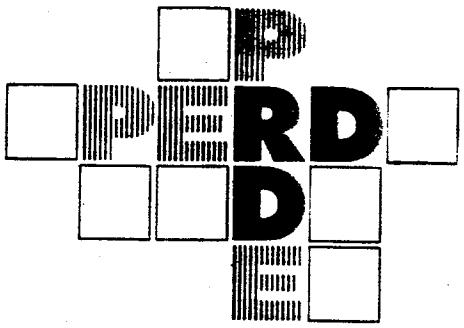

PERFORMANCE OF WINDOWS USED IN THE ADVANCED HOUSES PROGRAM

PREPARED FOR:

Energy Efficiency Division
Energy Technology Branch/CANMET
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Ottawa, Ontario
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CITATION

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NOTE

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EXECUTIVE SUMMARY

All of the ten Advanced Houses used high-performance windows and passive solar design to achieve the required energy target. The windows ranged from double-glazed to quadruple-glazed with almost all using low-e coatings, inert-gas fills (argon or krypton) and insulating spacers. All of the houses used a combination of fixed and hinged windows (no house used sliding windows). To increase solar gains, two of the houses had windows selected by orientation: double-glazed on the south-side and quadruple-glazed on the other elevations.

The windows were compared on the basis of U-value, solar heat gain coefficient and Energy Rating. Nine of the ten houses used fixed windows with total-window U-values of 1.0 $W/m^2°C$ or less. The window with the lowest heat loss window is quadruple-glazed with three low-e coatings and krypton gas fill for a total-window U-value of 0.83 $W/m^2°C$. All of the houses used windows that meet or exceed the high-performance window requirements of the 1993 Ontario Building Code for electrically-heated buildings. Some of the specialty window products (e.g., skylights) and the south-side windows for the orientation-specific house designs did not meet the OBC-E requirements. The best-performing fixed window has an Energy Rating of +12 and the best-performing hinged window has an ER of +4.

The HOT2000 computer program was used to estimate the reduction in heating load from the use of high-performance windows in place of standard double-glazed windows and from the locating the majority of windows on the south side. All but one of the houses performed better than they would had they used the high-performance windows required by Ontario Hydro or the Ontario Building Code. All but two of the houses reduced the space heating load by orienting the windows for maximum solar gain. For five of the houses, the heating load was cut in half through these two measures. The average passive solar contribution for the houses is 19 kWh per square metre of floor area, of which 85% is from high-performance windows and 15% is from solar orientation. Using lower cost double-glazed windows on the south-side instead of quadruple-glazed showed only a minor increase in energy consumption. On average, each square metre of high-performance window reduced the heating load by 169 kWh annually.

RÉSUMÉ

Afin d'atteindre les objectifs énergétiques fixés, on a utilisé, dans les dix maisons performantes, des fenêtres à haut rendement et une conception solaire passive. Les fenêtres, à double ou à quadruple vitrage, comportaient presque toutes des revêtements à faible émissivité et des intercalaires isolants et étaient, dans la majorité des cas, remplies d'un gaz inerte (argon ou krypton). On a utilisé, dans toutes les maisons, une combinaison de fenêtres fixes et pivotantes (aucune fenêtre coulissante n'a été posée). Dans deux des maisons, on a choisi les fenêtres en fonction de l'orientation afin d'accroître les gains d'énergie solaire: on a posé des fenêtres à vitrage double du côté sud et à vitrage quadruple sur les autres façades.

On a comparé les fenêtres en fonction de leur valeur U, de leur coefficient d'apport par rayonnement solaire et de leur rendement énergétique. Dans neuf des dix maisons, on a utilisé des fenêtres fixes d'une valeur U totale de 1,0 W/m^2°C ou moins. La fenêtre dont les pertes thermiques étaient les plus faibles comportait un vitrage quadruple et trois revêtements à faible émissivité et était remplie de Krypton; sa valeur U totale était de 0,83 W/m^2°C. Dans toutes les maisons, on a utilisé des fenêtres conformes aux exigences de haut rendement du Code du bâtiment de l'Ontario de 1993 pour les bâtiments chauffés à l'électricité (CBO-E). Certaines fenêtres spéciales (par ex. les puits de lumière), de même que les fenêtres posées du côté sud des maisons conçues selon l'orientation, ne satisfaisaient pas aux exigences du CBO-E. La fenêtre fixe la plus performante avait un rendement énergétique de +12, tandis que le rendement énergétique de la fenêtre pivotante la plus performante était de +4.

