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In This Issue: We examine various aspects of the building envelope, including exterior trim, exterior sheathing, building envelope peer reviews, building envelope commissioning, and vapor retarders.

On the Cover: This three-dimensional, highly detailed computer model rendering of a building flexes into the virtual sky. © Flat Pyramid.
WHAT ABOUT THE TRIM?

A critical element of the building envelope has been ignored for too long.

By Derek A. Hodgin, PE, RRO, RRC, REWC, RWC, RBEC, CDT

Depending on installation details, exterior trim can be a critical element of the building envelope, particularly on single- and multifamily residential construction. However, this critical component has virtually been ignored by the building code and code-referenced standards. This fact has recently come to light as more and more troubles with exterior trim have been documented (Photos 1, 2, and 3). Exterior trim components are typically installed along roof lines as fascia board, around windows and doors, at building corners, and at floor lines—all of which are areas that are most susceptible to elevated moisture.

The troubles with exterior trim typically include water-related deterioration, often originating behind the trim (where it can be hidden from view) and/or at joints that allow wicking of moisture that can result in visible swelling and delamination. In some instances, significant water-related damage can exist with no obvious visible damage to the exterior finish (Photo 4). As this deterioration continues, the underlying wall assembly is exposed to more and more water infiltration. The deterioration is most pronounced in "engineered" trim products, which are highly sensitive to moisture; but it has also been observed on some natural, less-durable wood species used for trim. However, Mother Nature has never provided a ten-year warranty or made marketing statements regarding "long-lasting durability allowing for decades of service life." Cement and plastic-based trim products, which are
nearly immune to water-related damage, appear to be performing adequately to date and are not discussed in this paper.

To compound the problem, manufacturers of exterior siding and trim products have historically displayed a lack of understanding regarding the building envelope as a system of individual components, each with specific needs to accomplish long-term durability. This lack of understanding has been distributed to contractors in the form of poor installation instructions. These instructions have lacked sufficient information (or actually provided defective details) regarding integration of building components used in an exterior wall assembly (i.e., not requiring weather-resistant barriers [WRB] to be properly integrated with flashing, not requiring cut ends of trim to be sealed, and requiring flashing to be sealed with caulk). The applicable building code(s) have only made general references to flashing and weather resistance of exterior walls, leaving the fate of the exterior trim to the contractor. In order to avoid deterioration, the exterior trim must not get wet for prolonged periods of time. The same lack of proper consideration of detailing all
components in an exterior wall assembly is what caused the construction industry so many problems with EIFS. In fact, the areas of problems with engineered trim are essentially the same areas where EIFS was documented to have problems with water intrusion (Figure 1). This paper is intended to highlight where we have fallen short with engineered trim products, in hopes of promoting improved practices for the future.

ENGINEERED TRIM PRODUCTS

The term “engineered” trim is simply a euphemism for the more technically correct term of medium-density fiberboard (MDF) and the less technically correct term of hardboard. This appears to be an effort made by manufacturers of exterior trim and the Composite Panel Association (CPA), the North American trade association for the particleboard (PB) and MDF industries, to steer clear of terms that conjure images of well-documented problems with hardboard siding that have been the subject of lawsuits for decades.

Regardless of the name used to describe the wood-based exterior wall cladding products, it is the experience of the author that most (if not all) building products of the exterior siding and trim family are MDF. This opinion is based on manufacturer test data and independent testing that reveals a specific gravity (SG) within a range of

![KEY AREAS THAT MUST BE PROPERLY FLASHED AND SEALED](image)

Figure 1
0.74 and 0.81, which is consistent with the definition of MDF by the Wood Handbook® (SG = 0.50 to 0.80). Hardboard is defined as having an SG of 0.90 to 1.0, although hardboard siding products typically have an SG in the MDF range. In summary, all of the siding and trim products evaluated to date are technically classified as MDF by the Wood Handbook definition, regardless of how the products are marketed.

COMMON OBJECTIVES

As building owners, designers, contractors, and occupants, we should share the following common objectives: durable, low-maintenance, attractive buildings that provide long-term functional service. In this regard, building materials should be properly selected for their intended purpose. It is incumbent upon manufacturers, designers, and contractors (those who collectively deliver the end product into the stream of commerce) to consider all aspects of each product in order to meet the common objectives stated above.

For the manufacturer, these aspects include, but may not be limited to, the following:

- Proper research and development of engineered building products,
- Adequate testing that actually simulates in-service conditions. (This requires an understanding of the building code and accepted typical construction practices), and
- In order to meet the common objectives, adequate instructions for designers and contractors who use this product. (This requires an understanding of the exterior wall assembly and how an individual product will be integrated with adjacent components.)

