The Hidden Risks of Green Buildings:
Why Moisture and Mold Problems are Likely

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The great irony of building green in the southeast is that the very concepts that are intended to enhance a building's performance over its entire lifetime are many of the same concepts that make a building highly susceptible to catastrophic moisture and mold problems during its first few years of operation.

While green buildings (also sometimes called sustainable design) have many positive benefits, there is also strong evidence to suggest a direct correlation between new products/innovative design and building failures—especially in hot, humid climates. Simply put, departing from the "tried and true" often means increasing the risk of building failure.

Two strong characteristics of most green buildings are: 1) the use of innovative, locally-produced products and 2) the implementation of new design and construction approaches that are intended to reduce energy usage and be environmentally sound.

These environmental goals are typically organized around a set of nationally accepted benchmark guidelines such as those of LEED (Leadership in Energy and Environmental Design), which is the standard established by the U.S. Green Building Council (USGBC). LEED certification is a checklist and point system of recommended practices where achieving various point levels can certify the building as having achieved silver, gold, or platinum status. These practices involve such issues as efficient water and energy use, the reuse of waste materials, and the use of renewable and regionally produced products.[1]

The overall goal of these new materials and procedures is to achieve a structure with reduced negative environmental impact —both during construction and throughout the building's life. The intent of building green is unquestionably noble and good, and should be aggressively pursued for the improvement of the Earth's environment. However, because of the dramatic change that this will present to the design and construction industry, its implementation will present new risks that are likely to be both technical and legal in nature.

Some of the legal risks are fairly obvious, such as the risk of not meeting a building owner's expectation of achieving a certain level of LEED certification (i.e., implied or even written warranties). Other risks are more obscure, such as:

- The failure of new products to meet their promoted performance levels, which is more likely with new materials.
- Accepting the higher standard of care that a green building might present—what is currently considered "best practices" may now become the new expected "standard of care."
- Failing to recognize (or prepare for) the unknowns in cost and schedule impacts that a green building might present.

It is even unclear if a LEED certified building can be built under a design-build method of construction without the construction team assuming huge amounts of unknown risks because of the vague definition of what is considered "green."

The building industry has been historically conservative, relying on time-proven construction materials and methods. The introduction of new materials and methods has not always proven to be successful and sometimes has resulted in notable building failures, especially those related to moisture intrusion and mold contamination.

The proliferation of new products and innovative building approaches related to green development is challenging the design and construction community in such a dramatic fashion. These changes virtually guarantee an increase in building failures and lawsuits. Past experience indicates that many of these failures will be predictable and some are likely to be catastrophic.[2]

Examples of Technical Risks for Contractors & Designers

Moisture intrusion, whether bulk water intrusion through the building envelope or relative humidity increase due to the heating, ventilating, and air-conditioning (HVAC) system, results in a large percentage of construction liability claims in the U.S. Moisture intrusion not only results in building deterioration, but has been linked to occupant comfort and health issues, especially in those buildings that become contaminated with mold.[3] Sustainable building practices, some of which are part of the LEED accreditation process, can increase the potential for moisture intrusion if not carefully considered and implemented. Examples include:

- Vegetative roofs which obviously are more risky than conventional roofs (due to the constantly wet conditions) and must be carefully designed, constructed, and monitored after construction.
- Improved energy performance through increased insulation and the use of new materials which may change the dew point location in walls, resulting in damaging condensation and a reduced drying potential for wall assemblies.
- Reuse of existing buildings or recycled components which may not provide optimum water-shedding performance in new configurations or may not be readily integrated to the adjacent new materials.
- Use of new green construction materials that have not been field-tested over time.
- Increased ventilation to meet indoor air quality (IAQ) goals that may unintentionally result in increased interior humidity levels in hot, humid climates.
- Building startup procedures, such as "building flush out," which could result in increased moisture intrusion and mold growth.

New green construction materials appear to be entering the market at an accelerated rate as manufacturers realize the benefits of green products. Because many of these products help to achieve multiple LEED credits, designers working on green buildings are eager to specify these products. The risk to contractors is that many of these new products are not time-tested, and designers often do not have the time to fully research the efficacy of these products. If the new product fails, it may be considered a design error, but it may be difficult to determine if it is a design error, an installation error, or a product defect. Additionally, general contractors must rely on sub-contractors to install new materials who they may not have experience with the new material for proper installation.

Some of the expandable foam insulation products are examples of new green materials that pose risks. The water absorption properties of these insulation materials can be quite different than what designers expect as compared to traditional fiberglass insulation. Increased absorption of water into the insulation could negatively affect the wall performance. This is not to say that such materials should not be used; however, their properties need to be recognized and accommodated in the design.

