Exterior Rigid Boardstock Insulation Moisture Management Issues

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Published By: The Construction Specifier
Date: September 2013
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The Message

Exterior Rigid Boardstock Insulation Moisture Management Issues by John Koester, CEO, Masonry Technology Inc. When the message is absolutely critical, and not heeding the message increases the likelihood that a disastrous outcome will occur, then repeating the message is (or should be) a professional imperative! This has never been more true than with the issue of specifying and installing rigid boardstock insulation exterior of WRB's and exterior sheathing on the exterior building envelope. I repeat, use great caution when specifying and installing rigid boardstock insulation exterior of WRB's and exterior sheathing on the exterior building envelope!

This is not "crying wolf!" There are well-founded reasons supporting the necessity of vigilance on the part of architects, builders and building owners.

- Most boardstock rigid insulation has some moisture-resistant characteristics.
- When layered against a weather-resistant barrier (WRB) on exterior sheathing, an undrained cavity/void will be created that may entrap moisture.
- Installing a thickness of rigid boardstock insulation over WRBs and exterior sheathing may have an impact on the fastening patterns and/or structural requirements to secure thin veneers (stucco, adhered thin stone and thin brick and various other siding systems).
- Rigid boardstock insulation may have dynamics of its own.
- Installing a thickness of rigid boardstock insulation over WRBs and exterior sheathing will impact exterior building envelope rough openings and the installation procedure of windows, doors, louvers, etc. into these rough openings.

These conditions may occur separately or in concert, but in either case their impact needs to be understood and designing, specifying and installation need to be adjusted to accommodate them.

"To be sustainable, a building must not only be efficient and durable but also economically viable. From this, new methods of enclosure design have been examined that provide high thermal performance and long-term durability but also take opportunities to reduce material use (including waste), simplify or integrate systems and details, and potentially reduce overall initial costs of construction.

One concept relating to enclosure design is to incorporate the use of exterior foam insulating sheathing into the construction of the wall assembly. As with any building enclosure system, appropriate detailing for the management of water, vapor, and energy transfer are necessary." (BSC 2007)

Accommodation

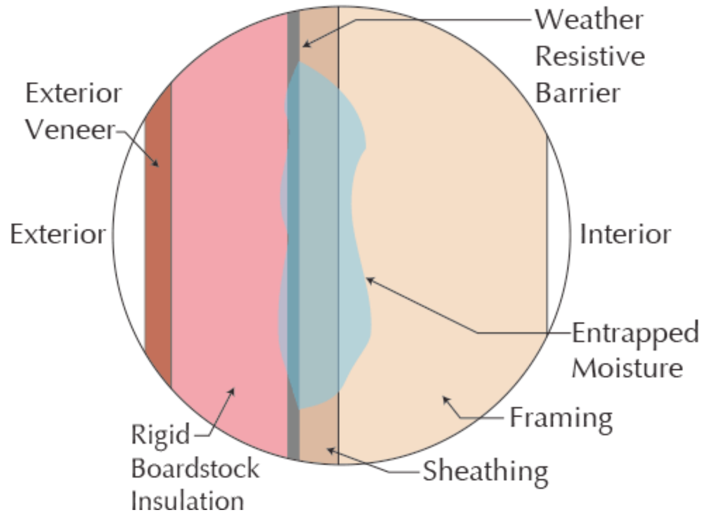
Rigid boardstock insulation can range from being very porous to virtually waterproof. These characteristics must be known and the exterior building envelope designed to provide for them. This is no easy task, and it involves significant understanding and careful design.

