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Unexpected Expansion Of Fiber Cement Panels

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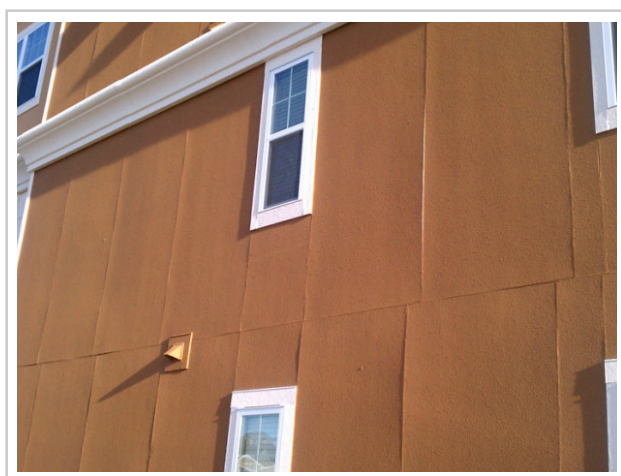
Fiber cement panels have become a preferred cladding system for a clean, monolithic aesthetic typically associated with more expensive claddings such as stucco or EIFS. But the industry is seeing an alarming number of panel failures resulting in costly building repairs. Many of these failures point to panel joint design and excess movement.



This luxury apartment building was only six months old.

Notwithstanding requirements of control and expansion joints, conventional practices advocate 1/8" gaps when panels are aligned vertically and 1/8" to 1/4" gaps at horizontal joints. Where spans are significant in length, product manufacturers recommend consideration of movement due to the coefficient of thermal expansion (COTE) as well as movement due to moisture. The coefficient of thermal expansion simply describes how the size of a material changes in response to changing temperatures – expressed in dimensional change per degree. The coefficient of thermal expansion varies between 3.6^{-10} to 7.6^{-10} in/in degree F according to most panel manufacturers. Under normal conditions, movement due solely to thermal properties is accommodated by the conventional 1/8" recommendation. For example, assuming James Hardie's published longitudinal and transverse COTE values of 6.7^{-10} in/in degree F and 7.6^{-10} in/in °F would result in expected expansions of 0.08" and 0.0367", respectively (assuming a 4'x10' panel and 0 to 100°F).

But what are the effects of moisture-induced movement? Manufacturers report moisture movement of 0.05% to 0.098% of length based on testing performed to ASTM C1185. When added to expected thermal movement, movement could actually exceed the 1/8" requirement by over 40%. Furthermore, James Hardie recognizes that, under normal conditions, adjacent fiber cement panels with elastomeric tape joints may move in excess of 5 mm (0.1965"), which is over 50% greater than the conventional 1/8" requirement. This amount of movement, whether caused by moisture or non-moisture factors, would well exceed expected elasticity performance of most sealants. The effect of panel edge swelling, which may exceed 1.5% of thickness at saturation, further compounds the problem.

The defaulted reliance on 1/8" spacing also defies industry standards for proper sealant joint design which have long required a minimum sealant width of 1/4" and a width to depth ratio of 2:1. Panel thickness of 5/16" often results in sealant being applied either too deep (relative to width) or too shallow – either will result in premature cracking and reduced service life.

No discussion of fiber cement panel movement would be complete without some understanding of ASTM C1185 (Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards). For the purpose of determining moisture movement, ASTM C1185 stipulates specimen exposures to practical equilibrium at a relative humidity range of 30-90% and a temperature of 73F (±4F). Moisture movement testing is performed independently of water tightness. In other words, the results assume that bulk water is not introduced and that bulk water is not transferred to the back side of the panel. We argue that such assumptions are flawed and that joint performance should anticipate bulk water wetting to the back side.

We have seen an alarming number of sealant failures associated with a wide range of fiber cement panel applications (e.g. DEFS, synthetic stucco, textured finishes). Many of these failures occur within five years of installation and point to excessive panel movement, insufficient edge support, inadequate control joints, and poor sealant design. Below we provide broad recommendations intended to extend the service life of fiber cement panels on framed wall construction.

1. Vertical joints in the field should accommodate 1/4" spacing in climates subject to extreme temperature changes.
2. Design joints for proper moisture resistance and release.
3. Employ joint covers or battens.
4. Achieve required panel edge support.
5. Fiber cement panels for Direct Applied Exterior Finish (DEFS) applications are not suitable for cold climates or climates that receive greater than 20" of rainfall precipitation.
6. Fiber cement panels utilizing taped joints are not suitable for cold climates or climates that receive greater than 20" of rainfall precipitation.
7. Fiber cement panels should always be installed in conjunction with a ventilated or pressure equalized rainscreen.

February 14, 2012 in Featured. Tags: ASTM C1185, Building Defects, Building Envelope, Building Resiliency, Coefficient of Expansion, Fiber Cement, Fiber Cement Expansion, Freeze Thaw Damage, James Hardie, Moisture Management, Moisture Performance, Resilient Buildings, Resilient Design, Sealant, Sealant Joints, Wall Design, Wall Panels

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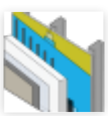

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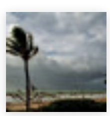

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