The Risks of Building Green in the Southeast

by J. David Odom and Richard Scott

The great irony of building green in the Southeast is that it may substantially increase a contractor's risk of lawsuits. Building green means adding more wall and roof insulation, decreasing a building's energy use, providing better ventilation, and using more organic products.

Unfortunately, building scientists and forensic engineers who specialize in construction failures in hot, humid climates say these green building features also create structures with higher risks of failure.

Two characteristics of most sustainable or "green" buildings are: 1) the use of innovative products to improve a building's performance and 2) the implementation of new design and construction techniques. The intent of these new products and procedures is to build a structure with minimal environmental impact throughout the building's life.

While this is a noble concept, the history of building failures indicates that when new products are used, or traditional construction processes are significantly altered, the performance of buildings is often adversely affected. Sometimes these changes in building performance result in dramatic failures, especially in hot, humid climates.

Two vivid examples of catastrophic failures that resulted from new products or changed procedures include:

- The problems experienced in Florida by the Martin and Polk County courthouse failures in the early 1990s, which were partially the result of significant increases in the ventilation rates promulgated by ASHRAE in 1989 – including a 300% increased ventilation from previous standards. This ventilation increase was intended to reduce indoor air-quality complaints and probably was successful in many parts of the country. In the Southeast, however, it was responsible for many moisture and mold problems in buildings where outside moisture loads were high and dehumidification and condensation problems were increased.
- The early generations of exterior insulation and finish systems resulted in many catastrophic moisture and mold conditions. These failures occurred throughout the country due to pervasive rainwater intrusion into the building envelopes. The failures were largely the result of a new type of wall system that came to market without adequate knowledge about its susceptibility to failure. (Later generations of EIFS systems were modified to eliminate many of these problems.)

What the building science and forensic community learned from these and other failures was that significant changes in design and construction methods can have short-term negative impacts. Performance improves only after the building community begins to understand these new products, or the manufacturers modify the products to make them more user-friendly.

The environmental goals of green building are organized around a set of nationally accepted benchmark guidelines such as LEED, which becomes a checklist of recommended practices.

The intent of green design is unquestionably good, and should be pursued. But implementing green design is bringing unprecedented change and, we believe, substantial risks to the building industry.

For contractors, in addition to the obvious risks of unknown construction costs, unanticipated schedule impacts, or the liability of not meeting specified LEED goals, there are other, more obscure, risks. These risks include increased moisture and mold problems.

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The risks of moisture and mold problems are particularly increased in green buildings since many LEED credits involve modifications to the building envelope and the HVAC systems–historically two problem areas even in traditional buildings.

The building industry has historically relied on time-proven materials and methods that have served it well. And while the use of new products must not be abandoned, past building failures should be convincing proof that any new product must undergo a much higher degree of scrutiny or failures are virtually guaranteed.

New Green Products These products appear to be entering the market at a rate that can be described as phenomenal. >>

Because the literature of many of these products suggests that they help to achieve LEED certification, designers engaged in green building projects may feel compelled to specify these materials.

It is our experience that many of these new products have limited field testing, and designers most likely do not have the time to fully research their effectiveness or limitations. The irony is that products with virtually no field testing are being recommended for buildings with life expectancies of 50-plus years so that they can be called sustainable, and it is these very products that may contribute to the shortened life of the buildings.

One risk for contractors is that the failure of a new product may be attributed to a construction error even though the deficiency may be largely a design error or a product defect. In a design-build project a green product failure will surely be attributed to the construction team since they control many of the decisions. Also, inexperience with these new materials will likely increase the potential for premature material failure.

An example of a green product that poses risks is expandable foam insulation materials. Many of these have wonderful properties such as improving air tightness of the wall, improving thermal performance, and often desirable water vapor transmission characteristics.

However, the water-absorption properties of some of these insulation materials can be substantially different from what designers expect compared to traditional fiberglass batt insulation.