Designing an exterior building envelope that may have two or more layers of boardstock materials that can range from porous to virtually waterproof and that may be vapor retarders under various conditions, carries a significant risk. This design/detail involves the possibility that infiltrated water may be entrapped or one or more of these layers being an "ill-placed" vapor retarder (i.e. "cold vapor retarder") will allow water vapor to condense on its surfaces (either side) under certain conditions. (see #1)

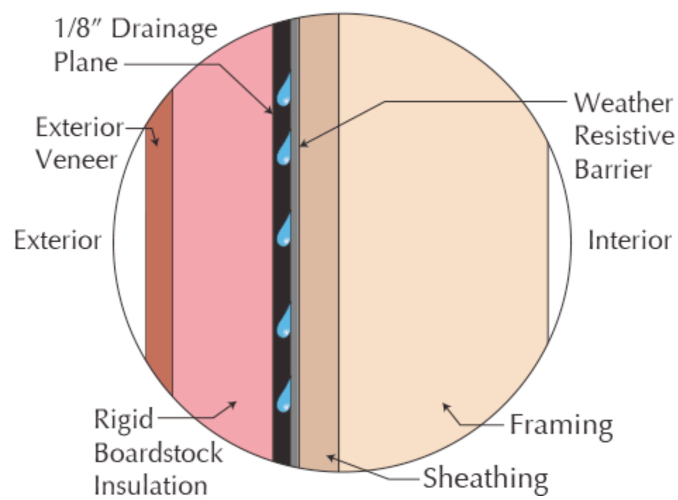
There is only one design/ detail that provides a chance of success. That design/ detail includes a method that effectively drains moisture that may accumulate on the surfaces as a result of being an "ill-placed" vapor retarder ("cold vapor retarder") or is entrapped infiltrating water between the layers, down and out of the building envelope. (see #2) "The fundamental principle of water management is to drain the water downwards and outwards out of the building envelope and away from the building. In order for the building and building assemblies to drain properly, detailing of the drainage plane must be carefully designed." (BSC 2007)

If the exterior building envelope has a designed drainage plane between these layered materials at the surfaces of these potential vapor retarders, any water vapor that condenses and turns to "liquid water" or is present from infiltrating water, will have a pathway down and out of the exterior building envelope. The caveats are that not all drainage planes are equally effective, and once the "liquid water" reaches the bottom of the building envelope, there must be a designed, effective weep system. (see #3)

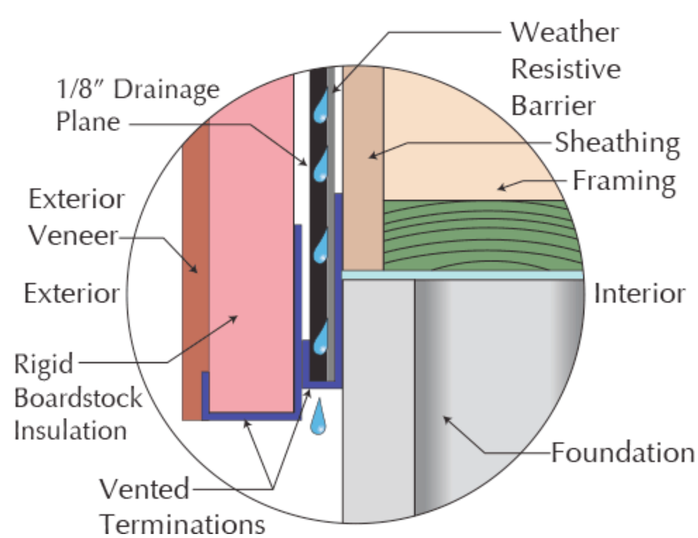
Entrapped Moisture
Condensation or Infiltrated Water
Drawing #1