On s'est servi du programme informatique HOT2000 pour estimer la réduction de la charge de chauffage imputable à l'utilisation de fenêtres à haut rendement plutôt que de fenêtres à double vitrage ordinaires et au fait de placer la plupart des fenêtres du côté sud. On a obtenu, dans neuf des dix maisons, une meilleure performance que si on avait utilisé les fenêtres à haut rendement exigées par Ontario Hydro ou le Code du bâtiment de l'Ontario. Dans huit des dix maisons, on a réduit la charge de chauffage des locaux en orientant les fenêtres de façon à optimiser les gains d'énergie solaire. Dans cinq des maisons, ces deux mesures ont permis de réduire de moitié la charge de chauffage. Le rayonnement solaire passif constituait un apport moyen de 19 kWh par mètre carré de surface de plancher, dont 85 p. 100 sont attribuables aux fenêtres à haut rendement et 15 p. 100, à l'orientation des fenêtres par rapport au soleil. Le fait de poser du côté sud des fenêtres de moindre coût, à vitrage double plutôt que quadruple, n'a entraîné qu'une faible hausse de la consommation d'énergie. En moyenne, chaque mètre carré de fenêtre à haut rendement réduisait la charge de chauffage de 169 kWh par année.

1. INTRODUCTION

In 1991, Energy, Mines and Resources Canada announced the Advanced Houses Competition. Consortia from across Canada submitted proposals to construct homes that met stringent energy and efficiency targets and were designed to have minimal negative environmental impact. As a result of a two-stage competition, ten house designs were selected for construction. The ten house designs were developed and built independently with the only common design constraint being a total-house energy target of approximately one-half the R2000 energy target (which in itself represents a significant energy reduction over conventional practice).

Designs teams had to incorporate new building concepts and technologies to meet this strict energy goal. Some technologies were used in only one or two houses, whereas others were widely used. One of the most widely used technologies among the 10 Advanced Houses was high-performance windows. All houses used windows that offer significant energy savings over conventional windows. In addition, most of the house designs incorporated passive solar design principles of proper window orientation. Given the nature of the design competition, it is significant that all ten winning designs used high-performance windows and passive solar to meet the energy target.

This report examines the performance characteristics of the windows used in the Advanced Houses and assesses the energy savings and passive solar contribution of these windows. The assessment was made using the HOT2000 computer program and the "as-designed" house details supplied by each team. At the time of report preparation, several homes were still under construction and most of the others had not yet updated design drawings and computer files to reflect "as-built" design. The difference between as-designed and as-built with respect to windows is expected to have little effect on the window and passive solar energy savings.

2. ADVANCED HOUSE WINDOWS

2.1 Window Descriptions

A wide range of window designs and manufacturers were used in the ten Advanced Houses. Window details are summarized in Table 2.1. In most cases, each house used products from the same manufacturer. The two houses that used skylights and the solarium in the Novtec, were supplied by a different company than manufactured the windows for these houses. The clear double-glazed windows in Maison Performante are not included in this table or the report because they are located in an unheated solarium. In two of the houses (Envirohome-Nova Scotia and Maison Performante-Quebec), the glazing system varied with orientation to maximize solar contribution at minimum cost. In several of the houses, the desired framing system and/or glazing type was not available for specialty products (e.g., patio doors, skylights). In these cases, the designers often had to use a lower performing product (as noted in the Table).

Table 2.2 summarizes the window technologies used in the principal windows for the ten houses (product variations for specialty products were ignored for this table). Nine out of ten of the Advanced Houses used windows with inert gas fills and all used some type of insulating spacer. The windows used in the Advanced Houses could be described as triple or quadruple-glazed with two low-e coatings, inert-gas fill, insulated spacer and low conductivity frame.

It is interesting that all ten houses used a combination of fixed and hinged windows; none used sliding windows. Three of the houses (B.C., Novtec, and P.E.I.) used non-vertical glazings. The P.E.I. house, with eight skylights, has the heaviest concentration of non-vertical glazings.

