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## Joe Lstiburek, PhD, PE

The Life and Times of the Dean of Building Science Part 2

This week we welcome back Joe Lstiburek, PhD, P. Eng. for a discussion about his new book **"Moisture Control for Residential Buildings"**. The first edition came out in 1991 and with all the changes to code, materials, methods, etc. it was time for a new addition. Mission accomplished now it's time to LEARN MORE about the current state of Moisture Control for Residential Buildings!

JOSEPH LSTIBUREK, B.A.Sc., M.Eng., Ph.D., P.Eng., is the founding principal of Building Science Corporation and an ASHRAE Fellow. He is a building scientist who investigates building failures. Dr. Lstiburek received an undergraduate degree in Mechanical Engineering from the University of Toronto, a master's degree in Civil Engineering from the University of Toronto and a doctorate in Building Science Engineering from the University of Toronto. He has been a licensed Professional Engineer since 1982.

The Wall Street Journal referred to him as "the dean of North American building science." Fast Company magazine called him "the Sherlock Holmes of construction". He is internationally recognized and his work has influenced building codes and standards in every climate zone. He is a recipient of the Carl Cash Award from ASTM, a "Becky" from the Ontario Building Envelope Committee (OBEC) and the EEBA Legacy Award all for lifetime contributions to building science. He has also been inducted into the Building Performance Industry Hall of Fame and has received the NESEA Professional Leadership Award for "changing the way we think about building science and how we perform our work". Dr. Lstiburek is an acclaimed educator who has taught thousands of professionals over the past four decades and has written countless papers. He has a joy for telling tall tales to his protégés and audiences. LEARN MORE this week on IAQ Radio+.

## Nuggets mined from today's episode

*What led to the writing of this new book?* This book is an update of the original Moisture Control Handbook published by the U.S Department of Energy and Oak Ridge National Laboratory in October, 1991.

- We don't build out of rocks and hundred-year-old trees anymore. Tree and rock buildings dry in both directions.
- We have very little energy exchange from the inside to outside and vice versa; and
- We have heating, cooling, and ventilation systems that condition the inside almost year-round.
- Physics remains unchanged, we now understand more and "engineered wood is an insult to both wood and engineering".
- Drying requires energy exchange. HIGH LEVELS OF insulation can adversely affect a building's longevity BY REDUCING DRYING POTENTIALS.
- There are only two types of windows: windows that leak or windows that will leak.

*In the book you state that building assemblies get wet from the outside, get wet from the inside, and start out wet. How important is the moisture storage capacity of construction?*

- It is hard to give advice without the necessary fundamental background.
- If moisture accumulates beyond about 16 percent by weight, wood surfaces are likely to develop mold.
- Note that the surface mold limit is different than decay. There are "decay fungi" and there are "mold fungi" – they are not the same.
- Decay can be initiated when the moisture content by weight exceeds the fiber saturation point. The fiber-saturation point for most wood species used in construction is approximately 28%
- However, once decay has begun, stopping decay requires reducing the fiber-saturation point below 20%. The "on switch" for decay is 28%. The "off switch" is 20%.
- Brief spikes above 28% are not often an issue. Brief in this context is several days.

*What is the most important concept about controlling moisture for residential construction?*

- Accept the fact that buildings will get wet and encourage drying!
- Controlling rainwater entry above grade and groundwater entry below grade is the single most important issue, to address with respect to moisture damage and have been the preoccupation of generations of builders and designers.
- Air transport and vapor diffusion are not such obvious contributions to the wetting of building assemblies with air transport being much more significant than vapor diffusion.

*Where is the first condensing surface in today's construction?*

- The first condensing surface in a wall cavity is typically the interior surface (back side) of the exterior sheathing.
- Concealed condensation can be controlled by reducing the entry of moisture into the wall cavities or by elevating the temperature of the first condensing surface. Elevating the temperature of the first condensing surface in a heating climate can be accomplished by installing insulation to the exterior of the first condensing surface. Continuous exterior insulation serves this function

*What are the four moisture transport mechanisms predominant in building science?*

- Liquid flow due to gravity, surface tension, momentum (kinetic energy) and air pressure
- Liquid flow due to capillary suction
- Vapor flow due to air transport
- Vapor flow due to diffusion

*Drain the Building?*

- Layer the levels and drain away from the building with each layer directing water further away.
- Prevent rainwater from becoming groundwater.
- A wall is not a roof!