Drainage Plane
Drawing #2



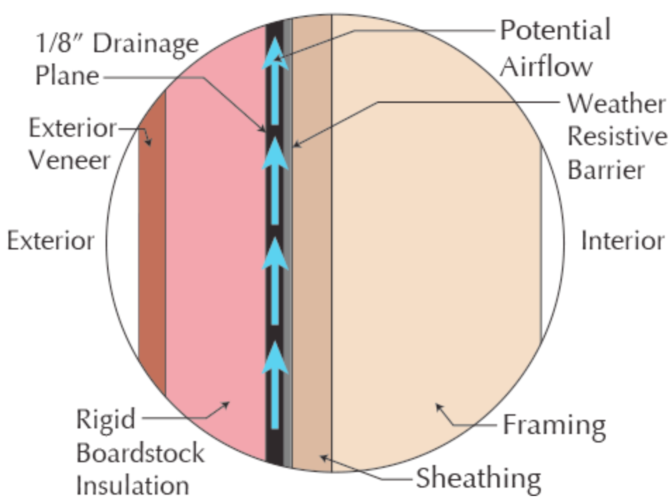
Drainage Plane with Weep Detail
Drawing #3



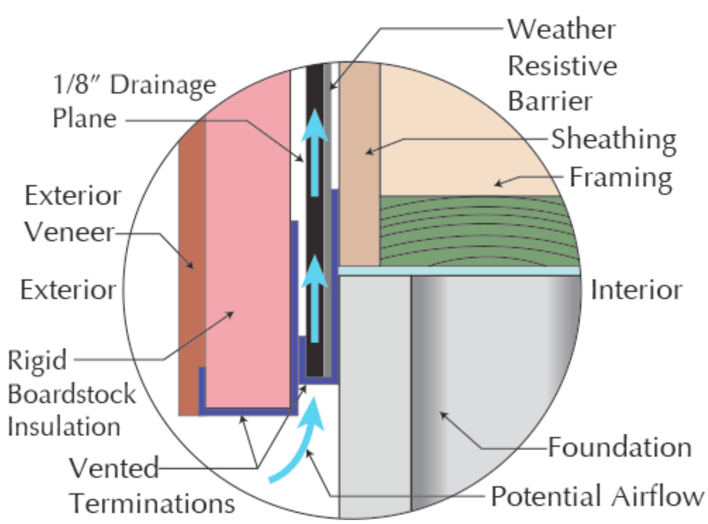
The drainage plane is a void (a "continuous plane") that separates the interior side of the rigid boardstock insulation that is layered on the exterior surface from the weather resistant barrier (WRB) installed on the exterior sheathing. Including a drainage plane may decrease the "R" value of the wall because of the potential for airflow, but in testing conducted by the EIFS industry, that decrease is minimal. A drainage void of 1/8" decreased the "R" value by less than 10%. (see #4A and #4B) However, a void of more than 1/8" reduced the "R" value dramatically.

It should also be noted that there are other sustainability factors involved. While energy use is important, a rainscreen building envelope without moisture management

