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INTRODUCTION

With over 30% of all energy consumed in developed countries occurring in the built environment, it is not a surprise multiple performance rating systems exist for commercial and residential buildings. The USGBC Leadership in Energy and Environmental Design (LEED) is one of the most popular. It covers 8 areas for sustainable buildings of which energy is one area. The EPA's Energy Plus program has been used on over 400,000 buildings and focuses on energy only. ASHRAE's Building Energy Quotient (bEQ) programs covers energy both as *designed and as operated*. The as *operated* asset rating can help building owners with programs to improve their real building performance.

Recently a new rating system, Passive House, has gained a foothold in North America. This paper will discuss the basis of Passive House and how you can learn more.

PASSIVE HOUSE ORIGINS

Figure 1 – Certified Passive House Nursery School with Swegon GOLD DOAS units, Skvode, Sweden

Passive House Institute (PHI) was created in 1988 by Wolfgang Feist and Bo Adamson. It focused on ultra-low energy buildings particularly residential homes based on initial work developed in the United States and Canada in the early 1980s.

"Passive House is a building standard that is truly energy efficient, comfortable and affordable at the same time."[1]

Today there over 50,000 buildings that have followed the Passive House approach all over the world and a second certifying organization Passive House Institute US (PHIUS) has emerged offering a similar building certification option for North American projects.

In German *PassivHaus* means passive building. While the original projects were mostly residential spaces, the program is now used for all types of buildings in all climate zones.

Both Passive House programs focus on energy performance while being mindful to maintain indoor air quality and thermal comfort. Both programs require use of heat or energy recovery ventilation. Both certification programs use a performance based approach (as opposed to a prescriptive approach more common in North America) which gives the designer more freedom on the path to compliance.

Passive House Institute US (PHIUS): "Passive building comprises a set of design principles used to attain a quantifiable and rigorous level of energy efficiency within a specific quantifiable comfort."[1]

Thermal comfort is achieved for the most part through passive measures such as insulation, very high grade windows, shading techniques and air tightness.

[1] Source: passiv.de/en/02_informations/01_whatisapassivehouse/01_whatisapassivehouse.htm

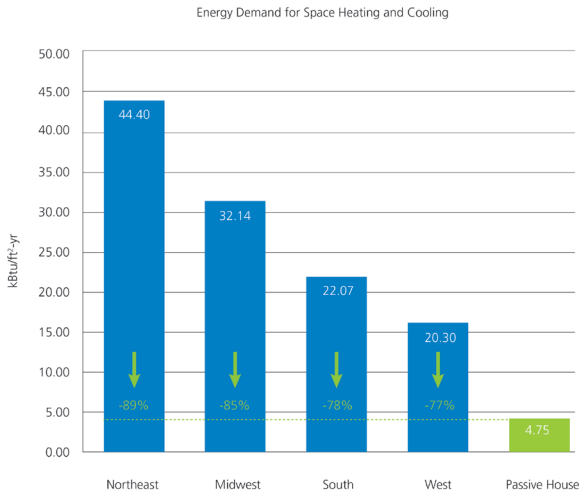

Figure 2 – Energy Demand for Space Heating and Cooling in Residential Buildings.[2]

PASSIVE HOUSE CERTIFICATION

Building Certification – PHI

Passive House Institute is headquartered in Germany, and the PHI building certification standard is applied in Europe and also on projects in North America.

The PHI certification program has three levels – Classic, Plus and Premium. A Classic rating is near net zero energy. Plus and Premium ratings have on site power generation that will meet or exceed net zero energy. All categories of certification are pass-fail. Table one presents the requirements for each certification category.

For example, to achieve PHI certification, a building must be constructed and verified to meet the following criteria;

- Space heating demand not exceed 15 kWh/m²-yr (4.75 kBtu/ft²-yr) or 10 W/m² (3.2 Btu/ft²) of usable living space.
- Total primary (source) energy of less than 120 kWh/m²-yr (38 kBtu/ft²-yr)
- 0.6 Air changes/hr @ 50 Pa (0.6 ACH @ 0.2 inches w.c.)

PHI-certification is performance based so the designer has the freedom to choose the best design to achieve the result.

PHIUS follows the intent and pillars of the Euro version but has modified the goals for the USA, to specify very specific location based climate data, adjustments for occupancy and increased quality control.