Table 2.1: Description of Windows Used in Advanced Houses

House	Window Type	Manufacturer	No. of Glazings	Frame	Low-E	Spacer	Gas Fill
B.C. Advanced House	casement/picture	All-Weather	3	1 metal-clad wood	2-AFG Comfort-E^2	Super Spacer	Krypton
	patio door	All-Weather	2	vinyl	1-AFG Comfort-E^2	Super Spacer	Krypton
	skylight	Velux	2	metal-clad wood	1-Low-E	Aluminum	Argon
Saskatchewan Advanced House	casement/hinged/ door/fixed	Dorwin	3	fibreglass	2-AFG Comfort-E	Super Spacer	Argon
Manitoba Advanced House	awning/casement/ fixed	Willmar	4	aluminum-clad wood	2-HM88 1-PPG Sungate 100	metal/foam	Krypton
Waterloo Region Green Home	awning/casement/fixed	Dorwin	3	fibreglass	2-LOF Energy Advantage	Super Spacer	Argon
	door lites	Baylite	3	N/A	2-LOF Energy Advantage	TB Alum.	Argon
Neat Home, Hamilton	casement/ fixed-casement	Pollard	3	wood	2-PPG Sungate 100	Super Spacer	Krypton
Innova House, Ottawa	casement/hinged/ door/picture	Pollard	3	vinyl-clad wood	2-LOF Energy Advantage	Super Saver	Krypton
Maison Novtec, Quebec	fixed/awning	Solaris	2	vinyl	1-LOF Energy Advantage	metal/foam	Argon
	solarium	Zytco	3	thermally-broken aluminum	1-HM88 HM55 (roof)	steel	Air
Maison Performante, Quebec	fixed/casement (south side)	Fenergic P.V.C. Inc.	2	vinyl	1-Comfort E^2	aluminum	Argon
	fixed(non-south sides)	Fenergic P.V.C. Inc.	4	vinyl	2-HM88	metal/foam	Krypton
Envirohome, N.S.	fixed/casement door (south side)	Martin Windows	2	vinyl	1 E=0.2	aluminum	Argon
	fixed/casement (non-south sides)	Martin Windows	4	vinyl	2-HM88	metal/foam	Krypton
PEI Advanced House	fixed/awning/door	Visionwall	4	wood	2-HM88	insulating spacer	Air
	skylight	Velux	2	metal-clad wood	1-Low-E	Aluminum	Argon

Table 2.2 Summary of Technologies Used in Principal Windows (numbers in parentheses indicate number of houses using technology)

Frame Type	# of Glazings	# of Coatings	Gas Fill	Spacer Type
wood (5)	3 (5)	2 (8)	Krypton (5)	Silicone Foam (5)
vinyl (3)	2 + 2 films (4)	1 (1)	Argon (4)	Metal and Foam (4)
fibreglass (2)	2 (1)	3 (1)	Air (1)	Other insulating spacer (1)

2.2 Window Performance Characteristics

The Canadian Standards Association (CSA) has recently developed a standard procedure for rating the energy performance of windows [CSA, 1993]. This Standard describes the procedures to be used to determine window U-value, solar heat gain coefficient (SHGC) and Energy Rating (ER). The Energy Rating is a measure that is intended to reflect the overall heating energy impact of a window in a typical residential building. The ER is a heat balance calculated over the heating season for average Canadian winter conditions averaged over the four cardinal orientations or:

Energy Rating = Solar Heat Gain - Transmission Heat Loss - Infiltration Heat Loss

or, mathematically,

$$ER = 72.2*SHGC - 21.9*Uw - 0.54*I/Aw$$

where SHGC is the solar heat gain coefficient of the total window,
Uw is the total window U-value,
I is the window air leakage rate at 75 Pa pressure difference,
Aw is the window area.

The Energy Rating (or ER) can be positive or negative. A positive value indicates that the window produces a net energy gain over the heating season. In the supplement to the CSA standard, the methology for calculating specific energy ratings (or ERS) is given. ERS, although not a rated quantity required by the standard, allows users to determine the best window for each orientation.

Many manufacturers had the Energy Ratings for their windows evaluated using a draft version of the CSA A440.2 standard in order to qualify for Ontario Hydro's Window Incentive Program. That program required ER values of greater that +2 for fixed windows and -11 for operable windows according to the preliminary version of the A440.2 standard. The approved version of the A440.2 Standard was finalized in late 1992. The major difference between the draft and the final versions is that the SHGC is to be evaluated at a solar spectrum corresponding to air mass 1.5, instead of air mass 2. For most windows, the change in spectral distribution reduces the SHGC by 2 to 4 percent and the Energy Rating by approximately 2 to 3 points. Thus, most published Energy Rating values (prior to 1993) should be reduced by 2 to 3 points to compare to the values given in this report.

As a result of the Ontario Hydro Window Incentive Program, the 1993 Ontario Building Code requires electrically heated homes to use windows that have an ER -13 (operable) or +0 (fixed) evaluated in accordance with the latest version of the standard. Windows that qualified for the Ontario Hydro program qualify for the 1993 OBC for electrically heated buildings. A double-glazed, low-e, argon-filled window in a well-designed frame would be required to meet these programs. In this report, windows that meet these requirements will be referred to as "high-performance windows". (For comparison, conventional double-glazed wood-framed windows would have an ER of -30 if operable, and -15 if fixed and will be referred to as "standard windows".)

