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Case Study on Energy Saving Potential of Installing Certified Passive House Windows

Klearwall is supplying Certified Passive House windows to the above gut renovation of a townhouse in Manhattan. The project is targeting the EnerPHit retrofit Passive House standard, led by Brooklyn Architect In Cho of ChoShields Studio.

As can be seen from the above artist's rendering a considerable proportion of the front and rear facades will be glazed. The project features 920 square feet of windows and doors, 50% of which is south facing (to the rear), with 42% north facing (to the front). The glazing fraction is approximately 65%.

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This study compares the performance of the windows being used with the following two alternative types (specified in more detail in the table below):

- Existing single pane windows, with solid wooden frames; and
- Energy Star windows (double pane) with aluminium glazing spacer bar and fitted in the traditional manner in NYC with no overlapping of insulation on the frame.

Key Performance Stats

The energy modelling for this case study was completed in the Passive House Planning Package (PHPP) Version 8.0. The specification used for each of the three window types is specified in the table below.

	Glass U-value *BTU/hr.ft^2.F*	**Glass SHGC** *Unitless*	**Frame U-value** *BTU/hr.ft^2.F*	**Typical Psi-value of glazing spacer bars** *BTU/hr.ft.F*	**Typical Psi-value of window install** *BTU/hr.ft.F*
1. Existing single pane windows	1.021	0.87	0.440	0.0000	0.086
2. Energy Star windows	0.299	0.50	0.317	0.0439	0.086
3. Klearwall Certified Passive House Windows	0.105	0.61	0.133	0.0138	0.023

SHGC – solar heat gain coefficient

Thermal Comfort Provided by Different Glass Types

Traditionally radiators are placed in front of windows in order to compensate for the low surface temperature of the glass when it's cold outside. When there is a difference of more than 7.2^{o}F between the indoor air temperature (assumed to be 68^{o}F) and the radiant temperature of the glass, humans experience discomfort due to the radiant temperature asymmetry.

In the table below, the interior surface temperature of the glass is presented according to (a) average NYC winter low temperatures (December to February) as well as (b) the 'Polar vortex' that hit NYC in January 2014.

	Average NYC winter low *External temp. 25°F*	**Polar vortex of January 2014** *External temp.5°F*
1. Existing single pane windows	35.1 °F	20.4 °F
2. Energy Star windows	58.5 °F	54.1 °F
3. Klearwall Certified Passive House Windows	64.7 °F	63.1 °F

Table - interior surface temperature of glass according to external temperatures

Where cells are shaded pink, discomfort would arise without a radiator underneath. Where cells are shaded green, no radiator would typically be required underneath the window in order to provide acceptable comfort.

As can be seen from the table above, glass with a U-value similar to that used by Klearwall is required to provide high comfort levels in both weather scenarios where no radiator is used underneath the windows.

Savings on Heating Costs in Year 1, by Year 10 and Year 20

The heating cost for this project once it has been retrofitted (assuming that the EnerPHit standard is reached) is presented below, comparing the single pane option with Energy Star and the Klearwall Certified Passive House windows. Energy prices are based on the June 2014 cost of 401.8 US Cent per gallon for heating oil, and assuming an average price increase per year for energy of 3% (representative of price fluctuations since 2011).

	Heating Costs in Year 1	**Heating Costs by Year 10** (cumulative)	**Heating Costs by Year 20** (cumulative)
1. Existing single pane windows	$3,168	$36,322	$85,135
2. Energy Star windows	$1,750	$20,061	$47,020
3. Klearwall Certified Passive House Windows	$868	$9,947	$23,314

As can be seen from the table above, installing Certified Passive House windows equal to that supplied by Klearwall would save over $60,000 in heating costs over 20 years compared to the existing single pane windows.

Using Energy Star windows would reduce heating costs by 45% compared to the existing single glazing over the same period, but could still cost in the region of $24,000 in additional heating compared to the Klearwall performance based on our analysis using PHPP.

Summary

The following conclusions are drawn from this study:

- When considering window replacement take care to think not only about the performance of the glass, but also the insulation of the frame and the Psi-value (thermal bridge coefficient) of both the glazing spacer bars and the installation detail. Without these 4 factors combined, the **true overall performance** of the window is unknown.
- Aside from energy savings, it is important also to think about **comfort levels** in your project during the cold winter months. The Klearwall windows presented here will avoid radiant temperature asymmetry even during severe weather events such as the Polar Vortex. Plus you can get rid of those clunky radiators under the window and enjoy a more open view from your home or office.
- The **long term savings** of using Passive House Certified windows provided by Klearwall are very significant and in most cases will easily justify the (potential) additional cost of the initial investment. Many customers tell us, on the other hand, that our windows and doors are actually cheaper than products of lower performance.