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February 18, 2013 by Alan

LAUNCHING A NEW PASSIVE HOUSE IN MARYLAND

A Green Builder's Dream Come True
At long last, plans for my first Passive House—a new home in Derwood, Maryland for Anne and Elliot Grant—are ready to submit for a building permit. It is truly exciting to have clients who are committed to what is possibly the highest standard for sustainable design: the Passive house standard. Completing our Design Build team on this project is Joseph Klockner and Company of Takoma Park, Maryland.

Passive House Planning Package
The design includes preparation of the Passive House Planning Package (PHPP), an extensive energy modeling program that analyzes every important element of the house and its mechanical systems. The program also considers characteristics of the site including micro-climate, tree cover, and exposure to wind. Our PHPP was submitted to Passive House Institute United States (PHIUS) for pre-certification, and after some serious review and refinement, is nearly ready for approval.

Achieving Passive House Pre-Certification Requirements
To be granted pre-certification the completed passive house planning package must demonstrate a house that will use

- a maximum energy for heating no greater than 4.75kBtus per square foot per year
- a maximum total energy for all purposes no greater than 38kBtus per square foot per year.

To achieve these energy efficiency requirements, the house will be insulated to the following levels:

- roof: R-69 (code minimum is R-49)
- walls: R-54 (code minimum is R-20)
- floor: R-37 (code minimum is R-19)
- windows: triple glazed U-0.16 to U-0.21 (code minimum isU-0.35)

Further, the house must achieve an extremely high degree of air tightness. During construction, the house will be inspected several times with particular emphasis on air tightness. Passive House requirements permit no greater than 0.6 air changes per hour (ACH) measured at standard test pressure. Conventional building code allows up to 3.0 ACH. That would be five times higher than the Passive House value.

Using Natural Assets of the Site to Achieve Passive Standard
The lovely 3 acre wooded site is adjacent to Rock Creek Regional Park and Lake Frank. The actual building location is in a small clearing, surrounded by tall tulip poplars and other hardwoods. Although the dense tree cover will help keep the house cool in summer, it created a challenge in making the numbers work for the Passive House heating requirements. Every window and door opening had to be individually analyzed to determine potential for net heat gain (or net loss) over the course of the season. By trial and error, each opening was adjusted in size and glass type for higher or lower solar heat gain coefficients (SHGC) until optimum modeled performance was achieved.

Currently, International Energy Conservation Code prescribes a solar heat gain coefficient maximum of 0.40, to limit overheating in summer. Passive Houses–no surprise here–must be in the 0.50 to 0.60 range. The Grant Residence windows range from 0.53 on the east, north, and west, to 0.62 on the south. To use code compliant windows would have a severely detrimental effect on the modeled performance.

NEXT POST: Does a Passive House have to look weird?

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For those who love decimal points, grid lines and spread sheets, please feel free to geek out on the statistical breakdown of our passive house planning package in the chart below.

Climate:	Washington DC*									
Window Area Orientation	Global Radiation (Cardinal Points)	Shading	Dirt	Non-Perpendicular Incident Radiation	Glazing Fraction	SHGC	Reduction Factor for Solar Radiation	Window Area	Window U-Value	Window R-Value
maximum:	kBTU/ft²yr	0.75	0.95	0.85				ft²	BTU/hr.ft².F	hr.ft².F/BTU
North	44	0.70	0.95	0.85	0.493	0.53	0.28	28.19	0.18	5.68
East	121	0.20	0.95	0.85	0.599	0.53	0.10	69.23	0.17	5.79
South	231	0.43	0.95	0.85	0.636	0.62	0.22	183.00	0.18	5.70
West	123	0.19	0.95	0.85	0.611	0.53	0.09	70.65	0.16	6.20
Horizontal	193	0.69	0.95	0.85	0.659	0.44	0.37	5.96	0.31	3.23
		Total or Average Value for All Windows.				0.58	0.18	357.04	0.17	5.73