[2] USA, 2005, Source: Department of Energy

		Criteria			Alternate Criteria
Heating					
Heating Demand	kBtu/ft²-yr	≤ 4.75			
Heat Load	Btuh/ft²				≤ 10
Cooling					
Cooling + Dehumidification Demand	kBtu/ft²-yr	≤ 4.75 + dehumidification			Variable limit value
Cooling Load	Btuh/ft²				≤ 3.2
Airtightness					
Pressurization Test	ACH	≤ 0.6 ACH @ 0.2 inWc			
Renewable Primary Energy		Classic	Plus	Premium	
Renewable Primary Energy Demand	kBtu/ft²-yr	≤19	≤14.3	≤9.5	± 4.75 bBtu/ft²-yr deviation from criteria with compensation different amount of generation
Renewable Energy Generation	kBtu/ft²-yr		≥19	≥38	

Table 1 – PHI Criteria [3]

	Zone 1A (Miami)	Zone 3C (San Fran.)	Zone 4A (New York)	Zone 4C (Vancouver)	Zone 7 (Calgary)	
Energy Budget Source Energy Demand	Residential: 6200 kWh/yr*person Non-Residential: 11.1 kWh/yr*ft² (38 kBtu/yr*ft²)					
Infiltration	0.05					CFM/ft² of enclosure @0.2inWC
Mechanical Heating Demand	1	2.5	4.3	5.5	7.8	Btu/yr*ft²
Mechanical Peak Heating Load	1.3	2.7	3.9	3.8	5.7	Btuh/ft²
Mechanical Cooling Demand	19.6	1	4.9	1	1	Btu/yr*ft²
Mechanical Peak Cooling Load	5.5	3.2	4.5	2.9	3.3	Btuh/ft²
Comfort	Not Established					Hours >75F
Ventilation Rates	Residential: 0.3 ACH | Non-Residential: per code					

Table 2 – PHIUS Building Certification Criteria

PASSIVE HOUSE CERTIFIED PROFESSIONALS

Like other building standards, both PHI and PHIUS certify professionals involved with Passive House construction, but with greater specialization. PHIUS certifies Consultants, Builders, and Raters and Verifiers. PHI grants certification for Consultants (CPHC), Designers (CPHD) and Tradespersons.

PASSIVE HOUSE CERTIFIED PRODUCTS

PHI also certifies key components used in building construction including windows, compact heatpumps, drain water recovery and energy recovery ventilation (ERV) units. PHI's ERV certification criteria include 10 criteria, and the application of ERV on PHI-certified projects in North America is supported by published protocol.[3]

PHIUS verifies building/panel systems[4] and windows[4]. Although PHIUS does not yet certify ERV, they do publish protocol for the proper application of ERV on projects intended to be PHIUS certified.

While Passive House has been well known in Europe for the last two decades, it is a relative newcomer to North America. In the last few years interest in the high performance standard has grown both in residential and commercial projects.

SWEGON AND PASSIVE HOUSE

Swegon has a long history with Passive House through its Nordic roots. The Swegon GOLD energy recovery ventilating (HRV/ERV) unit is PHI certified, having met each of the (10) PHI criteria over the external pressure ranges specified in the PHI standard. The resulting passive house application flowrates are 315 to 5300 CFM. Swegon GOLD units are manufactured in North America and carry the ETL listing.

GOLD AIR HANDLING UNIT

Widely-recognized in Europe, Swegon's innovative technology is now in North America. The GOLD DOAS unit enables designers to re-think system design to improve comfort, reduce operational costs, and maximize usable space. GOLD has the lowest overall sound power levels and smallest footprint of any unit in its class. In healthcare, office, and institutional markets, GOLD helps promote employee effectiveness and attendance by improving indoor air quality and thermal comfort.

In addition, Swegon offers a complete range of accessories to meet project requirements for comfort, pressurization control, airborne moisture. This newsletter updates the Technical Bulletin dated March 2016.

Figure 4 – Swegon PHI-Certified Energy Recovery Ventilation (ERV) Unit

Figure 5 – Hogasskolan School, Certified Passive House with Swegon GOLD DOAS units, Knivsta, Sweden. (http://www.swegonairacademy.com/case-studies/hogasskolan-in-knivsta/)

ADDITIONAL INFORMATION

www.passiv.de | www.PHIUS.org | www.passivehouse.ca
www.swegonairacademy.com | www.swegon.com

Swegon offers continuing eductions coursework on the topic of Passive House ventilation. 1.0 CEU are available through AIA-CES, PHIUS and GBCI. Please contact us for more information on Passive House, GOLD or to book a training session.

[3] Mechanical Ventilation of High Performance Passive House Buildings in NA
http://www.passivehouseacademy.com/images/library/hints_tips/Protocols_for_H_ERV_Use_in_North_America_Final_Issued.pdf

[4] PHIUS Technical Committee ERV/HRV modeling protocols
http://www.phius.org/PHIUSPlus2015docs/2015-3-13%20ERV.HRV%20Protocol.pdf