Building Biology: 7 Keys to Health and Resilience
SBE16 Toronto
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EcoNest Architecture Inc.

Graduated U of T B Arch 1978
Developed MCS from a sick building
Learned how to build healthier buildings
Wrote a book...... 3 times
Discovered Building Biology
Designed many nature-based homes
using principles of Building Biology
Wrote another book
Wrote another book
Practice, consult and teach
Building Biology
A holistic approach to health in the built environment
Nature is the Gold Standard for a healthy human environment and the ultimate model for perpetual ecological balance.

Building Biology recognizes that
Almost Always…
Biological Compatibility = Ecological Performance
The European context

Cornwall England 1539
Cob Construction
Limburg an der Lahn 13th century
Waddle and Daub and timberframe
Rhone Valley  France,  250 years old
Rammed Earth Construction
Seven Common Denominators

1. Massive wall construction
2. High Hygric Buffer Capacity
3. No vapor barrier
4. Radiant heat
5. Non-toxic—petrochemical free
6. Proven History of Use
7. Long life span.....Biodegradable
1. Mass Wall Construction
In North America our building codes, energy guides and “green building” score cards consider insulation to be the primary strategy for energy efficiency. High performance is usually accomplished with petro-based foams.
Light Frame Construction
a uniquely North American Industry
R-Value.... Just one factor in thermal performance

- Heat storage capacity of house (mass)
- Interior surface temperature
- Type of heating: radiant vs. convection
- Design: room configuration
- Compass orientation
- Passive climate controls
- Shape of building
- Window placement and size
- Occupant behavior
Building Biology advocates a balance of thermal mass and insulation in order to achieve maximum comfort and energy efficiency.

Courtesy: Baker-Laporte and Assoc.
Thermal Mass ("battery")

Graph Credit: Chris Reardon
Some Mass Wall Envelope Alternatives Available in North America
Adobe construction
Light Straw/Clay Construction
Straw/Clay Construction
Rammed Earth Construction
Nk’ Mip Desert Cultural Centre
Osoyoos, British Columbia
HBBH 2008
Kooralbyn Hotel, Australia
Wood Insulated Concrete Forms (WICF)
2. High Hygric Buffering Capacity
Hygric Buffer Capacity

The capacity of a wall system to store vapor without deterioration or loss of performance

For a 2,000 sq. ft. solid masonry
... 500 gallons.

For a steel frame home with gypsum sheathing
... 5 gallons.
Earth masonry humidity buffering for 4mx4mx2.4m high room

Water absorption with relative humidity change from 30% to 90% (kg of water)

- Earth masonry: High clay content
- Earth masonry: Low clay content
- Concrete blockwork
- Fired brick masonry

http://www.greenspec.co.uk/unfired-clay-bricks.php
Mould Chow - Just add water
Hygric Buffer and Health

There is an optimal humidity range for human health. The goal of Building Biology is to maintain these optimal levels naturally.
The risk with whole house humidification: dark + moisture + dust = mold
Natural Balance

- Unsealed woods
- Oil & wax finishes
- Natural fibers
- Unsealed cork
- Clay plaster
3. No Vapor Barrier
Building envelope is...our third skin

You wouldn’t do this!
Why do this!?
Building Biology vs. Conventional approach to vapor diffusion

Allow for the free flow of vapor through the wall. Wall materials must not deteriorate under maximum loads.

Prevent vapor from entering wall. Wall materials will deteriorate under minimum loads.

Image: Baker-Laporte/Collette
Vapour Diffusion Retarder Placement - Conventional Construction

Note: Fairfield, Iowa, August average temp 87°F, Humidity 88%
Miami, Florida, August average temp 90.6°F, Humidity 87%
Water: Try and stop it!
Smart Vapor Retarder

- Prevents wetting
- Promotes drying
- Permeable air barrier in summer
- Class 2 Vapor retarder in winter

Credit: foursevenfive.com
4. Radiant Heating/Natural Climate Control
Healthy Heating

- Radiant – Like the sun
- Thermal mass storage creates even comfortable heat
- Healthy natural ion balance
- Does not blow air/dust/mold/VOC’s around
- Creates heat zones avoiding thermal monotony
- <2°C head to foot
- Does not fry dust
- Uses very little fuel
- Quiet
Forced Air Heating…
A North American specialty

It's dries air
Inefficient: Heats air…an insulator!
It is uneven…too hot…too cold
It's noisy
Furnaces Fry Dust - a pollutant
Creates Ion depleted air
Ductwork has drawbacks!
Masonry Heating

“Consider these things: One firing is enough for the day; the cost is next to nothing; the heat produced is the same all day, instead of too hot and too cold by turns; One’s whole day is a realized dream of bodily comfort.”

Mark Twain from Some National Stupidities
While fire is burning

10 hours later
Ventilation

HRV or ERV a health necessity for airtight, lightweight sealed construction

But how much is enough?
This air:

not the same as this air:
Ionization

In nature there is an abundance and approximate balance of positive to negative ions. Some places are richer than others.
Other natural conditions deplete negative ions

“It was one of those hot dry Santa Anas that come down through the mountain passes and curl your hair and make your nerves jump and your skin itch.”