					Window Rough Openings		Installed		Glazing		Frame		SHGC	U-Value	
Description	Nr	Deviation from North	Angle of Inclination from the Horizontal	Orientation	Width	Height	in Area in the Areas worksheet	Nr.	Select glazing from the WinType worksheet	Nr.	Select window from the WinType worksheet	Nr.	Perpen-dicular Radiation	Glazing	Frames
		Degrees	Degrees		in	in	Select:		Select:		Select:		-	BTU/hr.ft².F	BTU/hr.ft².F
N LIB E	1	0	90	North	53.00	29.00	N WALL 2	5	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
N KIT B LEFT	2	0	90	North	29.00	29.00	N WALL 2	5	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
N KIT B CENTER	3	0	90	North	29.00	29.00	N WALL 2	5	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
N KIT B RIGHT	4	0	90	North	29.00	29.00	N WALL 2	5	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
E BED A	5	90	90	East	37.00	65.00	E WALL GABLE &	16	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
E BAT C	6	90	90	East	29.00	51.00	E WALL GABLE &	16	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
E LIB DR2	7	90	90	East	43.75	84.13	E WALL LIBRARY	18	INTUS SHGC 0.53	2	INTUS DOOR FR	2	0.53	0.09	0.26
E GAB A	8	90	90	East	37.00	65.00	E WALL GABLE &	16	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
S BAY D LEFT	9	180	90	South	41.00	65.00	S WALL BAY	12	INTUS SHGC 0.62	1	INTUS WINDOW	1	0.62	0.11	0.17
S BAY D RIGHT	10	180	90	South	41.00	65.00	S WALL BAY	12	INTUS SHGC 0.62	1	INTUS WINDOW	1	0.62	0.11	0.17
S BED D LEFT	11	180	90	South	41.00	65.00	S WALL M BED	13	INTUS SHGC 0.62	1	INTUS WINDOW	1	0.62	0.11	0.17
S BED D RIGHT	12	180	90	South	41.00	65.00	S WALL M BED	13	INTUS SHGC 0.62	1	INTUS WINDOW	1	0.62	0.11	0.17
S DOR D RIGHT	13	180	90	South	41.00	65.00	S WALL DORMER	14	INTUS SHGC 0.62	1	INTUS WINDOW	1	0.62	0.11	0.17
S DOR D CENTER	14	180	90	South	41.00	65.00	S WALL DORMER	14	INTUS SHGC 0.62	1	INTUS WINDOW	1	0.62	0.11	0.17
S DOR D RIGHT	15	180	90	South	41.00	65.00	S WALL DORMER	14	INTUS SHGC 0.62	1	INTUS WINDOW	1	0.62	0.11	0.17
W PAN C	16	270	90	West	29.00	51.00	W WALL ENTRY I	6	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
W FOY C	17	270	90	West	29.00	51.00	W WALL ENTRY I	6	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
W DIN A	18	270	90	West	37.00	65.00	W WALL GABLE E	7	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
W LIV A	19	270	90	West	37.00	65.00	W WALL GABLE E	7	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
W GAB A	20	270	90	West	37.00	65.00	W WALL GABLE E	7	INTUS SHGC 0.53	2	INTUS WINDOW	1	0.53	0.09	0.17
SKYLIGHT FAKRO	21	180	18	Horizontal	22.00	39.00	SOUTH MAIN RO	2	FAKRO SKYLIGH	4	Clad Wood Casei	17	0.44	0.09	0.45
S FOY DR1	22	180	90	South	47.75	84.13	S WALL LIV RM	11	INTUS SHGC 0.62	1	INTUS DOOR FR	2	0.62	0.11	0.26
S LIV DR2	23	180	90	South	43.75	84.13	S WALL ENTRY	10	INTUS SHGC 0.62	1	INTUS DOOR FR	2	0.62	0.11	0.26

Passive House energy modeling figures for new green home in Maryland

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February 19, 2013 by Alan

DOES A PASSIVE HOUSE HAVE TO LOOK WEIRD?

The short answer is, no.

The "Tyranny" of Passive House
In his Discourses, Plato has Hippias The Sage assert that

"…law is the tyrant of mankind, and often compels us to do many things which are against nature."

The Passive House system is truly rigorous. Often it requires modifying a decision or restraining an impulse that would be natural in another context. Specifying an open masonry fireplace in your design program would be a triple nightmare for the Passive House Consultant to deal with.

> The flue damper. The darn thing would leak so much it would be nearly impossible to reach the air tightness level required to satisfy the energy models.
>
> The mass of the chimney would constitute a significant thermal bridge.
>
> Stoking up a blazing fire would probably very quickly overheat the super insulated space, forcing the occupants to open doors and windows.

Never fear. The passive house occupant need not forfeit the vision of a cozy winter's evening by the fire. There are a few wood stoves and prefabricated fireplaces on the market that are virtually airtight. They can maintain a fire at a low enough output to provide the cozy atmosphere that we naturally seek, without the disadvantages noted above.