Reduced "R" Value
Potential Air Flow in Wall
Drawing #4A



Reduced "R" Value
Potential Airflow at Weep
Drawing #4B

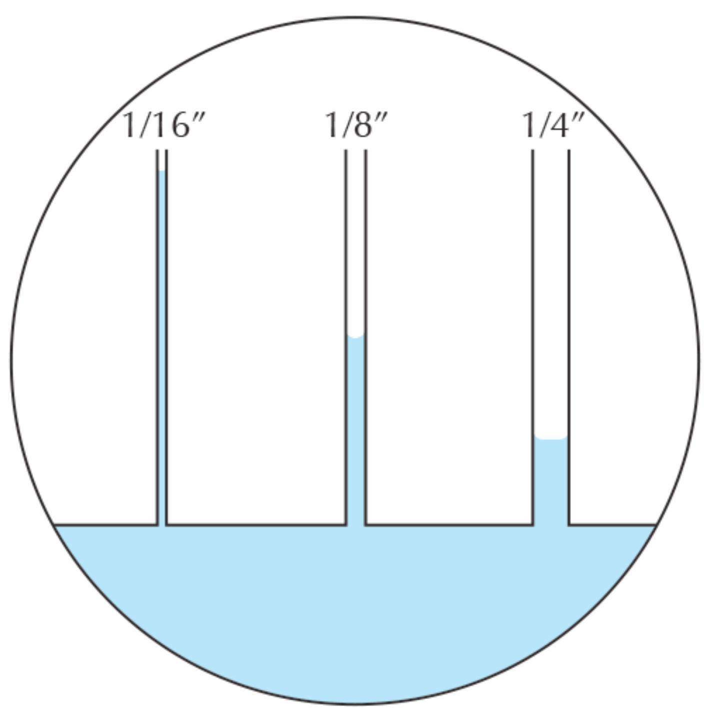


has an increased risk of material damage from entrapped moisture. Also, energy inputs may increase due to the need for dehumidification, and diminished "R" value of wet insulation. Finally, entrapped moisture can increase health risks for building occupants by creating the conditions that encourage microbial growth (mold, etc.).

The EIFS industry's accepted standard for this void is 1/16" to 1/8". MTI and others in the construction industry believe that the void should be a minimum of 1/8" to facilitate drainage because a void of less than 1/8" may encourage capillary action. (see #5) When determining the depth of the drainage plane (drainage void) a balance must be struck between effective moisture management, energy conservation, human health and welfare, aesthetics and material conservation.

The impact that a thickness of rigid boardstock insulation has on fastening patterns and other structural requirements for various types of veneers (stucco, adhered thin stone and thin brick, etc.) also needs to be considered by designers, builders and building owners. Adding a thickness of rigid boardstock insulation moves the weight of these veneers out and away from the structural wall members. Longer, stronger fastener screws

Capillary Action
Drawing #5

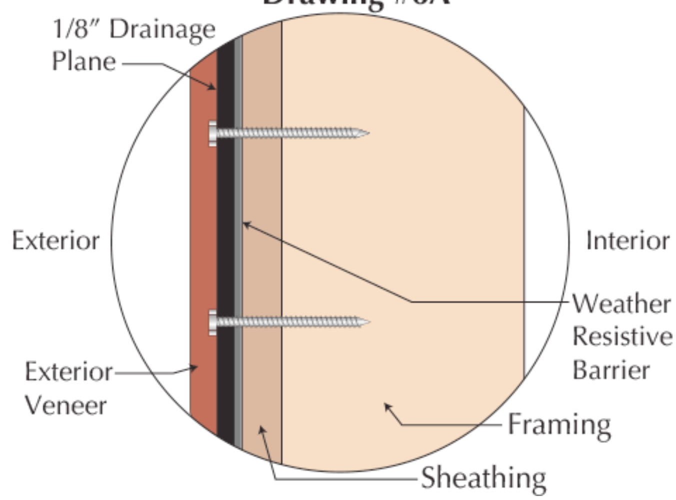


and structural extension devices (metal Z- furring) will be needed to compensate for this change. The other factor that may complicate this matter and will need to be addressed is that rigid boardstock insulation may have dynamics of its own that may add movement stressors to these systems. (6A, 6B, 6C, 6D)

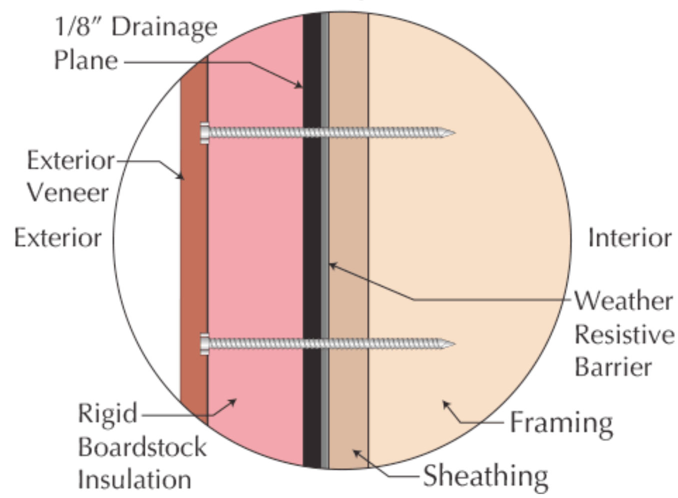
The impact that rigid boardstock insulation has on exterior building envelope rough openings and the installation procedures of windows, doors, louvers, etc. when it is layered on over the WRB and the exterior sheathing of the exterior building envelope is an unknown that is still being debated. (see 7A & 7B)