- Kickout flashing is now part of the code and the current standard of care.
- Drain the rain ON the plane. Don't be a dope slope. IF YOU WANT TO Save cash flash!

*What is a Screen Assembly?*

- Every cladding system leaks, so its important to provide a drainage layer AND A DRAINGE SPACE/GAP TO GO WITH THE DRAINAGE LAYER.
- Screen assemblies have multiple layers dedicated to water management.
- Screen systems assume some rainwater will enter and provide a mechanism to remove it.
- Perfect barrier systems rely on the exterior cladding to shed water effectively for the life of the building. Mass/storage systems assume that rainwater that enters dries both outward and inward without damaging the materials that comprise the system.

*First what are some examples of water control layers?*

- Water control layers are typically water repellent materials (building papers, house wraps, rigid insulations, fluid-applied coatings, fully adhered membranes, sheet goods) located behind the cladding and are designed and constructed to drain the rainwater that passes through the cladding.

*A common problem for IAQ investigators is brick construction with landscaping covering the bottom of the brick, a very limited drainage plane and in many cases no water control layer. How do you recommend we fix these when brick is not drained?*

- *Stucco. Or if stucco isn't an option use a moisture resistant paint or coating.*

*What is a Drained Window and Door Opening?*

The bottoms of the openings at their exterior are unsealed to permit drainage to the exterior.

- If the interior crawlspace is lower than the exterior grade, a sub-grade perimeter footing drain is necessary as in a basement foundation

*Many basement water proofing companies promote interior drainage. When do we need to go to interior drainage?*

- May be only option for remediation and rehabilitation work.

Joe Lstiburek's additional comments:

- Wood Trim - All six surfaces of the trim (the front, the back, the edges and the end cuts) should be sealed
- Due to significant energy efficiency improvements over the past several decades, air conditioning loads have been reduced to such an extent that typical air conditioning systems no longer run long enough to control interior moisture levels. Supplemental dehumidification, typically using dehumidifiers working in conjunction with air conditioning systems, is necessary in hot-humid and mixed-humid climates.
- Dilution is not the best solution to indoor pollution. Source control is. If contaminants are not internally generated or released, then high levels of dilution with outdoor air are not necessary. Source control for the building, ventilate for the people.
- It is likely that a combination of balanced ventilation, mixing and distribution of exterior ventilation air at a rate lower than is currently typical coupled with supplemental dehumidification in hot-humid and mixed humid climates is necessary.
- In cold climates, the same strategy, but without the supplemental dehumidification is likely. In all climates source control of indoor contaminant generation or release from building materials and furnishings will also be necessary. The alternatives are high exterior air ventilation rates coupled with significant dehumidification and humidification based on climate zone and time of year.
- Installing both interior and exterior air control layers can address the weakness of each.
- Interior Air Control Layer - Interior air control layers need to address air leakage concerns at multiple locations.
- Interior Air Control Layer - Resistance to air flow (airtightness) at the interior of building assemblies can also be provided by sealing the interior cladding (gypsum board) to framing elements. This approach is applicable in all climate zones.
- Airtightness can be provided at the exterior surfaces of building assemblies. This can be accomplished by installing a continuous sealed building paper or building wrap over the exterior sheathing. It can also be accomplished by

sealing the exterior sheathing to framing elements. Exterior continuous rigid insulation can also be sealed to the framing elements to act as an exterior air control layer.

- In cooling climates supply ductwork is often located outside of conditioned spaces in vented unconditioned attics and vented unconditioned crawlspaces. These ducts tend to depressurize the space, inducing the infiltration of exterior hot and humid air while dumping cold air-conditioned air into the attic or crawl space. Leaky return ducts also can draw radon and pesticides into the enclosure along with contaminants from attached garages. An obvious solution to ductwork located outside of conditioned spaces is to locate them inside of conditioned spaces. However, in most applications adequate space is not available. A more robust approach is to construct conditioned attics and conditioned crawlspaces thereby locating the ductwork within conditioned spaces.

*Final Thought?*

Don't let the Covid stuff freak you out. Have 4-5 air-changes per hour of MERV filtered INTERIOR air. Don't increase the RH.

*Z-Man signing off*

Trivia Question:

Name the building related non-profit, non-governmental organization established by the U.S. Congress in the Housing and Community Development Act of 1974, Public Law 93-383?

Answer: NIBS, National Institute of Building Science

Answered by Jack Springston