Because many of the windows used in the Advanced Houses were prototypes, independent thermal property values were generally not available. For this report, window thermal property values were calculated in accordance with the requirements of the latest version of CSA A440.2. The centre-glazing U-value and SHGC were calculated using the VISION3 computer program [U of W, 1993]. The frame and edge-of-glass U-values were calculated using the FRAME 3.0 [Enermodal, 1992] computer program in those cases where frame design drawings were available. Where frame information was not available, U-values had to be estimated using values published in the 1993 ASHRAE Handbook of Fundamentals. When infiltration results were not available, fixed windows were assumed to have no air leakage and hinged windows were assumed to have a value of 0.30 m^3/h/metre of crack of length (typical of hinged windows). The thermal property values were determined for the reference window sizes given in the A440.2 Standard and were not based on the actual window sizes in the houses.

Table 2.3 lists the thermal property values for the windows used in the Advanced Houses. Energy Ratings were calculated for all glazed products. Skylights and hinged glass doors are not included in CSA A440.2: these products were evaluated assuming they were casement windows and sliding glass doors, respectively. Fixed windows are evaluated at a size of 1200 X 1200 mm and hinged windows are evaluated at a size of 600X 1220 mm (as required by the Standard). The larger size and generally small frame heights means that the fixed window properties are dominated by the centre-glazing properties. The opposite is true for hinged windows, where the smaller window size and larger frame heights mean that frame effects are very important.

The window property data used by the house designers in simulating the house performance were not used because the procedure described above is more rigorous and is based on the most recent version of the CSA Standard. In general, the values given in Table 2.3 are poorer than the values used by the design teams, but for the most part the differences are small. The reader is cautioned that because of some of the estimates made, the values listed in Table 2.3 are not the exact product ratings of the manufacturers listed in Table 2.1. The values should, however, be a reasonable representation of windows of similar design.

Table 2.3a: Fixed Window Properties

Name	Type	Frame Height (mm)	Frame U-value ($W/m^2\ ^oC$)	Edge-Glass U-value ($W/m^2\ ^oC$)	Centre-Glass U-value ($W/m^2\ ^oC$)	Total U-value ($W/m^2\ ^oC$)	CG Solar Heat Gain Coefficient	Total SHGC	Energy Rating (W/m^2)
B.C. Advanced House	Picture	41.0	2.10	1.07	0.84	1.05	0.51	0.35	-5
Saskatchewan Advanced House	Fixed & Door Lites	56.0	1.15	1.02	0.80	0.90	0.45	0.37	7
Manitoba Advanced House	Fixed & Door Lites	41.0	2.10	0.77	0.61	0.83	0.40	0.35	7
Waterloo Region Green Home	Fixed & Door Lites	56.0	1.07	1.21	0.95	1.02	0.56	0.46	11
Neat Home, Hamilton	Fixed	75.0	1.63	0.91	0.72	0.96	0.46	0.36	4
Innova House, Ottawa	Fixed	46.0	1.58	1.13	0.89	1.03	0.56	0.48	12
Maison Novtec, Quebec	Fixed	41.0	2.40	2.24	1.76	1.93	0.71	0.62	2
Maison Performante, Quebec	Fixed, Dbl. (south side)	41.0	2.80	2.63	1.72	2.03	0.69	0.60	-1
	Fixed	41.0	2.80	0.84	0.66	0.97	0.44	0.38	7
Envirohome, Nova Scotia	Fixed, Door Lites, Side Lites (south side)	40.0	2.10	2.66	1.76	1.97	0.71	0.62	2
	Fixed with Superglass	40.0	2.10	0.84	0.66	0.88	0.44	0.39	9
PEI Advance House	Fixed & Door Lites	57.0	1.70	1.05	0.83	1.02	0.44	0.36	4
Standard Windows	Fixed	39.3	3.88	3.27	2.82	3.03	0.76	0.67	-18
High-Performance Windows	Fixed	39.3	2.37	1.81	1.56	1.71	0.63	0.55	2

Table 2.3b: Hinged Window Properties

Name	Type	Frame Height (mm)	Frame U-value ($W/m^2\ ^oC$)	Edge-Glass U-value ($W/m^2\ ^oC$)	Centre-Glass U-value ($W/m^2\ ^oC$)	Total U-value ($W/m^2\ ^oC$)	CG Solar Heat Gain Coefficient	Total SHGC	Energy Rating (W/m^2)
B.C. Advanced House	Casement	71.0	2.20	1.07	0.84	1.34	0.51	0.35	-5
Saskatchewan Advanced House	Casement	68.0	1.25	1.02	0.80	0.99	0.45	0.31	-0
Manitoba Advanced House	Casement/ Awning	71.0	2.20	0.77	0.61	1.17	0.40	0.27	-7
Waterloo Region Green Home	Casement/ Awning	68.0	1.25	1.21	0.95	1.11	0.56	0.39	4
Neat Home, Hamilton	Casement	75.0	1.47	0.91	0.72	1.02	0.46	0.31	-1
Innova House, Ottawa	Casement	75.0	1.67	1.13	0.89	1.22	0.56	0.37	-1
Maison Novtec, Quebec	Awning	71.0	2.60	2.24	1.76	2.15	0.71	0.48	-13
Maison Performante, Quebec	Casement (south side)	82.0	1.78	2.63	1.72	1.96	0.69	0.44	-12
	Casement	82.0	1.78	0.84	0.66	1.12	0.44	0.28	-5
Envirohome, Nova Scotia	Casement (south side)	80.0	2.10	2.66	1.76	2.10	0.71	0.46	-14
	Casement with Superglass	80.0	2.10	0.84	0.66	1.22	0.44	0.28	-7
PEI Advance House	Awning	114.0	1.70	1.05	0.83	1.31	0.44	0.23	-13
Standard Windows	Casement	78.0	2.82	3.27	2.82	2.93	0.76	0.50	-29
High-Performance Windows	Casement	78.0	2.09	1.81	1.56	1.81	0.63	0.41	-11

