Is Green Housing Healthy Housing? Examining the Evidence

4th Annual Residential Building Design + Construction Conference

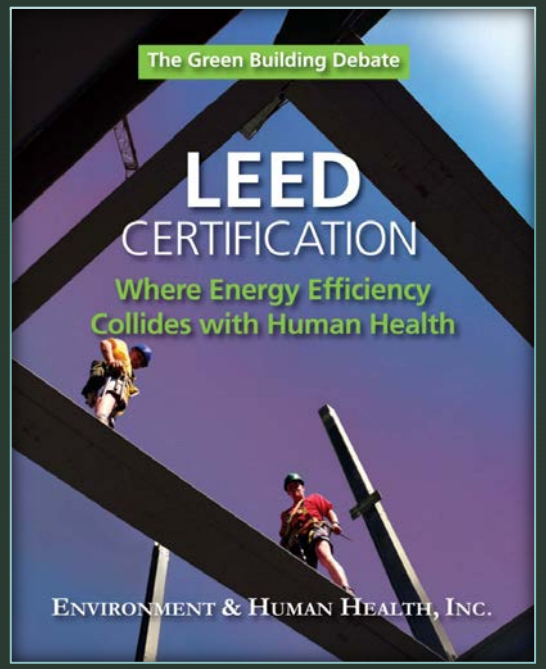
Feb 28 – Mar 1 2018

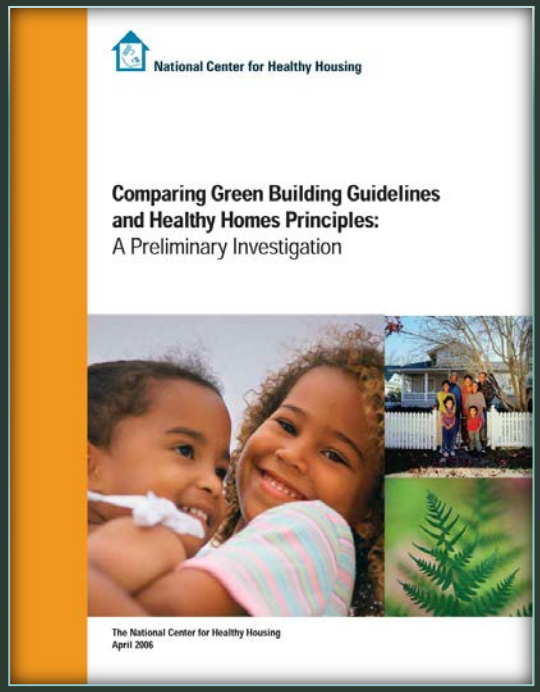
Sherry Ahrentzen, PhD
University of Florida

Elif Tural, PhD
Virginia Tech

James Erickson, PhD
Arizona State University

UNINTENDED CONSEQUENCES + LIMITATIONS OF “GREEN”





METHODOLOGY OF NCHH 2006 STUDY

Coding Correspondence of Green Guidelines with Healthy Building Principles

Criteria	LEED for Homes	NAHB Green Home Building Guidelines	Green Communities	ALA Health House	Energy Star Indoor Air Package	Relevant Criteria
Keep It Dry						
For conventional hot water heaters and equipment that condense water (e.g., air conditioner, dehumidifier) install drains or catch pans that capture overflow or leaks.	1	0	3	3	3	LEED MR 4.1; NAHB Sec. 4.1.1, GCI 7-8, ALA 191, EPA 4.9;
Do not install mold-susceptible materials such as vinyl wallpaper, paper-faced gypsum board, and unsealed grout in wet areas. Use highly durable, moisture-resistant materials in tub/shower enclosures (cement board, fiberglass-reinforced board).	1	1	3	3	3	LEED MR 4.1; NAHB Sec 5.3.2; GCI 7-10; ALA 50, 183; EPA 1.20

National Center for Healthy Housing. *Comparing Green Building Guidelines and Healthy Housing Principles.* April 2016

