



LOCATION

**Bardwell House,
Annapolis, MD**

Challenge

This existing waterfront home's basement suffered from the typical issues associated with combining a tight building envelope with high summer humidity and a cool basement—rather common in the Northeast of the United States. The resulting elevated dew point produced an unhealthy, damp, moldy environment.

In addition to such indoor discomfort, the Bardwells suffered allergic reactions to the mildew and all-around toxic environment. Solutions for remediating such indoor environments often include increasing dehumidification, but then over-cooling and excess energy use can become an undesirable added extra.

So, how do you make a home and its basement dry, mold-free, allergen-free, and radon-free while lowering energy costs significantly? First, you gather a team that excels at thinking outside the box: Architect James Wright, builder Skip Bennet, and engineer scientist Klas Haglid.

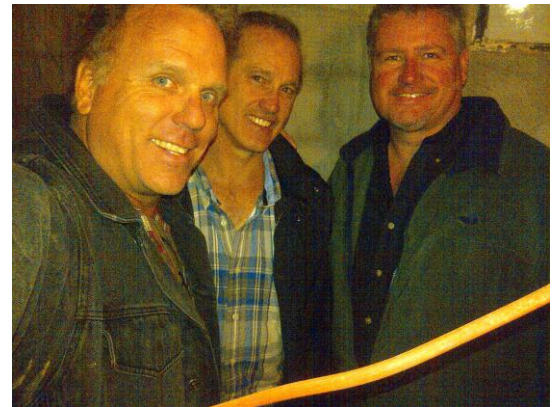


Photo: James Wright (Left to Right) James Wright, Skip Bennet, Klas Haglid

Solution

The answer lay in creating a Geothermal "ventilation" system utilizing natural 'basement energy' where the subterranean temperature of the earth provides pre-tempering of outside air or cooling of internal air using the thermal mass of the floor and walls of the basement via a ventilation cavity under the floor. The brainchild of James Wright fostered by Skip Bennett's intuition, this new incorporation of 'Earth Coupling' via what became a patented geothermal ventilation system played a key role in this home earning the title of the world's first Geo-Solar Passive House by Net Zero Homes. (continued...)

“We gutted the existing damp basement and prepared the wall surfaces for encapsulation,” says Wright. Typically, encapsulation of a basement or crawl space includes installation of a vapor barrier, adding a dehumidifier, and the closing of vents. In this case, they installed high-density foam paneling on the basement walls and floor with a small ventilation cavity. Further, they sealed the home envelope from the subgrade to the roof.

Wright, Bennett, and Haglid converted the home to PHIUS passive house retrofit standards while they were at it. Such homes generally see a 90% annual energy reduction. When put to work with a tight envelope and a high-efficiency energy recovery ventilator (ERV) system, this ‘basement energy system’ doesn’t need additional power to operate it.

For excellent pre-tempered ventilation, an ERV along with a fully insulated duct system with intake/output systems in the basement and attic. Not only does the ERV system offer high-efficiency heating and cooling, it also aids in the control of humidity—especially crucial for this home.

Klas Haglid, who did the technical engineering for the project, says, “There is a balance between excellence in building envelopes and HVAC optimization, and we do this with computer algorithms.”

The computer modeling energy data for the basement energy system shows that the basement geo-cavity of the Bardwell House yields amazing performance by using geothermal pre-tempering of outside air or by cooling the internal air with the thermal mass in the floor and walls of the basement. In fact, the special under-the-floor ventilation system can provide up to 1.7621 tons of geothermal mass cooling.

(continued...)



(Photo: James Wright) Skip Bennet installs the high-density foam panels that will help create a thermal mass slab.



(Photo: James Wright)
Input and output on a BPE Energy Recovery Ventilator

Typically, the HVAC system for a house this size would normally weigh five tons. However, with the high-efficiency building envelope, basement geo-cavity thermal preconditioning, and Haglid's energy recovery unit (a heat exchanger or energy recovery device that preconditions outdoor air with exhaust air), the HVAC system can be replaced with a unit under a single ton or with a ¼-ton dedicated dehumidifier system that will not have to run very often. In addition, the ERV amplifies the dehumidification by another 80%, delivering dehumidification reduction in the realm of one dollar spent to three dollars saved. Better still, this system is minimizing the annual energy demand which is achievable via a small photovoltaic array of 5kW or less. (continued....)

Energy Cost Budget / PRM Summary

By Haglid Engineering & Associates, Inc.

