Industrial Revolution

Every home makes compromises among different and often competing goals: comfort, convenience, durability, energy consumption, maintenance, construction costs, appearance, strength, community acceptance, and resale value. Often consumers and developers making the tradeoffs among these goals do so with incomplete information, increasing the risks and slowing the adoption of innovative products and processes. This slow diffusion negatively affects productivity, quality, performance, and value. This department of Cityscape *presents, in graphic form, a few promising technological improvements to the U.S. housing stock. If you have an idea for a future department feature, please send your diagram or photograph, along with a few well-chosen words, to elizabeth.a.cocke@hud.gov.*

Rainscreens: An Established Technique for Advanced Wall Construction

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Abstract

Exterior wall claddings have been found to be durable over many years when installed on poorly insulated, inefficient structures. As emphasis has been put on increased insulation in the building envelope—the lack of heat transmission across wall assemblies has reduced the ability of these systems to dry after they become wet. That is when rainscreen systems become a solution to increase the durability of light-frame wall systems. The increased ability to drain bulk water and to dry by convection allows for wall systems to have a sustainable interaction with the environment.

The Status Quo

Since the publication of the 2006 International Residential Code (IRC), residential structures have been constructed with a code-mandated water-resistive barrier (IRC R703.2) as one layer within exterior wall assemblies. This water-resistive barrier is the primary layer that provides a dedicated drainage plane for shedding bulk water resulting from rain and snow events. Numerous manufacturers produce wraps and papers that comply with water-resistive barrier code requirements, making this provision a commonly understood and implemented practice.

Although a properly installed water-resistive barrier can be an effective means of preventing bulk moisture intrusion in building cavities, it is commonly accepted in the building community that all wall assemblies will become wet at some point during their service life (Matthews, 2010). Some limitations of conventional wall assemblies employing water-resistive barriers include the following—

- Simply installing a code-compliant water-resistive barrier does not necessarily address the need for a wall assembly to effectively dry should it become wet.
- Flashing at wall openings (doors, windows, etc.) and utility penetrations is commonly installed incorrectly, increasing the likelihood of moisture intrusion or entrapment.
- Increased levels of insulation in walls reduce the ability of walls to dry through diffusion when water vapor is present and when it is necessary to dry moist building materials.

As energy codes continue to require increased insulation levels in wall cavities, the need for additional drying capability becomes crucial to providing a building that can sustain the effects of wetting and drying over time.

Rainscreen Cladding Assemblies

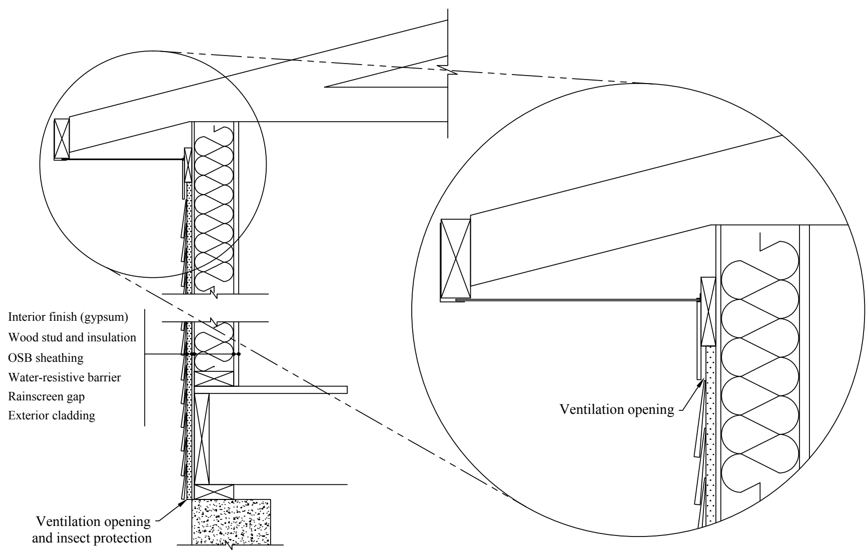
Rainscreen cladding assemblies modify conventional light-frame wall assemblies by including an additional layer or air space behind the exterior cladding. This layer's primary purpose is to enhance drainage and to provide additional drying capability through ventilation. Builders can achieve this enhancement by manipulating commonly available building materials or by implementing proprietary rainscreen components that are commercially available through building component suppliers.

The main concept behind a rainscreen assembly (or system) is the designed inclusion of a gap behind exterior cladding, whether that cladding is a brick veneer, a fiber cement siding, or any number of other common products. This gap provides enhanced drainage and drying characteristics to the overall wall system. Research and observation have shown that an effective rainscreen must employ a gap with a minimum depth of 1/4 inch (Holladay, 2013). It is common, however, for rainscreen gaps to have dimensions of 1/4, 3/8, 1/2, or 3/4 inch. The depth of the gap will often depend on the material used to construct the gap. For example, plywood furring strips typically come in thicknesses of 1/2 or 3/4 inch, while some proprietary products are manufactured to depths of 1/4 inch. Some literature recommends other gap thicknesses such as 1 inch, which has proven to be suitable for providing a rainscreen for masonry claddings (Mas et al., 2011).