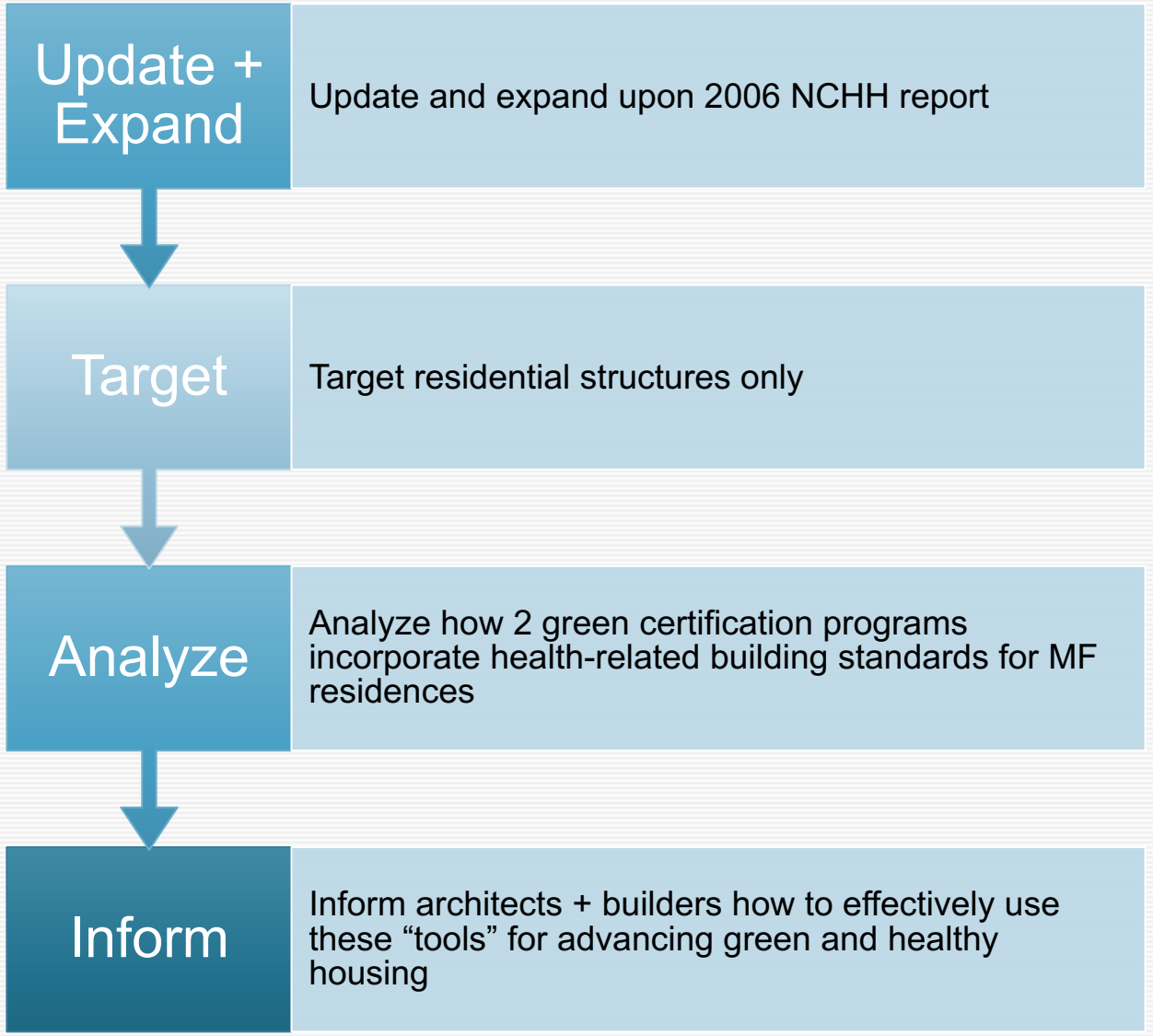
Comparison of Different Green Programs for Healthy Building

