1
- › Tremco Dymonic 100, Dymonic FC, and Vulkem 116
- › 3M 740, 760, and 4000UV Hybrid Adhesives Sealants
- › Prosoco AirDam STPe

Acoustical Sealant

These products have a single use at the interior of the wall assembly. They are used to seal the joints in polyethylene sheets, and are not suitable for any other purpose. In general, given that they are fully encapsulated inside the wall and are formulated to remain uncured (i.e. sticky) throughout their life-cycle, product selection is generally straightforward.

Example products:

- › Tremco Acoustical Sealant
- › Mono Acoustical Sealant

Insulation

The selection of insulation type is based on a variety of factors, including cost, availability, acoustic characteristics, vapour and liquid moisture retention and transmission, thermal performance, density, and airtightness. There are numerous types of insulation and manufacturers to choose from. Each manufacturer will be able to provide technical data for their proprietary formulation. The various wall guides and Appendix B provide further guidance on insulation product uses and installation approaches.

Batt:

- › Owens Corning EcoTouch PINK FIBERGLAS and Thermafiber UltraBatt mineral wool insulation
- › Rockwool COMFORTBATT Stone Wool
- › Johns Manville Fiberglass Building Insulation
- › CertainTeed Sustainable Insulation

Extruded Polystyrene (XPS) Rigid Foam Board Insulation:

- › Owens Corning Foamular and Foamular CodeBord XPS
- › DuPont Thermax Sheathing polyiso and Styrofoam Cladmate XPS
- › Soprema Sopra-XPS

Expanded Polystyrene (EPS) Rigid Foam Board Insulation

- › Plasti-Fab PlastiSpan, DuroFoam EPS, and DuroSpan GPS
- › Airfoam Korolite EPS

Rigid Mineral Wool

- › Owens Corning Thermafiber RainBarrier ci High Compressive (80, 110, and Max)
- › Rockwool COMFORTBOARD 80 and 110
- › Soprema Soprarock MD and DD
- › PowerWool RIGIBOARD ONE

Semi-Rigid Mineral Wool

- › Rockwool CAVITYROCK
- › Owens Corning Thermafiber RainBarrier 45 and HD

Wood Fibre Board

- › Gutex Multitherm and Thermoflex
- › STEICOtherm dry and STEICOflex
- › Pravatex Isolair

Fibrous Loose Fill and Blown

- › Soprema SOPRA-CELLULOSE AB
- › Owens Corning PINK FIBERGLAS
- › GreenFiber Cellulose Blown-In Insulation

Spray Foam (Professional Use Only)

- › BASF Walltite
- › DuPont FROTH-PAK Foam Sealant
- › Demilec Closed-Cell and Open-Cell Insulation
- › Polarfoam PF-7300-0 SOYA
- › Johns Manville Corbond



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