The point is, that Passive House limits some decisions, but it does not dictate them.

Passive House Likes Traditional Home Styles
There are a number of architectural characteristics of a Passive House that facilitate performance. To keep warm here in our Mid Atlantic winters, Passive Houses like to spread out in the sun, and look to the south. At the same time, they like generous overhangs and shutters to avoid overheating in summer. Provision for cross flow ventilation, such as windows on two exposures in each important room, and operable skylights, can reduce the need for mechanical air conditioning during the shoulder seasons. In other words, it could easily look like a traditional bungalow or cottage.

Passive House also likes simple massing—corners, offsets, and projections present challenges to achieving airtightness, and inevitably introduce thermal bridges. In this sense, it could also be a cape cod or colonial style house.

Some features fight against the grain. Our clients, the Grants of Derwood Maryland, wanted mulled windows—but the muntin bars reduce the amount of light passing through by as much as 5%. Passive House cares deeply about this—when this amenity was factored into the Passive House Performance Package (PHPP), the performance fell off perceptibly.

But there was always a solution somewhere, by enlarging south facing windows, or adding additional insulation to compensate for the loss of solar gain.

Are you wondering what this house is going to look like when it's done? Here's a rendering of the Grant House. Not too weird looking, is it?

The Passive House cuts a strictly simple silhouette on the landscape.

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March 11, 2013 by Alan

PROGRESS ON OUR PASSIVE HOUSE PROJECT

The architectural portion of the plans for the new Passive House in Derwood, MD has been approved by the Montgomery County building authorities. Site plan review is on going.

Concurrently, PHIUS's review of the project is nearly complete. Ryan Abendroth and Lisa White have scrutinized nearly two dozen, densly detailed Excel worksheets that comprise the Passive House Planning Package (PHPP), and have identified several items that needed refinement. Final revisions should be complete later today.

The long and short of the process is, our initial design was extremely close to meeting the Passive House Standards . To make the nut, we will have to improve the thermal performance of the building envelope–so for simplicity and economy, we have chosen to add 1/2" of insulation under the floor slab.

This entry was posted in Design Build and tagged Passive House, Passive House Planning Package, passive house standard, PHIUS, PHPP. Bookmark the permalink.

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May 14, 2013 by Alan

NEW HOME PROJECT ACHIEVES PASSIVE HOUSE PRECERTIFICATION

After five rounds of revision, PHIUS has awarded the Grant Home project Passive House Pre-Certification status. Youzza! The reviewers delved into every detail of insulation, windows, and mechanical systems–even the amount of tree cover around the house site.

The easy part is over. Now, all we have to do is build it. Over to you, Joseph Klockner and crew…

PHIUS
Passive House Institute US

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September 13, 2013 by Alan

NEW PASSIVE HOUSE UNDER WAY IN DERWOOD, MARYLAND

One of the most gratifying moments in the course of any project–whether for a new home or an addition–is that point when the foundation is in place. The design has long been completed, and has been finally approved by Montgomery County. The Passive House analysis and design features have been precertified by PHIUS. The bank has appraised the project, and issued the construction loan. All that hard work and anxiety is over.

Most importantly, the retrograde motion of digging into the earth is reversed–progress is now upward! All the risks of excavation–will we hit rock, or bottomless muck; will we get caught in a summer gully washer that fills the hole with water and mud–all that is over. Now there is something permanent we can see and touch.

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September 20, 2013 by Alan

PROGRESS ON A PASSIVE HOUSE

Work on the Passive House continues in Derwood, Maryland. The rough plumbing that goes under the slab–or "groundworks"–is now in place. You can see stubs of white pipes sticking up where the bathroom, powder room, kitchen, and laundry are located. The interior of the foundation has been backfilled with gravel, and is now being capped with a layer of sand.

Sand in this case is a somewhat unusual application, but Erhan Tolu, our structural engineer, required it as a cushion for the next layer: an airtight membrane, and above that, 9 inches of high-density polystyrene, or "geo-foam." Geo-foam is capable of carrying intense loads–in this house, it will support the interior bearing walls, as well as several

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posts that carry much of the weight of the roof. Erhan's concern was if the foam were placed directly over gravel, it would settle over time into the space between the sharp points of the individual stones. This would also perforate the airtight membrane.

In many Passive Houses, geo-foam supports the entire house; however, the slope of this lot required the masonry foundation walls to lift the northern portion of the house above grade. To further protect the exposed portion of the foundation walls from cold, they are clad with 3 inches of geo-foam, and protected by cement board. The exposed cement board will ultimately be covered with stucco.