Healthy and Affordable Building Principles	LEED for Homes	NAHB Green Home Building Guidelines	Green Communities	ALA Health House	Energy Star Indoor Air Package
KEEP IT DRY*	◒	○	◒	●	◒
KEEP IT CLEAN	○	○	○	●	○
KEEP IT WELL VENTILATED	◒	○	◒	●	●
KEEP IT SAFE	○	○	○	○	○
KEEP IT FREE OF CONTAMINANTS	○	○	◒	●	●
KEEP IT PEST FREE	○	○	◒	●	●
KEEP IT WELL MAINTAINED	●	●	●	●	●

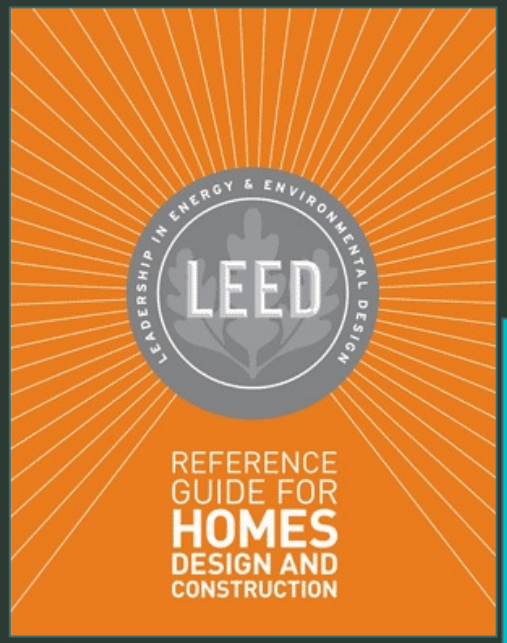
* Received credit for detailed climate-based durability plan.

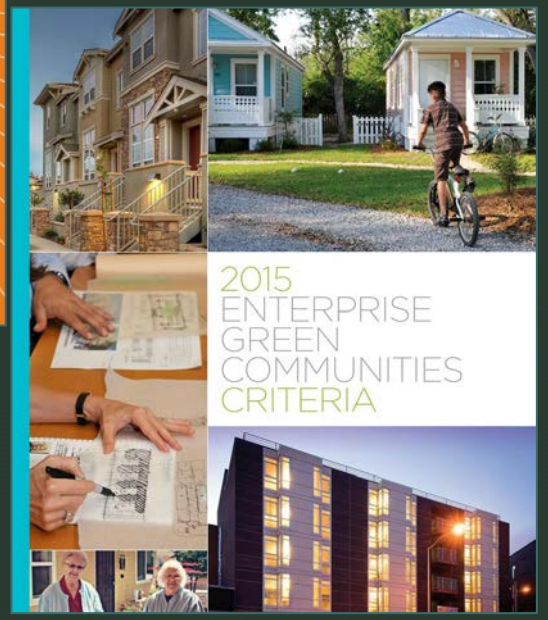
● all criteria required ◒ 75% of criteria required ○ less than 75% of criteria required