Table 2.3c: Specialty Window Properties

Name	Type	Frame Height (mm)	Frame U-value ($W/m^2\,°C$)	Edge-Glass U-value ($W/m^2\,°C$)	Centre-Glass U-value ($W/m^2\,°C$)	Total U-value ($W/m^2\,°C$)	CG Solar Heat Gain Coefficient	Total SHGC	Energy Rating (W/m^2)
B.C. Advanced House	Skylight	23.0	13.10	2.92	2.10	3.55	0.62	0.56	-38
	Patio Door	88.0	2.50	2.06	1.62	1.89	0.70	0.55	-2
Innova House, Ottawa	Hinged Patio Door	88.0	2.30	1.13	0.89	1.24	0.56	0.44	4
Maison Novtec, Quebec	Solarium - Windows	32.0	6.60	2.33	1.32	2.05	0.57	0.52	-8
	Solarium - Roof	32.0	6.60	2.26	1.23	1.97	0.31	0.28	-23
Maison Performante, Quebec	Tilt-turn Door (south side)	121.0	1.66	2.63	1.72	1.85	0.69	0.49	-6
	Tilt-turn Door	121.0	1.66	0.84	0.66	0.98	0.44	0.31	0
Envirohome, Nova Scotia	Patio Door	121.0	1.66	2.66	1.76	1.88	0.71	0.51	-5
PEI Advance House	Skylight	23.0	13.10	2.92	2.10	3.55	0.62	0.56	-38

2.3 Comparison of Window Performance Characteristics

The windows used in the Advanced Houses were compared on the basis of U-value, SHGC and Energy Rating. Separate comparisons were made for the two window types used (fixed and hinged). To keep the comparisons straightforward, specialty products (e.g., patio doors and skylights) were not included. For eight of the ten houses, one window design was used on all elevations. Two window designs were used for the Nova Scotia house and Maison Performante because they selected different window types based on orientation: double-glazed low-e, argon windows on the south elevation and quadruple-glazed windows on the other elevations.

Figure 2.1 compares the total U-values for the fixed windows used in the Advanced Houses. In general, the windows fall into three groups according to the number of glazings. Three of

the four quadruple-glazed windows have total U-values below 1.0 (Manitoba, Nova Scotia and Maison Performante); only the PEI quadruple-glazed system has a total U-value greater than 1.0, due to the fact that it does not use an inert-gas fill. The Manitoba fixed window has the lowest total U-value (0.83) because it uses three low-e coatings (the most used in any other window is two). The triple-glazed windows offer only slightly poorer U-values than the quadruple-glazed systems. The triple glazed systems have U-values between 0.90 and 1.08 $W/m^2°C$. The three double-glazed windows have much higher U-values, close to 2.0 $W/m^2°C$.

The total U-values for the hinged windows (Figure 2.2) are noticeably higher than for the fixed windows, reflecting the increased effect of the frame. The total U-values for the windows that used fibreglass frames with interior insulation (Saskatchewan and Waterloo) hardly changed, whereas the hinged windows in the Manitoba house have a total U-value 40% higher than their fixed counterpart.

Figures 2.3 and 2.4 show the total-window solar heat gain coefficient for the fixed and hinged windows, respectively. Fixed windows have higher SHGCs than hinged windows because the smaller frame results in less blockage of the sunlight. For passive solar heating purposes, windows should have a high SHGC. The double-glazed windows, although having poor (i.e., high) U-values have the best SHGC, greater than 0.6 for the fixed version. Despite having triple-glazed windows, the two houses that used the LOF Energy Advantage low-e coating (Waterloo and Ottawa) have fairly high SHGC values. The fixed window in the Hamilton house has the lowest SHGC among triple-glazed window because it has a high frame height, the same height as the hinged window.