For the designer (not always included in single-family residential projects), these aspects include, but may not be limited to, the following:

- Proper research and evaluation of building products,
- Review of manufacturer test data that simulate in-service conditions. (This requires an understanding of the building code and accepted typical construction practices),
- Review of manufacturer instructions to determine adequacy of integration of the individual product with adjacent exterior-wall components, and
- Supplemental instructions (as determined to be necessary) to the contractor.

For the contractor, these aspects include, but may not be limited to, the following:

- Proper research and selection of building products,
- Complying with the applicable building code and local construction practices, and
- Adhering to manufacturer instructions in order to meet the common objectives.

THE BUILDING CODE

It is the author’s opinion that merely building to minimum building code requirements results in the worst building that a contractor can construct legally and get away with. It should be considered the weakest link in accomplishing the common goals stated above. However, with all of its shortcomings, the code includes adequate

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provisions for manufacturers to develop new and innovative building products. Specifically, the code allows for "alternate materials" to be used, as long as adequate evidence is provided to indicate that the product is "...at least equivalent of that prescribed in this code in suitability, quality, strength, effectiveness, fire resistance, durability, dimensional stability, safety, and sanitation."

When hardboard siding manufacturers expanded their product lines to include trim products, there was no standard that specifically dealt with trim. Hardboard siding is subject to code-referenced ANSI 135.6, but this standard does not currently address (and never has) the thicker trim products (commonly manufactured by gluing two pieces of hardboard siding product together). Additionally, it would seem obvious, particularly to those who understand exterior wall assemblies, that the new trim products would be exposed to harsher conditions than their siding counterpart. For instance, lap siding is installed on a vertical wall surface that has a significant gravitational benefit of promoting rapid drainage of water from the wall surface. Also, the lapped condition of the siding protects each course from water intrusion, leaving only the exterior face and butt edge exposed directly to moisture.

In contrast, the thicker trim products are installed in the absolute worst locations (in terms of exposure to elevated moisture) and do not have the same gravitational benefit. Specifically, fascia boards are exposed to water from the roof edge and/or gutters; window trim is exposed to water from window leaks; and trim at floor lines is exposed to water from wall areas above and from splash-up from below—particularly when the trim is adjacent to hard surfaces such as walkways and patios. These are all common building features that were known to manufacturers when the trim products were being developed and sold.

THE STANDARDS (NOT)!

According to the engineered trim industry and manufacturers, there are currently no standards that directly apply to engineered trim products. However, some experts (and manufacturers) have asserted that ANSI 135.6 (the hardboard siding standard) is applicable to exterior trim products. It is clear that trim products exceed the 1/2-in. thickness limitation imposed by this standard. Additionally, as described previously, trim products are installed in the areas of exterior walls that are most vulnerable to elevated moisture. It seems completely unreasonable to think that a standard used with questionable success for hardboard siding would be even remotely effective for producing a durable trim product. Finally, ANSI 135.6 requires all products that comply with this standard to be identified as such. The author is unaware of any exterior engineered trim product that has ever been identified as complying with any standard.

According to the CPA website, "An ANSI Engineered Wood Trim Standard is under development and is expected to be complete in 2012." If this standard were released today, it would be about 20 years after engineered trim came on the market, after millions of board feet had been sold to the public, and after numerous problems had been documented. It will be interesting to see what (if any) value the new standard will have in terms of providing a durable building component (one of the common objectives). The CPA membership includes all major manufacturers of engineered trim products. How stringent can the standard be without causing compliance problems for existing products? This is the same problem experienced in the roofing industry by nonasbestos-containing roofing tiles. The product standard was developed after numerous product failures had been documented. The standard was developed so that all manufacturers of nonasbestos-containing roof tiles (that had not pulled their product or filed for bankruptcy) would meet the standard. The result was a superficial standard of limited usefulness, and additional failures were documented.

The only standard that has been developed to address exterior MDF trim is ANSI A208.2. The 1994 version of this standard included provisions for exterior MDF, but the "exterior" aspect was removed in the very next version released in 2002. While there is debate as to the applicability of the 1994 standard to exterior MDF, many documents (including the Wood Handbook and various CPA documents) specifically reference the 1994 version as the standard for exterior MDF. It is unclear why the exterior reference was deleted.

It is worth noting that the physical properties required of exterior MDF (put forth by ANSI A208.2-1994) have been documented by the author to be much higher than any engineered trim product tested to date. Particularly, modulus of rupture (MOR), modulus of elasticity (MOE), and internal bond (IB) values routinely fall short of the referenced standard. These properties are considered to be important in predicting long-term durability of wood-based products.
BEST PRACTICES

The primary defense of failed “engineered” trim products is improper installation. While improper installation (installation that does not comply with the building code and/or the manufacturer instructions) may contribute to the extent of damage to a trim component, damages have also been observed on trim components of numerous buildings where the installation was properly installed (installation that complies with the building code and the manufacturer instructions. (See Photo 5.) In most cases, proper installation is confused with best practices.