INTENT AND SCOPE OF OUR STUDY

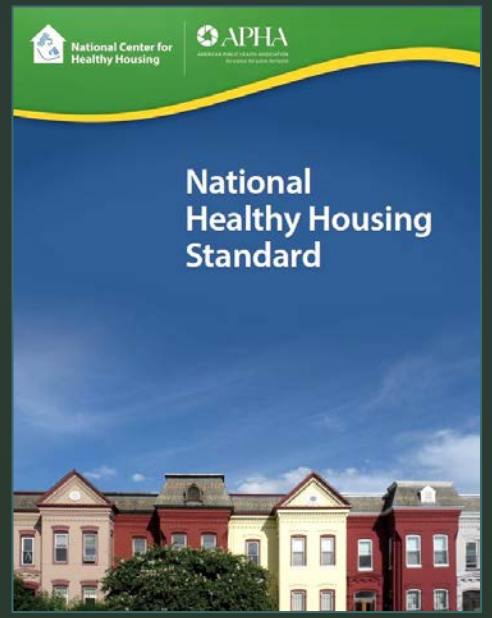


Green Certificate Programs



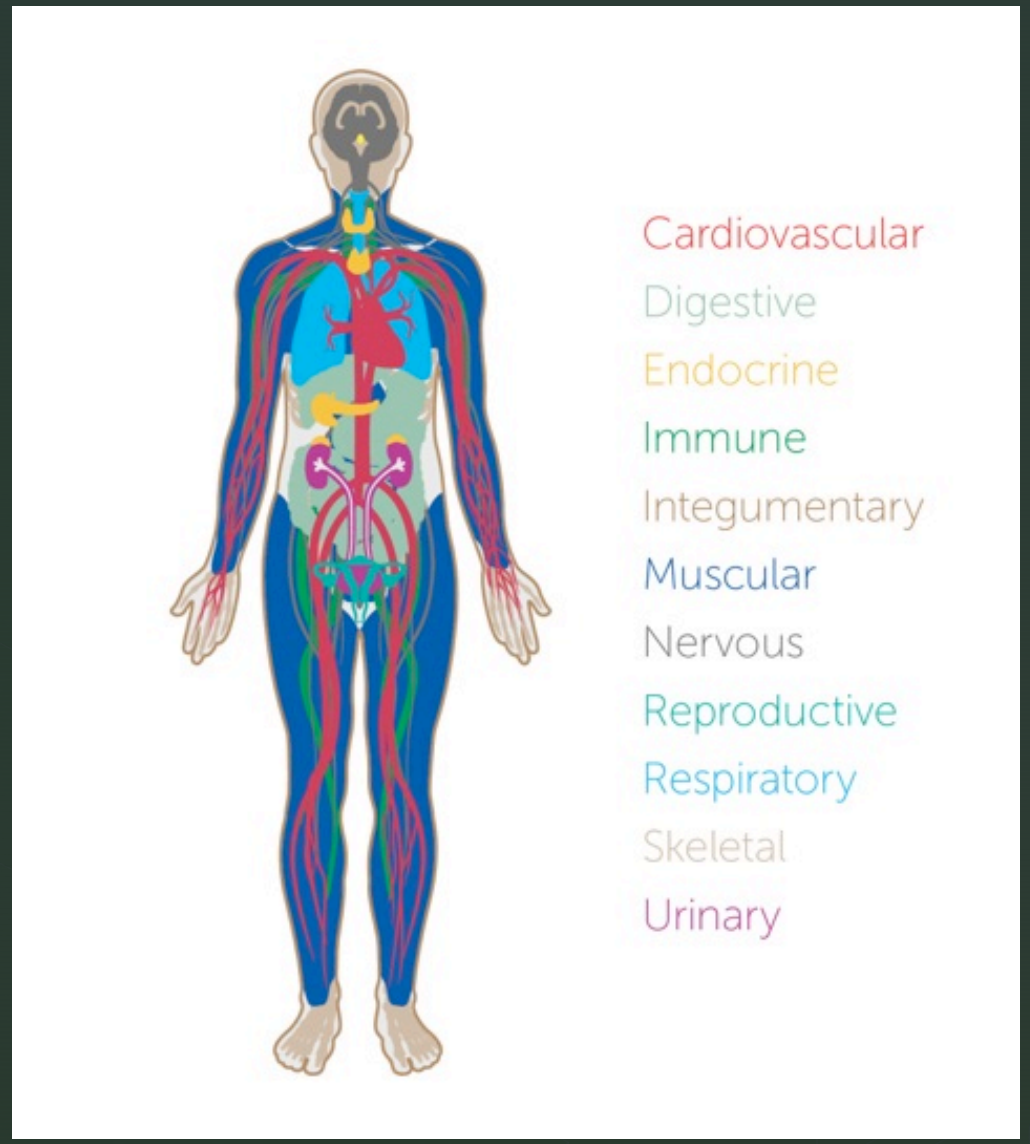


Health-Related Building Standards



Body Systems Applied to WELL Features

A simple way to address the built environment's **impact on the human body**



OUR METHODOLOGY

1. Identify specific health-related standards
   - *Biological Contaminants*
   - *Chemical Containments*
   - *Ventilation*
   - *Thermal Conditions*
   - *Water*
   - *Lighting*
2. Gauge correspondence of green guidelines with health-related standards through content analysis