Figures 2.5 and 2.6 display the Energy Rating for fixed and hinged windows. The Energy Rating is intended to be an indicator of the relative energy impact of the windows because it combines the effects of U-value and SHGC. The two triple-glazed windows with the high-transmission LOF coating (Ottawa and Waterloo) have the best fixed window Energy Ratings. The two products with the insulated fibreglass frame (Waterloo and Saskatchewan) have the best hinged window Energy Ratings. All of the windows meet the high-performance window requirements of the 1993 Ontario Building Code, with the exception of the Nova Scotia hinged double-glazed and the Maison Performante fixed double-glazed.

To put these values in context, the Energy Ratings for the Advanced Houses windows can be compared to the values for standard double-glazed windows and windows that just meet the requirements of the 1993 Ontario Building Code for electrically heated buildings (referred to as high-performance). Tables 2.5 and 2.6 compare the thermal properties for these windows for fixed and hinged types respectively. The thermal property data for the standard

Figure 2.1

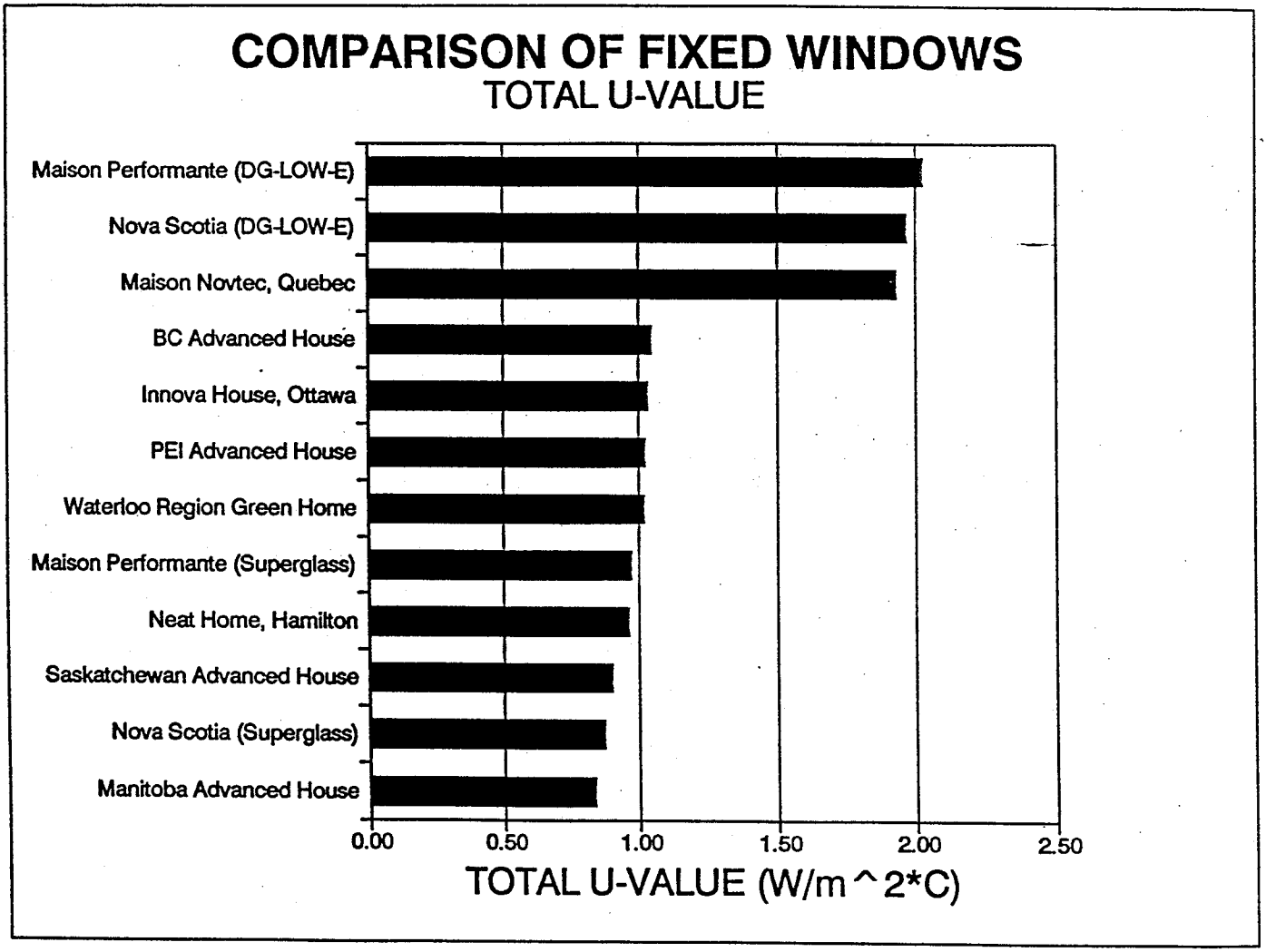

COMPARISON OF FIXED WINDOWS
TOTAL U-VALUE
Maison Performante (DG-LOW-E)
Nova Scotia (DG-LOW-E)
Maison Novtec, Quebec
BC Advanced House
Innova House, Ottawa
PEI Advanced House
Waterloo Region Green Home
Maison Performante (Superglass)
Neat Home, Hamilton
Saskatchewan Advanced House
Nova Scotia (Superglass)
Manitoba Advanced House
0.00
0.50
1.00
1.50
2.00
2.50
TOTAL U-VALUE (W/m^2*C)