Raymond Chandler
De-Ionization Indoors

- Forced air heating
- Stale air
- Synthetic building materials and finishes
- Electronic devices
- Carpeting
Ionization

- Natural building materials
- Natural unsealed finishes
- Radiant heating
- Fresh air
- EMR reduction
- Plants
Nature-based Strategies for
Thermal Comfort and Health

• Use technology as supplement not life support!!!
• Design for Climate
• Don’t de-ionize the air
• Maintain healthy humidity
• Design in Natural ventilation
• Use mass to store heat
5. Free of Toxics/Toxins
If homes had labels......
Creating healthy indoor air involves hundreds of design decisions, building protocols and materials choices from foundation to roof. Attention to finishes is “scratching” the surface.”
We Don’t Know Much

EPA can request data if chemical is causing harm
Can’t prove harm without the data

TSCA-Toxic Substance Control Act 1976
We Don’t Have Full Disclosure
MSDS/SDS will NOT Tell You

- Hazardous ingredients <1%
- Carcinogens <.01%
- Inert ingredients (can be most hazardous)
- Impact on occupant health
- PEL & TLV level untested or based on single exposure and set by industry obtainability
- Health effects don’t accurately portray long-term, synergistic or multiple exposures
- Based on very limited data. We don’t have health data on the vast majority of chemicals
<table>
<thead>
<tr>
<th>Red List Categories</th>
<th>Green Building Alliance</th>
<th>OEHHA</th>
<th>Living Building Challenge</th>
<th>EPA</th>
<th>Perkins + Will</th>
<th>Cradle to Cradle</th>
<th>Green Screen</th>
<th>HPD</th>
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What makes it Healthy?

Foam insulation

Wool batts

Courtesy: www.greenprojectmarketing.com

Courtesy: www.sheepwoolinsulation.net
6. Longevity
Putting Buildings Out in the Weather
Biodegradability
What Happens Post Mortem
Advanced Technology
The promise of the inspired idea

Access to culture in every living room
The banal reality-mindless entertainment
The promise of an inspired idea

Freedom from the vicissitudes of nature through advanced technology…International Style
Conquering climate

Through technology
At what cost and to whom?
The Banal Reality - fossil fuel dependency
A lightweight, kit of manufactured, mold-sensitive parts hooked up to life support.
“Technological progress is like an axe in the hands of a pathological criminal.”

Albert Einstein
7. A Proven History of Use
Is there a successful history of use?

1200AD to 2016+

1990AD-2004AD

Is there a successful **history** of use?
It is only in the last tiny fraction of human history …
Leaky Condo Syndrome

In Vancouver alone:

• $4 billion
• 900 building
• 31,000 housing units
• built between 1980-2,000+
Post WWII building *is* an experiment
We have created a Formula for Failure

Lightweight synthetic building systems that do not breathe trap moisture.
Moisture or vapour + impermeable barriers – hygric capacity = building failures = health failures
Summary
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<th><strong>BUILDING BIOLOGY</strong></th>
<th><strong>“GREEN BUILDING”</strong></th>
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<td>House as an Organism</td>
<td>House as a system</td>
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<td>Interdisciplinary base</td>
<td>Building Industry-based</td>
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<td>Flow Through Wall Design</td>
<td>Prescribed Vapor Barrier</td>
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<td>High hygric buffer capacity</td>
<td>Low hygric buffer capacity</td>
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<td>Balance of Mass and Insulation</td>
<td>R-value</td>
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<td>Radiant Heat</td>
<td>Improving Forced Air Heating</td>
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<td>Passive Climate controls</td>
<td>Energy Efficient technology</td>
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<td>Fresh Air</td>
<td>HRV, ERV</td>
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<td>Ion balance, sorption, unadulterated building materials, light and color balance, EMR concern, Geopathology, social impact, history of use</td>
<td>HUH?</td>
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Can we achieve sustainability by improving efficiency?

Let’s talk about unintended consequences
This house has it all…

Close proximity to local mass transit, ground source geothermal heat pumps, high flyash concrete, polished concrete floors, SIP panel construction, HRV's, etc. etc.

www.myearthboundhome.com/

Not massive wall construction
Requires vapor barrier
Low hygric buffer capacity
Forced air heating
A little less toxic, encapsulated toxins
Minimal history of use
Life span? Not biodegradable
“Green or Eco-efficient design is insufficient because it misses the real potential that arises out of the human presence on the planet: the possibility of organizing human activities so that they continually feed and are fed by the living systems within which they occur. It is not enough to aspire to mitigate the effects of human activity. People need to take their place again as a part of nature.”
Humans have always created durable shelter, within the closed circuit of nature, no waste, no pollution, using the natural materials at hand

...until very recently
Why compromise on your nest?
We don’t have to leave nature behind
When we walk through the front door.
Thank You!

Paula Baker-Laporte

www.econesthomes.com

paula@econest.com
A 2,000 sq. ft. log building can hold 1000s of gallons!

One cubic foot of wood can hold 9.4 lbs. of water
HOUSE AS A SYSTEM

AIR CIRCULATION

WATER CIRCULATION

INTERIOR CIRCULATION

ENERGY CIRCULATION

OUTPUT:
BIO-WASTE, EMR, POLLUTED H2O, FUMES

INPUT:
AIR SUPPLY, FOSSIL FUELS, CLEAN H2O?

Courtesy: Baker-Laporte/ Collette