Example: Data Collection Matrix for Identifying Correspondence between Specific Health Provisions and Green Measures

NHHS Biological Contaminant Provisions	HR R/O	LEED D+C	LEED O+M	R/O	F/P	EGCC	R/O	F/P
2.4 Kitchen floor sealed, water resistant, nonabsorbent, cleanable surface	R	--	--	--	--	6.8	R	F
Etc.								

Correspondence WELL and Green Programs: on Biological Contaminant Provisions

Biological Contaminants

Health Provisions	Green Certification Program		
WELL	EGCC 2015	LEED v4 HD+C	LEED v4 O+M
Required Provisions			
Microbe + Mold Control	○○	◒◒	○○
Healthy Entrance	○○	◉○	○○
Cleaning Protocol	○	○	○
Moisture Management	●◒◒○	○○○○	○○○○
Optional Provisions			
Air Infiltration Management	●	◒	○
Humidity Control	○	○	◒
Pest Control	○○	○○	◒○
Advanced Air Purification	○○	○○	○○
Antimicrobial Surfaces	○	○	○
Cleanable Environment	◒◒	○○	○○

Key: Health provision requirements are ...

● ◉ ○ met by required, optional, or not met by GCP measure

◒ ◒ partly met by required, or optional, GCP measure

Correspondence NHHS and Green Programs: on Biological Contaminant Provisions

Biological Contaminants

Health Provisions	Green Certification Program		
NHHS	EGCC 2015	LEED v4 HD+C	LEED v4 O+M
Required Provisions			
Kitchen	●	○	○
Moisture Prevention + Control	●●○○○○○○	○○○○○○○○	○○○○○○○○
Solid Waste	○○	○○	○○
Pest Management	●●◒○○	●●◒○○	◒◒◒○○
Optional Provisions			
Moisture Prevention + Control	●●●○	○○○○	○○○○
Solid Waste	○	○	○

Key: Health provision requirements are ...

● ● ○ met by required, optional, or not met by GCP measure

◒ ◒ partly met by required, or optional, GCP measure

Summary

- Neither green program covers much of WELL/Biological Contaminants (required or optional)
- Compared to WELL, green programs have more coverage of NHHS/Biological, especially Pest Management
- Advanced NHHS measures for controlling biological contaminants are better addressed in EGCC than LEED
- Guidelines for ongoing home upkeep for controlling contaminants are lacking in both green programs
- Latter could be advanced by simple design solutions (e.g. materials that are easy to clean, anti-microbial)

Correspondence WELL and Green Programs: on Chemical Contaminant Provisions

Chemical Contaminants

Health Provisions	Green Certification Program		
WELL	EGCC 2015	LEED v4 HD+C	LEED v4 O+M
Required Provisions			
Air Quality Standards	◒◒	○○*	○○
Smoking Policies	◒◒	◒◒	◒◒
VOC Reduction	●●◒◒○*	◒◒◒◒○*	○○○◒○
Air Filtration	○○○	○◒○	○◒○
Construction Pollution Mgt.	○○○○○	○○○○○	○◒○○○
Healthy Entrance	○○	◒○	○○
Pesticide Management	○	◒*	◒*
Fundamental Material Safety	●○○○	○○○○	○○○○
Optional Provisions			
Air Flush	○	○	○
AQ Monitoring + Feedback	○○	◒○	○○
Advanced Air Purification	○○	○○	○○
Combustion Minimization	●◒○	◒◒○	○○○
Toxic Material Reduction	◒○○○○	◒○***	○○○○○
Enhanced Material Safety	○	○	○
Cleaning Equipment	○○	◒○	◒○

Key: Health provision requirements are ...