Figure 2.2

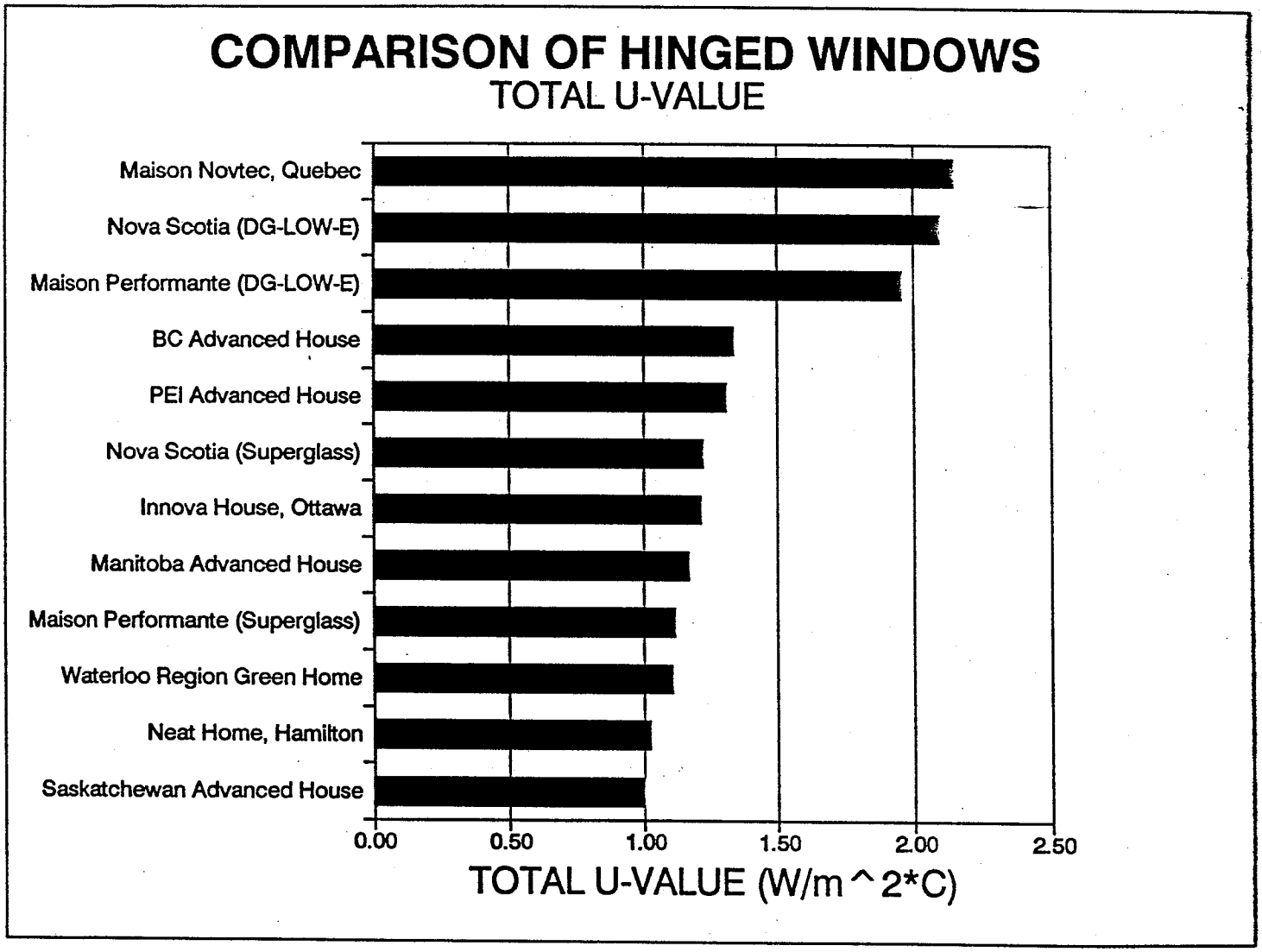

COMPARISON OF HINGED WINDOWS
TOTAL U-VALUE
Maison Novtec, Quebec
Nova Scotia (DG-LOW-E)
Maison Performante (DG-LOW-E)
BC Advanced House
PEI Advanced House
Nova Scotia (Superglass)
Innova House, Ottawa
Manitoba Advanced House
Maison Performante (Superglass)
Waterloo Region Green Home
Neat Home, Hamilton
Saskatchewan Advanced House
0.00
0.50
1.00
1.50
2.00
2.50
TOTAL U-VALUE (W/m ^ 2*C)