The idea that one part of a system may have a dramatic effect on the other members of a system is not a new way of thinking. Buildings are, by their very nature, a system of related components that are designed, selected and constructed by a team of architects, specifiers, owners, contractors and subcontractors. This complex process demands an integrated approach to building that reflects careful consideration of how each component affects all the others, and that information needs to be communicated to and shared among all those involved. This concept is known as "Whole Building Design."

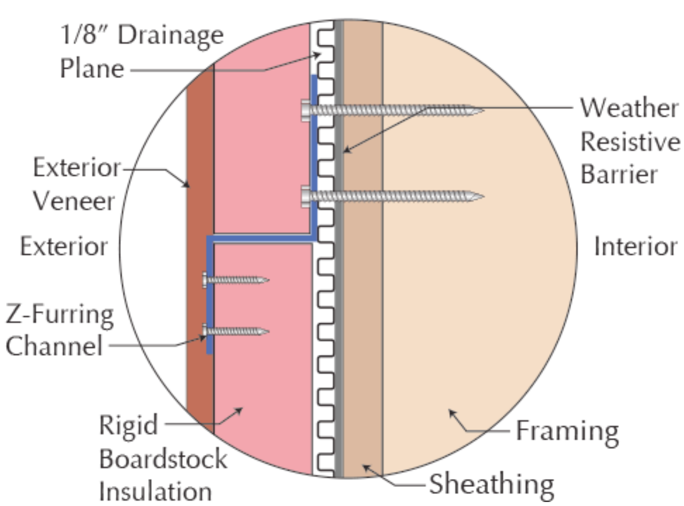
Screw Fasteners With No Rigid Boardstock Insulation Drawing #6A



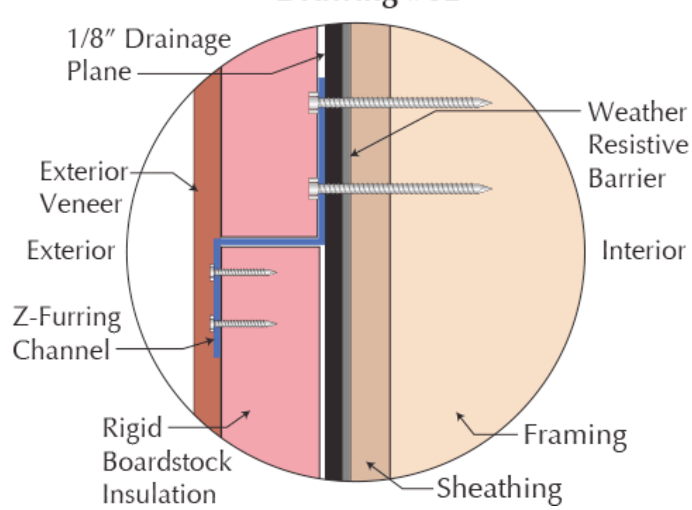
Screw Fasteners With Rigid Boardstock Insulation Drawing #6B