Great care is taken in this design where the porch and the screened porch supports intersect the main house foundation. Passive house design requires the elimination of thermal bridges. In conventional construction, supports for exterior structures would have been directly connected to the main foundation. In this case, these supports are separated by 3 inches of geo-foam.

Another essential Passive House feature is air-tightness. Under the slab we are using 15 mil polyethelene (6 mil is customary), with seams sealed with a rugged tape with an aggressive adhesive.

This entry was posted in Design Build and tagged Airtightness, Passive House, Thermal Bridging. Bookmark the permalink.

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September 26, 2013 by Alan

THE ESSENCE OF PASSIVE HOUSE

Drain, waste, and vent pipes are sealed to the 15 mil vapor and air barrier with rubber gaskets.

The essence of Passive House–or any kind of excellence in building–is attention to detail. Here is a prime example: air tight design, even under a concrete slab. If there is any hope hitting that hitting that important mark of 0.6 ACH@50PA–almost hermetic construction–it will be achieved by sealing every penetration in the building envelope.

the tight fitting gasket is caulked to the pipe, just for insurance!

Final preparations for pouring concrete include 9" of geo-foam, and wire reinforcement. The trough at the left is for thicker concrete to support interior bearing walls and columns. There is an additional 9" of insulation under the trough.

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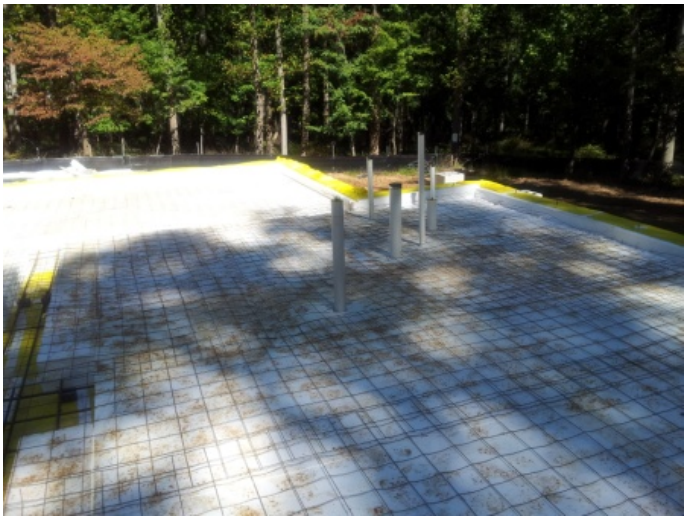

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October 7, 2013 by Alan

A PASSIVE HOUSE AND COSMIC CONSCIOUSNESS

An uncanny resemblance to a new Passive House

Walking down Carteret Street in Beaufort, South Carolina, this house–by its looks over 100 years old–caught my eye. It bears an uncanny resemblance to my Passive House design, presently under construction in Derwood, Maryland. It calls into question what forces of cosmic consciousness are in play here. I trust Professor Jung would be pleased, if not amused…

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Here’s the design for the Passive House, currently under construction.

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October 13, 2013 by Alan

NEW PASSIVE HOUSE RISES UP

New Passive House rises up from a soggy site (photo by Martin Moreno)

Here's a snapshot of progress on the new Passive House. The DC region has sustained unprecedented rainfall over the past four days. By the luck of the draw, Janet and I were on vacation, at a beach in South Carolina–where the weather was sublime. While there, we went kayaking on a backwater that flows into the Story River. There we saw an osprey, up in a tree–which in form bore a remarkable resemblance to these naked rafters. The weather is clearing now. Soon the air barrier surfaces will be complete, enabling us to do a preliminary air barrier test.

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October 19, 2013 by Alan

PASSIVE HOUSE IN DERWOOD, MD TAKES FORM

It was a gorgeous day to bike out and visit this Passive House project, located in Derwood, MD. The site is surrounded by forest, and abuts Lake Bernard Frank. The bike trail passes over the earthen dam, where I saw great blue herons sunning on the berm, and a banded kingfisher perched in a branch near the water. When I arrived at the site, a red tailed hawk was wheeling right above the house.

Here's a view of the west elevation. What has been erected so far is the first layer of the wall and roof assemblies, which will function as the structural shell of this Passive House. The yellow membrane–which extends under the slab–will be lapped over the green sheathing, and taped together with an aggressive, waterproof tape. Similarly, the reddish brown sheathing on the roof will be sealed to the walls with additional membrane and tape.