● ○ met by required, optional, or not met by GCP measure

◒ partly met by required, or optional, GCP measure

* Potential conflict with health measure

Correspondence NHHS and Green Programs: on Chemical Contaminant Provisions

Chemical Contaminants

Health Provisions	Green Certification Program		
NHHS	EGCC 2015	LEED v4 HD+C	LEED v4 O+M
Required Provisions			
Heating Systems	◒○○	◒○○	○○○
Air Sealing	○○	●◒	◒○
Chem. + Radiological Agents	◒	◒	○
Lead-Based Paint	●●●●○	◉◉◉◉◉	◉◉◉◉◉
Asbestos	○○○○	○○○○	○○○○
Toxic Substances in Materials	●◒	◉○	○○
Radon	●	○	○
Pesticides	◒○	◒○	◉○
Methamphetamine	○	○	○
Smoking Policies	◉◉○○	●●○○	●●○○
Optional Provisions			
Floors and Floor Coverings	◒○	◉◒	○○
Heating Systems	○	●	○
Air Sealing	○○	◒○	○○
Lead-Based Paint	○	○	○
Radon	○	○	○
Smoking Policies	○○	○○	○○

Key: Health provision requirements are ...

● ◉ ○ met by required, optional, or not met by GCP measure

◒ ◒ partly met by required, or optional, GCP measure

Summary

- Green certifications have more coverage in controlling chemical contaminants than biological ones
- For WELL, LEED covers more provision types than EGCC does; but little difference between green programs in covering required NHHS
- LEED covers more NHHS optional standards than EGCC
- LEED's innovation credit for material ingredients

Correspondence WELL and Green Programs: on Ventilation Provisions

Ventilation

Health Provisions	Green Certification Program		
WELL	EGCC 2015	LEED v4 HD+C	LEED v4 O+M
Required Provisions			
Ventilation Effectiveness	◒◒	◒◒	◒◒
Operable Windows	◒	○	◒
Optional Provisions			
Increased Ventilation	◒	◒	○
Direct Source Ventilation	○○○	○○○	○○○
AQ Monitoring & Feedback	○○○○	○○○○	◒○○○
Displacement Ventilation (DV)	○○	○○	○○
DV System Performance	○○	○○	○○

Key: Health provision requirements are ...

● ◉ ○ met by required, optional, or not met by GCP measure

◒ ◒ partly met by required, or optional, GCP measure

Correspondence NHHS and Green Programs: on Ventilation Provisions

Ventilation

Health Provisions	Green Certification Program		
NHHS	EGCC 2015	LEED v4 HD+C	LEED v4 O+M
Required Provisions			
HVAC Systems	○	◒	◒
Ventilation	●◒○○	●●○○	○○○○
Optional Provisions			
Ventilation	◒	○	○

Key: Health provision requirements are ...
● ◉ ○ met by required, optional, or not met by GCP measure
◒ ◒ partly met by required, or optional, GCP measure

Summary

- Green programs similar on required WELL ventilation provisions; but little, and little difference, on optional ones
- Fewer ventilation provisions in NHHS than in WELL

Doing Green and Healthy Can Be Done, Even in Affordable Housing:

Design decisions to address respiratory ailments while building to EGCC standards