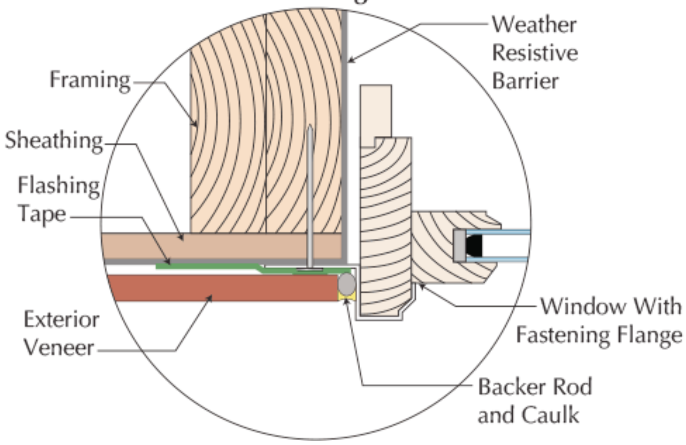
Top-Down View Z-Furring Channel Attached Vertically Drawing #6C



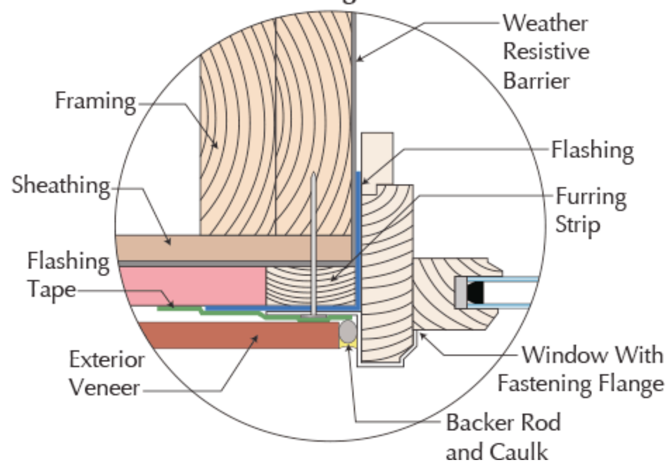
Side View Z-Furring Channel Attached Horizontally Drawing #6D



Window Installation With No Rigid Boardstock Insulation Drawing #7A



Window Installation Moisture Flange On Furring Strip Drawing #7B

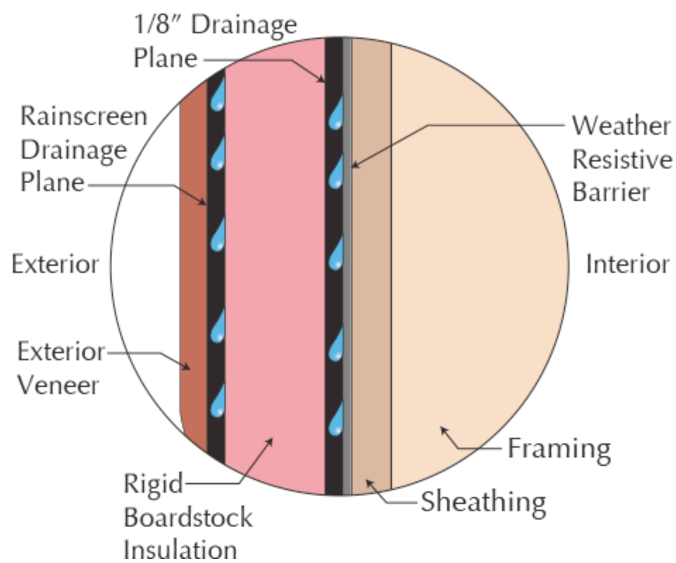


According to Don Prowler, FAIA, "A high-performance building cannot be achieved unless the integrated design approach is employed. To achieve this goal of a high-performance building, project goals are identified early on and held in proper balance during the design process; and where their interrelationships and interdependencies with all building systems are understood, evaluated, appropriately applied, and coordinated concurrently from the planning and programming phase. An integrated team of specialists working cooperatively throughout the entire project implements this integrated design approach." (Prowler, 2012)