Best practices are those details that are good ideas that should be specified by building designers (who are not always included in residential projects) and/or utilized by contractors to achieve the common goals, but are not required. The following details are considered to represent best practices for exterior trim installation:

- The installation of a weather-resistant barrier (WRB) when it is not specifically required
- The fabrication of flashing with “end dams” that preclude the lateral migration of moisture
- The sealing of cut (nonexposed) ends of trim boards
- The field application of primer on all six sides of trim boards
- The proper integration between flashing and WRB
- Back venting of trim components
- Sealing of horizontal flashing joints
- Beveling of unprotected horizontal projections
- Beveling of protected horizontal projections

Because the best practices described above are not required by the building code or manufacturer instructions, failing to comply with these practices does not represent improper installation. However, not complying with best practices may violate accepted industry standards. Specifically, the manufacturer should design products that meet the common goals based on exposure to typical construction details that meet the applicable building code and their instructions. It is considered to be unreasonable for a manufacturer to expect contractors to perform above and beyond minimum requirements. Specifically, exterior trim products should be durable and long-lasting (as claimed) when installed in accordance with the weakest links (the building code and the installation instructions). Reliance on a contractor doing anything beyond these requirements is wishful thinking.

CONCLUSIONS

It is often said that we learn much more from failure than success. If that is true, we could learn a lot about “engineered” trim products over the last 20 years. While improvements have been made to the product, we continue to (unrealistically) rely on best practices to protect the trim so that it provides a reasonable service life. Unfortunately, the code and manufacturer instructions fall short of best practices, and damage inevitably seems to occur. Based on the author’s experience, the recommendations below are considered to be necessary if we are to strive to meet the common objectives outlined above.

Stucco and Exterior Finish Cladding Systems

An RCI, Inc. Educational Program September 13-14, 2012 | Orlando, Florida

The Stucco and Exterior Finish Cladding Systems course is the second exterior-wall-specific course that builds on the fundamentals presented in the Exterior Walls and Science program. The purpose of the course is to provide essential information on material properties, design principles, evaluation techniques, and repair methods for stucco and EIFS.

Topics covered in this course include sound transmission, thermal bridging, coatings, testing methods, and the various codes and standards impacting stucco and EIFS.

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Manufacturers

- Produce a meaningful standard for "engineered" trim that will result in improved durability.
- Manufacture products that meet or exceed the meaningful standard.
- Provide products with a code evaluation report.
- Improve installation instructions by showing typical integration with adjacent building products and include (or at least reference) best practices.

Designers and Contractors

- Only use alternate products that have a current code evaluation report.
- Try to research the in-service performance history of products before making a selection.
- Review the product warranty to see what the manufacturer expects to have problems with, or has had problems with in the past.
- Always specify and/or employ accepted best practices when designing building assemblies comprising multiple components.

In summary, as we have learned (and continue to learn) from construction failures, wall assemblies must be properly detailed and constructed to provide long-term durability. The properties of each building component—both strengths and weaknesses—must be considered for the common objectives to be achieved. Until manufacturers, designers, and contractors recognize each individual building component as part of a system, we will run the risk of falling short of the common objectives. The recommendations provided by this paper are suggested in hopes of improving our current practices and reducing problems in the future.

REFERENCES

3. 2000 International Residential Code (IRC) for One- and Two-Family Dwellings.

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Derek A. Hodgson is a forensic engineer specializing in failure investigation of building envelopes and roof systems. He has investigated numerous types of roof failures resulting from hurricanes, tornadoes, hail, fire, ice, and deficient construction. Hodgson is a licensed professional engineer in 14 states; has RRO, RRC, RWC, REWC, and RBEC registrations from RCI; is a certified Third Party EIFS Inspector, Moisture Analyst, and Building Envelope Inspector with the Exterior Design Institute (EDI); and is certified as a wind and hail umpire with the Windstorm Insurance Network. He is the owner and president of Construction Science and Engineering, Inc. (CSE) in Westminster, SC. CSE also has branch offices in Asheville, NC; and Greenville, SC. Hodgson is a past member of RCI’s Interface Editorial Board and currently serves on the RCI Technical Advisory Committee (TAC).

American High-Performance Buildings Coalition Formed

Industry leaders have launched a new coalition called the American High-Performance Buildings Coalition (AHPBC). Its goal is to "inject a level of openness and transparency into the development of green building certification systems adopted by government agencies and other public authorities." The Center for Environmental Innovation in Roofing represents the roofing industry on the AHPBC steering committee. Its mission is to support and promote the development of true consensus-based building codes, standards, and rating systems for green buildings. For more information, visit www.betterbuildingstandards.com.