Increased absorption of water by these products can virtually eliminate the drying potential in wall and ceiling cavities, trapping moisture for long periods of time and resulting in mold growth. An additional problem is their tendency to mask water leaks by sealing the wall cavity until substantial structural damage has occurred. Also, even when a leak is known to exist, these expandable foams could inhibit the ability to quickly locate the specific water entry point and make the proper repairs.

While these products can have substantial benefits, their unique properties are likely to result in more building problems, which are probably going to be deemed construction-related.

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Increased Ventilation The amount of outside ventilation air necessary for occupant health and comfort has been debated for decades.

There are sound arguments on both sides of the debate–whether to increase air volume for comfort or decrease it for energy efficiency. With green buildings there will be an added emphasis on supplying more outside air to a building to achieve LEED environmental-quality credit. [Note: LEED recommends adding a minimum of 30% more ventilation than required by current ASHRAE standards–and most codes.]

This is especially risky in the Southeast, where outdoor relative humidity levels are elevated for most of the year. Experience with humid summers, has shown a direct correlation between the number of moisture problems and increased ventilation rates.

In short, in spite of the recommended additional outdoor air volumes that LEED suggests, increasing outdoor air is likely to be imprudent in most of the Southeast without exercising extreme care.

To effectively increase outside air ventilation while simultaneously reducing energy costs, designers will likely need to increase the complexity of the HVAC control systems to achieve adequate dehumidification. This will substantially add to a contractor's risk, as more complex control systems have historically been more susceptible to failure.

Also, the operation of complex HVAC systems has often caused an increase in unintended and detrimental pressurization relationships within buildings. This has caused humid outdoor air to be drawn into wall cavities, resulting in condensation and mold growth.

Building Startup Procedures LEED credits include a building "flush-out" procedure using significant increased amounts of outdoor air near the end of construction. The intent is to remove pollutant odors from the building that came from new materials and sealants, paints, etc. The amount of air suggested by LEED to meet this requirement virtually guarantees that any building in the Southeast–as well as much of the East Coast–will be at risk for mold problems.

If this flush-out process occurs during the less humid months of the year, it may be possible to avoid moisture and mold problems, but targeting the end of construction for the less humid months is unreasonable. Even in dry months, extreme care will be required due to the huge volume of outside air that LEED requires to be introduced into the building over a very short period of time.

This detrimental outcome is predictable because the minimum amount of flush out ventilation that LEED requires is 14,000 cu ft of outside air per square foot of floor area. In a 100,000-sq-ft building this equates to 1.4 billion cu ft of outdoor air. >>

Virtually no building's HVAC system is capable of dehumidifying that amount of outside air in spite of the fact that LEED also requires that the relative humidity in the building not exceed 60% during the flush-out period.

During the summer months this amount of outside air can contribute over 200,000 gallons of water in a 100,000-sq-ft building. This moisture, along with moisture from other sources such as drying paints, will likely be absorbed into building materials and will increase the risk of mold growth.

One alternative is to use temporary outside air sources for the building flush out, but it is doubtful that many contractors would identify this requirement and include it in their bidding. Including this cost in your bid (and it could be a substantial cost) could have the effect of overpricing your firm.

Most specifications put the general contractor in charge of the flush-out. Undoubtedly the system as designed will not be able to handle these moisture loads, and the contractor will be faced with several alternatives (all bad): project cost overruns to rent the temporary equipment, creating mold problems by using the building's HVAC system, or ignoring the project specifications.

Conclusions The marketplace is increasing the demand for green buildings, and it is clear that a contractor's ability to adeptly bid and construct green buildings will be an increasing business requirement over the next several years.

What is equally clear is that the benefits of green buildings will not be obtained by construction documents produced by designers inexperienced in green buildings and by contractors following normal risk management and quality control practices.

The successful contractors will implement an additional degree of care in the use of new products, a higher degree of scrutiny of the design documents, and an enhanced risk management plan.

Contractors can no longer assume that performing the construction exactly as it was designed will be adequate to avoid lawsuits. They will need to assume that the designer may be as unfamiliar with these new products and techniques as they are, and take appropriate measures to protect themselves. <<

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