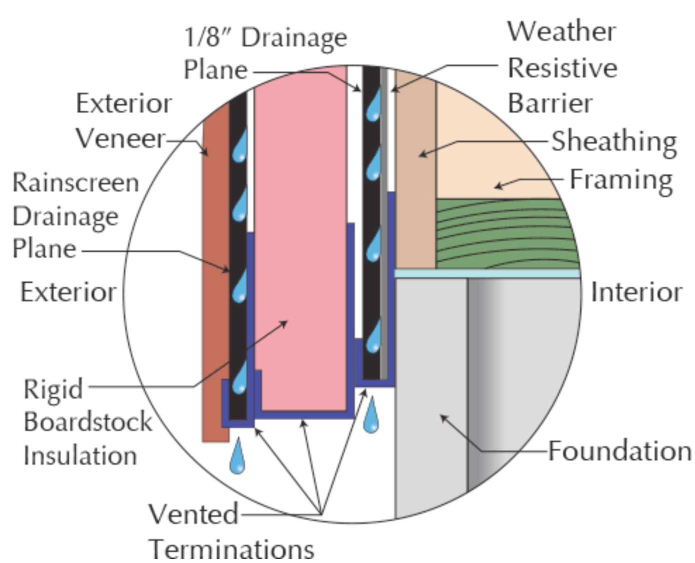
We can no longer design and build in the old way where each stakeholder does his or her own thing with little or no thought given to how it impacts all the other components and processes in this complex task of constructing a building. The following details are examples that MTI and others in the construction industry believe to be solutions to some of the questions in this article. (see 8A, 8B, 8C, 8D, 8E)

Holistic building should not be a hot button term but rather a goal that benefits all involved. All components of an exterior building envelope support one another and the overall goal of sustainability. The informed designer, builder and building owner are better prepared to execute the needed changes and take advantage of them. The uninformed designer, builder and building owners will be victims!

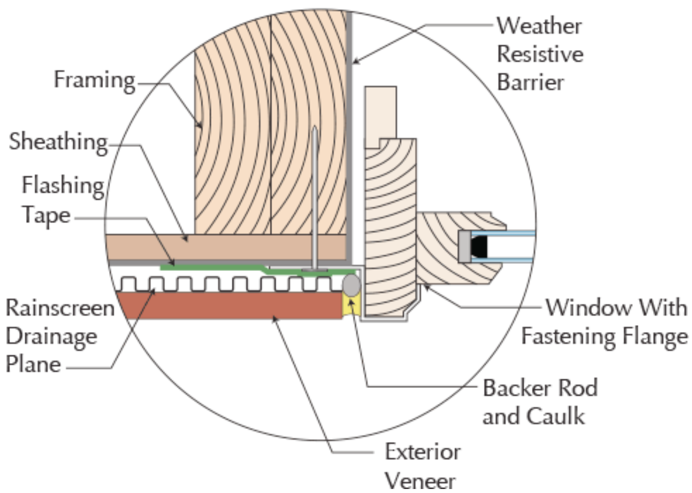
Drawing #8A



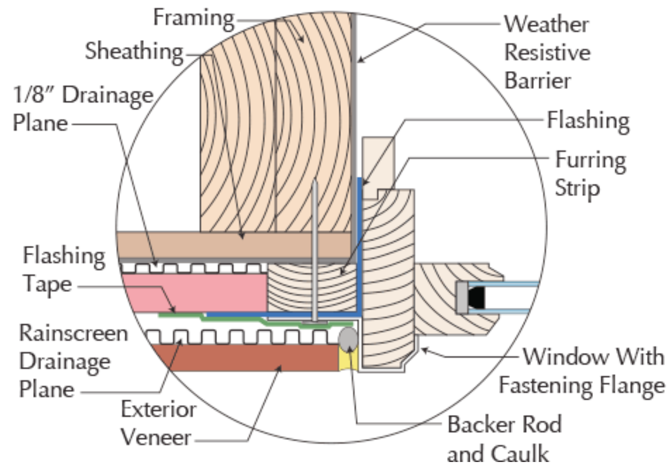
Drawing #8B



Drawing #8C



Drawing # 8D



Drawing #8E