A true rainscreen system also employs ventilation openings at the top and bottom terminations of the wall system. These ventilation openings, shown in exhibit 1, enhance the drying process by allowing convective currents to travel through the rainscreen gap. Although these ventilation

Exhibit 1

Rainscreen Wall Section and Ventilation Detail



openings provide an optimal rainscreen assembly, it is important to note that a rainscreen assembly without ventilation openings still provides enhanced drainage and drying capability (Holladay, 2013).

Although other studies have attempted to develop an analytical model for different phenomena involved in the drying process (Baskaran, 1994), most rainscreen design recommendations are based on field observation. Ongoing research, however, continues to attempt to bridge the gap between theory and practice (Kumar, 2000).

Typical Rainscreen Cladding Assembly

Conventional light-frame wall assemblies employed in residential construction will vary slightly, depending on geographic location and climate. It is quite common, however, for these assemblies to include 2x4 or 2x6 wall studs at a spacing of 16 or 24 inches on center and oriented strand board (OSB) or plywood exterior sheathing of a thickness near 1/2 inch, on top of which a code-compliant, water-resistive barrier has been installed as a house wrap or building paper.

Wall assemblies that are without a rainscreen gap will typically consist of an exterior cladding product installed on top of these components. When employing a rainscreen system, however, an additional component, product, or series of products will be installed before the installation of the cladding. These rainscreen components can be categorized into two main installation strategies—

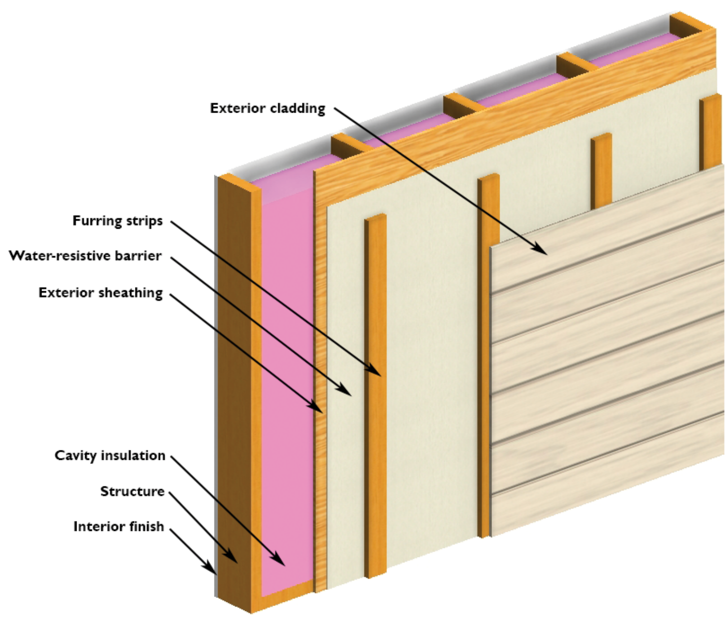
1. Furring strips.

2. Three-dimensional mesh or mat products.

Furring strips have been used on buildings for years in a variety of different configurations for a variety of purposes. When furring strips are used as part of a rainscreen system, they commonly are made of wood-based materials or plastic products that are fastened into the main structure of the building as shown in exhibit 2. Furring strips are most commonly installed vertically, although

Exhibit 2

Three-Dimensional Schematic of Rainscreen Wall Assembly



horizontal installation may be employed for those types of cladding that run vertically. For horizontal vented battens, however, the air-change rate is approximately one-half that of the vertical battens (Falk and Sandin, 2013).

Three-dimensional mesh or mat products—proprietary systems installed beneath exterior claddings—provide a rainscreen gap in the wall assembly. These products are often manufactured in rolls and are installed in rows on the exterior of the building. Some mesh or mat systems are specifically designed for specific cladding types, including hardcoat stucco and manufactured stone veneer.

Benefits of Rainscreen Cladding Assemblies

Including a rainscreen gap in the design of a light-frame wall assembly has numerous benefits—

- Rainscreen systems provide an additional factor of safety against moisture damage for high-R walls (Karagiozis and Kuenzel, 2009).
- The rainscreen gap provides a capillary break between the cladding and the water-resistive barrier.
- Rainscreen systems can be used on top of conventional water-resistive barriers and wall insulation products and do not commonly have issues with material compatibility.
- A rainscreen gap can be provided with readily available building materials, which can limit costs and reduce implementation barriers.

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