Over all that will nail base–a sandwich of foam and plywood. The walls will get a 3 1/2" layer, and the roof will get a 6" layer. The roof layer will extend about 30" beyond the outside walls to form the eaves. This projection will not only protect the walls from the weather, but will also shade the windows from the summer sun, while admitting the winter sun.

Then, a second set of framed walls will be built inside the walls shown in the photo. they will form a 10" deep cavity that will be filled with cellulose insulation. According to PHPP, the walls will achieve R-52.1, and the roof will achieve R-66.1

This is a view from the south west. When complete, the low sloped roof on the left will continue across the porch (defined by the block piers), and wrap around to the right and join the roof where the carpenters are working.

Here are views of the southeast (above) and northeast (below). A small screened porch will fill in the recess on the right.

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December 12, 2013 by Alan

PROGRESS ON PASSIVE HOUSE

As winter closes in, work continues on this Passive House project. The Intus triple glazed doors and tilt-turn windows are due to be delivered next week. When they are installed, we can perform a preliminary blower door test, to see how close we are to the mythic air tightness requirement of 0.6 ACH.

In the mean time, the duct system has already been installed, with dual distribution systems for tempered air, and for fresh air supply and exhaust. As soon as the building is closed in, other rough-in work will continue.

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December 20, 2013 by Alan

PASSIVE HOUSE CERTIFICATION

Andy Corral of Elysian Energy, getting acquainted with the project. Andy will be certifying that the work complies with Passive House requirements

Now that the rough carpentry is nearing completion, it was a perfect moment to bring out our Passive House Rater, Andy Corral of Elysian Energy, to see things in the flesh. I spent a good part of yesterday morning compiling a set of plans and documents for Andy to review, including a revised Passive House Planning Package (PHPP) that reflects the field changes and revisions that have taken place.

Some of the changes are minor tweaks–for example, substituting 4" of polyisocyanurate insulation for 6" of expanded polystyrene over the primary roof structure. The former has more than a 50% higher R-value than the latter; even as the total thickness is reduced, the net insulation value of the roof is increased by R-2.

> This gain is offset by the substitution of a custom wood front door for the Intus E-Forte UPVC door. Although the wood door has a smaller window, it has a lower net R-value, because–counterintuitively–the three layers of glass is more efficient than 2" of wood. It was almost jaw-dropping, how much this one change added to the Specific Space Heat Demand.

The massing of the Grant Residence is now apparent

Another major change is to enclose what had originally been designed as a screened porch. This space is intended for three season use, and will not have a heat source, but it

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will still reduce heat loss through the adjacent spaces. I've asked Elysian to help quantify the energy savings.

An area of some controversy remains. During the Passive House precertification process, I initially modified some of the PHPP defaults for ground conditions. These were rejected by PHIUS, and I had to beef up other areas of the building envelope to compensate. But during construction, we actually improved conditions beyond the initial input. The entire building subgrade was backfilled with an average of 3' of crushed stone, and then topped with 4" of sand to support the subslab insulation. This is a very effective thermal break with the underlying soil. Including these values in PHPP makes a significant positive impact.

On the other hand, the local climate seems to be slightly cooler than the PHPP default climate for Washington, DC. Passing by on my bike this morning, Lake Frank–a few hundred yards southeast of the Grant house–was completely frozen over.

If you'd like to read more about the background of this project, click here.

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March 6, 2014 by Alan

PASSIVE HOUSE MOMENT OF TRUTH: AIR TIGHTNESS TESTING

TESTING FOR AIR TIGHTNESS
AJ Soriano of Elysian Energy records blower door output. We came in at about .75 ACH @ 50PA–four times better than the IRC maximum, but still slightly higher than the PHIUS requirement.

With most of the rough mechanical, electrical, and plumbing work (MEP) complete, it was time to test the Grant Residence Passive House for air tightness.

We scored approximately 0.75 air changes per hour (ACH) at 50 pascals (PA) of pressure. Although this is four times tighter than the current energy code requires–it's not good enough for Passive House, which requires a reading no greater than 0.60 ACH@50PA. So we still have some tightening up to do.

The bad news is that the testing did not reveal any major leaks. That means mitigating that last little bit will be extremely difficult.

On top of that challenge, the items yet to be installed–the drier vent and the fireplace flue–are inherently leaky.

Using a smoke pencil, DJ searches for visible leaks. Unfortunately, he found very few–which will make additional tightening up very difficult.

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