Project Name: Bardwell Residence				Date: September 10, 2012								
City: Annapolis, MD				Weather Data: Baltimore, Maryland								
Note: The percentage displayed for the "Proposed/ Base %" column of the base case is actually the percentage of the total energy consumption. * Denotes the base alternative for the ECB study.				* Alt-1 Baseline - Standard Res			Alt-2 High Efficiency Concept - 1			Alt-3 High Efficiency with Energy		
				Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh	Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh	Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh
Lighting - Conditioned		Electricity		79.8	20	12	8.0	10	1	1.9	2	1
Space Heating		Electricity		0.0	0	0	0.0	0	0	18.7	0	12
		Gas		285.5	70	131	247.9	87	115	0.0	0	0
Space Cooling		Electricity		37.0	9	59	20.1	54	47	12.2	33	9
Heat Rejection		Electricity		4.8	1	7	2.6	53	6	0.0	0	0
Total Building Consumption				407.1			278.5			32.8		
				* Alt-1 Baseline - Standard Res			Alt-2 High Efficiency Concept - 1			Alt-3 High Efficiency with Energy		
Total	Number of hours heating load not met Number of hours cooling load not met			0 0			0 0			1,351 0		
				* Alt-1 Baseline - Standard Res			Alt-2 High Efficiency Concept - 1			Alt-3 High Efficiency with Energy		
				Energy 10^6 Btu/yr		Cost/yr \$/yr	Energy 10^6 Btu/yr		Cost/yr \$/yr	Energy 10^6 Btu/yr		Cost/yr \$/yr
Electricity				121.6		2,981	30.6		750	32.8		629
Gas				285.5		1,093	247.9		1,155	0.0		0
Total				407		4,074	278		1,905	33		629

(Table: Haglid Engineering & Associates®) The computer modeling energy data for the basement energy system shows that the basement geo-cavity of the Bardwell House yields amazing performance. ALT 3 uses the BPE, Inc®. Energy Recovery to achieve high efficiency.

Not only can a geo-thermal system save money on utility bills, but when you place a Basement Energy System in series with a passive house energy recovery ventilation system, it requires no additional power to operate.

Passive houses consume 90% less energy than typical homes. With this Geo-Solar hybrid home as a system concept, we predict performance to be close to 95% annual energy reduction.

US 20120305214A1

(19) **United States**
(12) **Patent Application Publication**
Wright et al.

(10) Pub. No.: **US 2012/0305214 A1**
(43) Pub. Date: **Dec. 6, 2012**

(54) **GEOTHERMAL HEATING AND COOLING VENTILATION SYSTEM**

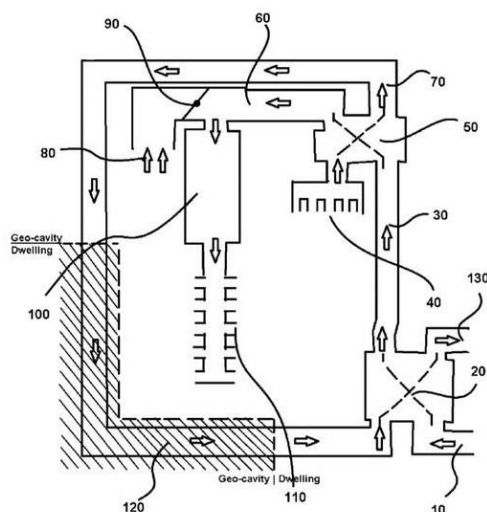
(76) Inventors: **James P. Wright**, Orinda, CA (US);
Walter L. Bennett, IV, Edgewater, MD (US)

(21) Appl. No.: **13/488,427**
(22) Filed: **Jun. 4, 2012**

Related U.S. Application Data
(60) Provisional application No. 61/493,404, filed on Jun. 3, 2011.

Publication Classification
(51) Int. Cl. **F24J 3/08** (2006.01)

(52) U.S. CL. **165/45**
(57) **ABSTRACT**
A system designed to introduce fresh air ventilation into the living space, eliminate contaminants, and add fresh air to augment a building's HVAC system. This is done in order to save energy, and the costs associated with heat loss in a building. The system employs the use of geothermal energy conferred to air via a cavity which is constructed in the basement, on the slab, in the crawl space and/or attic of a building. This cavity is created to circulate to absorb the geo and/or solar characteristics of a building, taking advantage of the consistent subterranean temperature of the earth and/or sun, in order to warm air from outside during the winter minimizing a heat sink, and cool air during the summer. One or more heat exchangers are used to transfer the energy from contaminated air in the cavity to clean air destined for the HVAC system.



The resultant Geothermal Heating and Cooling Ventilation System patent from the unique solution used to renovate the Bardwell home for comfort, reduced energy costs, and better health.

So, how do the Bardwells feel about their renovated home? In a grateful letter to James Wright, they had this to say: "When we first met, our main focus was the creation of a Passive House combined with the energy benefits from your new Basement Energy System. However, there has been a bonus from this unique continuous fresh air ventilation/basement energy system. Now that we have been living in our home for over eight months, any allergic reactions to mold, mildew, and other environmental toxins have dramatically diminished. In fact, our health and well-being have improved so much that now we often go on long walks, which is something we haven't enjoyed in years. Our home has become a rejuvenating retreat, greatly improving the quality of both of our lives."

(continued....)

Not only is that great testimony advocating for passive house and geothermal solutions but knowing the Bardwells' health has improved is the most important result for James Wright. He says, "It's more about health than it is energy {for me}, especially on the east coast where there is mold everywhere. We have petri dishes of houses we've now sealed up."

Indeed, when people can regain quality of life thanks to more efficient, clean methods of heating and cooling indoor environments, we are not just talking about the health of the planet anymore, but the people who are the children of Mother Earth!