Photo courtesy of Mithun

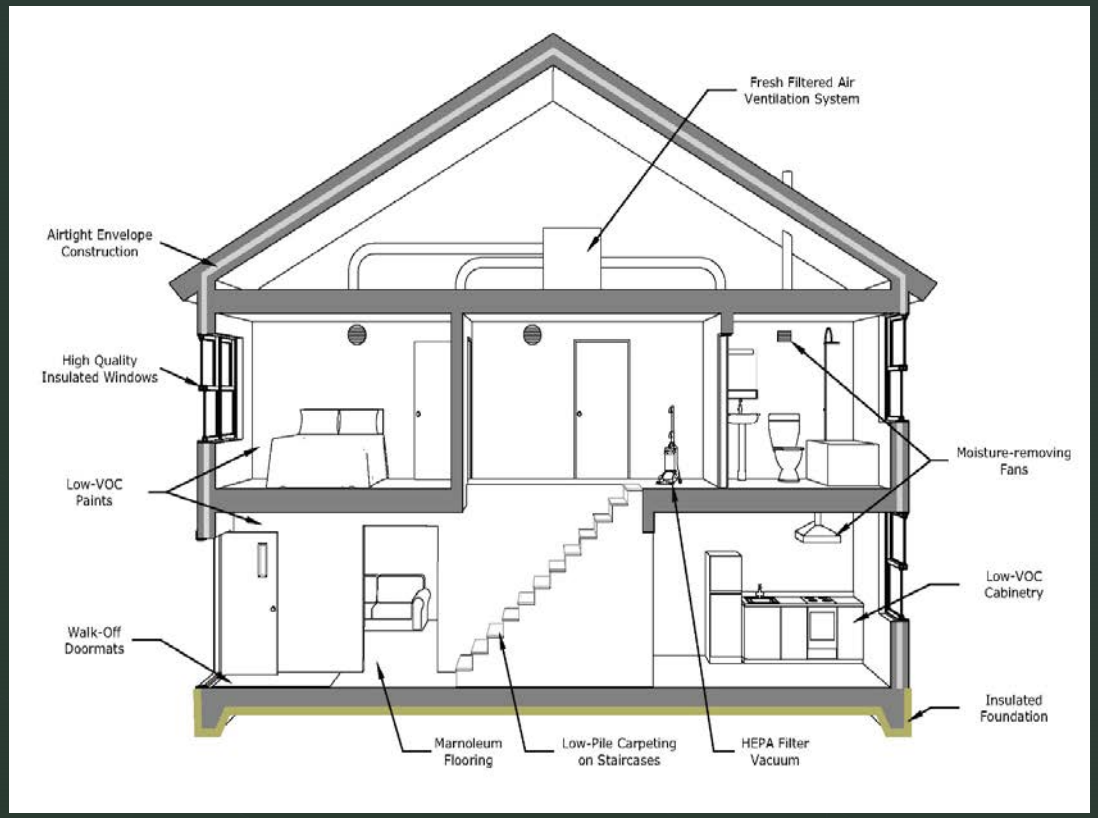


Diagram by James Erickson, adapted from Steve Barham, in Takaro et al, 2011

High Point Breathe-Easy Homes in Seattle, Washington

Summary: *Thermal*

- Green programs address most required health provisions but not optional ones
- Question whether valid standard for optimal thermal comfort of vulnerable populations is being addressed
- Key future concern due to impacts of climate change on residential structures

Summary: *Water*

- LEED has potential positive impact on surface and underground water quality protection
- No tests of water for chemical or biological contaminants, or safe limits for contaminants
- Need for continuous onsite testing and treatment when required

Summary: *Lighting*

- Green programs prioritize lighting for energy efficiency over that for health and well-being
- LEED O+M has credits for daylight access and light quality, but eliminated from the initial design process
- Light quality and surface reflectance values not addressed

CONCLUSIONS

- Green building addresses a certain segment of health-related concerns, but is far from being comprehensive
- To be *both* green and healthy at this time, it may be prudent to follow the guidelines of multiple certification systems
- WELL-MF and NHHS will likely evolve — Active Design and Inclusive Design more prominent in green programs than in these Healthy Building ones
- Many health-related guidelines contained in LEED O+M
- Integrated design process and facility management may play critical role

Sherry Ahrentzen, PhD
ahrentzen@ufl.edu

Elif Tural, PhD
etural@vt.edu

James Erickson, PhD
james.p.Erickson@asu.edu

Thank You.
Questions?