The amount of ventilation (outdoor air) necessary for occupant health and comfort has been debated for decades. Although there are sound arguments on both sides of the debate, the emphasis on increasing ventilation to achieve LEED environmental quality credits has increased the incentive to add more outdoor air to a building through its HVAC system (a minimum of 30% more outside air is recommended by LEED).[1]

This action is especially risky in the Southeast U.S., where outdoor relative humidity levels are elevated for a good part of the year. Experience in the Southeast, as well as other areas of the country with humid summers, has shown a direct correlation between the number of moisture problems and increased ventilation rates.

To effectively minimize the risk of moisture problems while increasing ventilation, designers need to increase the complexity and capacity of the HVAC components and control systems to achieve proper dehumidification. This adds to contractor risk, since complex systems fail more often than simple systems. Additionally, the complexity of the system operation can cause unintended pressurization relationships where local depressurization causes humid outdoor air to be drawn into interstitial building cavities, causing condensation and mold growth.[4]

Building owners, designers and contractors all assume more risk when they deal with complex, and possibly untried, technologies. Pinpointing whether the problem is design- or construction-related may be very difficult after the problem has already occurred.[5]

Building startup procedures to meet LEED credits include a flush-out of indoor containments using increased outdoor air either at the end of construction or during the initial occupancy period. The intent is to remove pollutants from off gassing of volatile organic compounds (VOCs) from new materials. The amount of air needed to meet the flush-out requirements places a Southeast US building at great risk because of the amount of moisture introduced with the increased outdoor air. LEED requirements are that a minimum of 14,000 cubic feet per square foot of floor area is required for flush out. This presents multiple problems: most HVAC systems are not designed to dehumidify that amount of outdoor air which, in a 100,000 square foot building, is 1,400,000 cubic feet of outside air. Depending on outside conditions at the time of the flush-out as much as 240,000 gallons of water can be added to a 100,000 square foot building. This added moisture will get absorbed into building materials, finishes, and furnishings, increasing the risk of mold growth.[6]

Most specifications put the general contractor in charge of the flush-out, including controlling the relative humidity levels during flush-out. If the system is not designed to handle the loads, the contractor is faced with a difficult challenge that may require the addition of a temporary, and extremely costly, dehumidification system.

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Conclusions

"There's one sure way to kill an idea: Sue it to death."

Quote from *ENR,* July 2008

What is the greatest risk to the green building movement? It's likely not the increased costs associated with certifying that buildings are green—it's more likely green buildings that don't perform to expectations and, in some cases, may experience significant failures. The increased costs of litigation and insurance that result from underperforming green buildings will be absorbed by designers (in a highly competitive marketplace) but most costs will be passed onto building owners. These increased costs, along with the negative publicity on failed green buildings, could dramatically influence building owners NOT to build green.

Only recently has the marketplace begun to recognize the various contractual, legal, and technical risks that are inherent to green buildings. A growing number of experts have suggested that the first two steps to improved green building risk management are to: 1) recognize the unique risks for green buildings in hot, humid climates and 2) develop a set of guidelines that merge the unique requirements in hot, humid climates with green building guidelines

In the Florida, our hot humid climate poses additional long-standing recognized technical risks, whether a building is sustainable or not. However, many of the green building concepts, such as those found in LEED requirements, exacerbate those technical risks. USGBC recognizes the climatic and regional technical gaps but has not addressed them in the current versions of LEED. These gaps may not be easily recognized by designers and contractors in their pursuit of LEED credits.

The design and construction community must not assume that if you build green then you will be building regionally correct. Until the gaps between regionally correct buildings and green buildings are addressed the design community would be advised to prioritize the lessons already learned from the waterproofing, humidity control, and building forensics community. Without these priorities, poorly functioning green buildings are the likely result and this could be the ultimate killer for the green building movement in our unique climate.

In our opinion the solution to good performing, green buildings in Florida are at least three-fold:

- Development of a unique set of Hot, Humid Climate Design Criteria that integrates (and prioritizes) hot, humid climate criteria with current green building practices. Best practices for hot, humid climates must take priority over green building practices.
- A detailed Green Building Risk Management Plan that provides guidelines for the design and construction team from concept through the 1-year warranty period. These guidelines would incorporate the best ideas of green building specialists, moisture control specialists, attorneys, and insurance companies.
- A hot, humid climate customized Building Commissioning Program that identifies, and resolves, the known conflicts between national green building criteria and specific regional criteria. ■

Liberty Building Forensics Group, LLC (www.libertybuilding.com) is a firm that specializes in forensic building investigations and expert witness/litigation support. Their staff has led the litigation support of some of the largest building failures in the country, including the $60 million defect claims at a luxury resort in Honolulu and the $20 million Martin County Courthouse problems. They have performed green building-related services on over $3 billion in new construction since 1995. Their staff has authored three manuals and over 50 technical publications.

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