

Building AMERICA   Building Science Consortium

There is No Such Thing as a Free Thermodynamic Lunch Or Mold...Why Now?

Joseph Lstiburek, Ph.D., P.Eng.
Building Science Corporation
www.buildingscience.com

 OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

Building AMERICA   Building Science Consortium

Strategies

Mold is a water problem
No water no mold

 OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

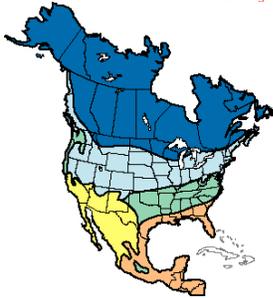
Building AMERICA   Building Science Consortium

Two Big Concepts

Climate and The Second Law
Incidental Water

 OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

Building AMERICA   Building Science Consortium



 OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

Building AMERICA   Building Science Consortium



Exposure

- Cold: 100% or more snow/ice, 100% or more wind
- Temp: 100% or more snow/ice, 100% or more wind
- Hot: 100% or more sun, 100% or more wind
- Wet: 100% or more rain, 100% or more wind
- Sea: 100% or more salt, 100% or more wind

 OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

Building AMERICA   Building Science Consortium

Strategies

Buildings should be suited to their environment. It is not desirable to construct the same manner of building in Montreal, Memphis, Mojave and Miami. It's cold in Montreal, it's humid in Memphis, it's hot and dry in Mojave and it's hot and wet in Miami. And that's just the outside environment. It is also not desirable to construct the same manner of building to enclose a warehouse, house, school, office, health club with a swimming pool, hospital or museum. The interior environment also clearly matters.

 OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

Firmness Commodity Delight

These are properly designed, when due regard is had to the country and climate in which they are erected. For the method of building which is suited to Egypt would be very improper in Spain, and that in use in Pontus would be absurd at Rome: so in other parts of the world a style suitable to one climate, would be very unsuitable to another: for one part of the world is under the sun's course, another is distant from it, and another, between the two, is temperate.

Marcus Vitruvius Pollio c. 90-20 B.C.E.



Strategies

Since we have more mold problems we must have more water problems...duh



Strategies

Since we have more mold problems we must have more water problems...duh

But we have less water....



Strategies

**The Key to Understanding Water Problems
Is Understanding Rate-Storage**



Strategies

Water Problem: When the rate of wetting exceeds the rate of drying, accumulation occurs. A problem exists when the quantity of accumulated moisture exceeds the moisture storage capacity of the material or system. The moisture storage capacity is material, time and temperature specific.



Strategies

**We are reducing the ability to dry
The materials we build with are different**






Building Science Consortium

We Do the Calculations for the Winter but the Buildings Rot in the Summer

Mark Bomberg



OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY




Building Science Consortium

We have two sides to a wall - the inside and the outside...duh.

Joseph Lstiburek



OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY




Building Science Consortium

Strategies

- Walls Get Wet From the Inside**
- Walls Get Wet From the Outside**
- Walls Can Dry to the Outside**
- Walls Can Dry to the Inside**



OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY




Building Science Consortium

Strategies

- Walls Will Always Get Wet**
- Walls Usually Start Out Wet**
- Wet Happens**



OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY




Building Science Consortium

Strategies

- Find The Water... and you will**
- Find The Mold**
- Clean Up The Mold**
- Dry The Building**
- Make Sure It Doesn't Happen Again**



OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY




Building Science Consortium

Strategies

- Heat Flow is From Warm to Cold**
- Moisture Flow is From Warm to Cold**
- Moisture Flow is From More to Less**
- Air Flow is From a Higher Pressure to a Lower Pressure**
- Gravity is Always Down ... the earth "sucks"**



OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

Strategies

Rain and Ground Water Work the Same Way Everywhere
Diffusion and Air Flow are Climate Dependant



Phases

- Solid** (snow and ice)
- Liquid** (rain and ground water)
- Vapor** (diffusion and air flow)
- Adsorbed** (surface diffusion)



The Important Ones

- Liquid** (rain and ground water)
- Vapor** (diffusion and air flow)