Figure 2.3

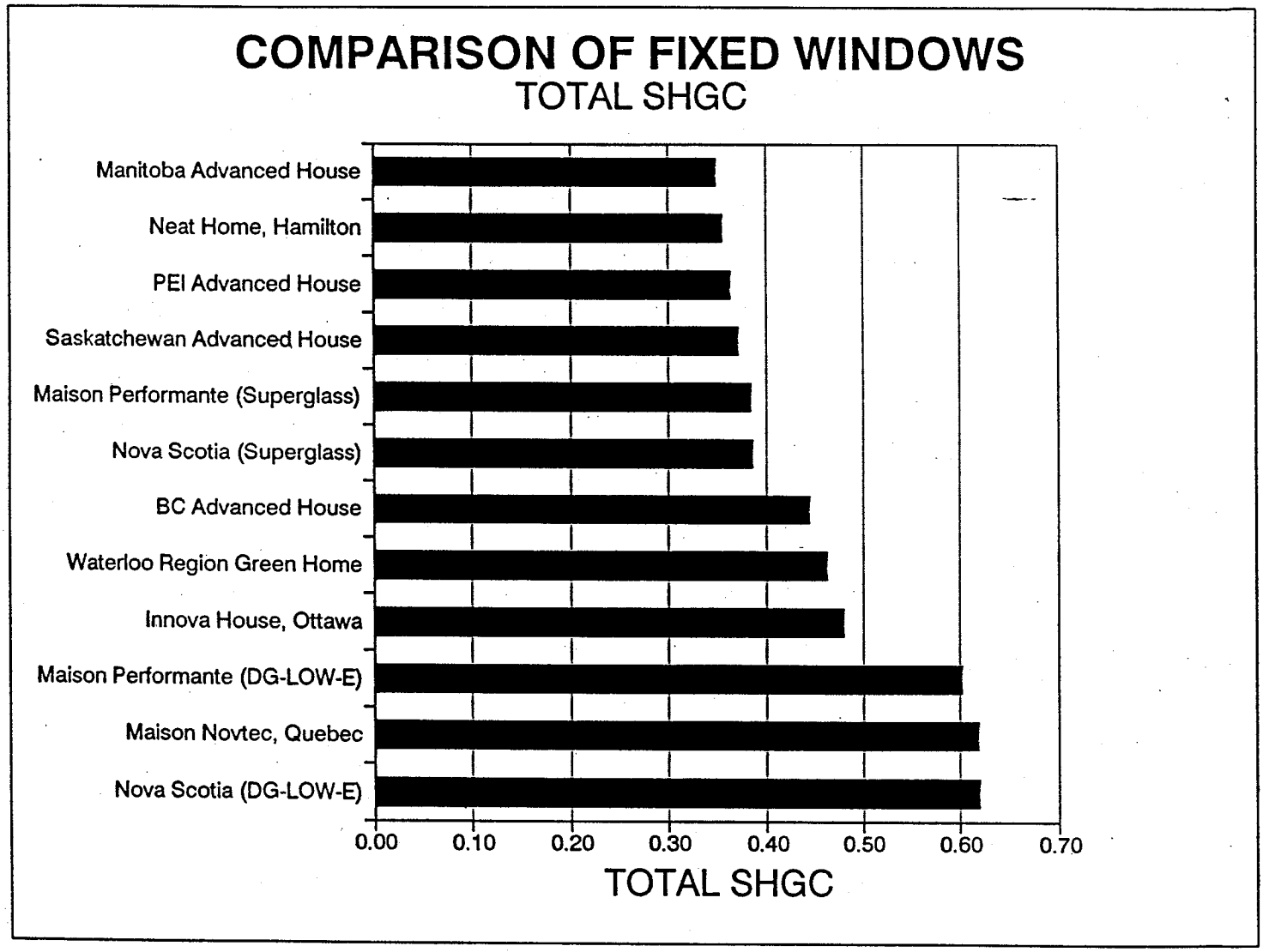

COMPARISON OF FIXED WINDOWS
TOTAL SHGC
Manitoba Advanced House
Neat Home, Hamilton
PEI Advanced House
Saskatchewan Advanced House
Maison Performante (Superglass)
Nova Scotia (Superglass)
BC Advanced House
Waterloo Region Green Home
Innova House, Ottawa
Maison Performante (DG-LOW-E)
Maison Novtec, Quebec
Nova Scotia (DG-LOW-E)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
TOTAL SHGC

Figure 2.4

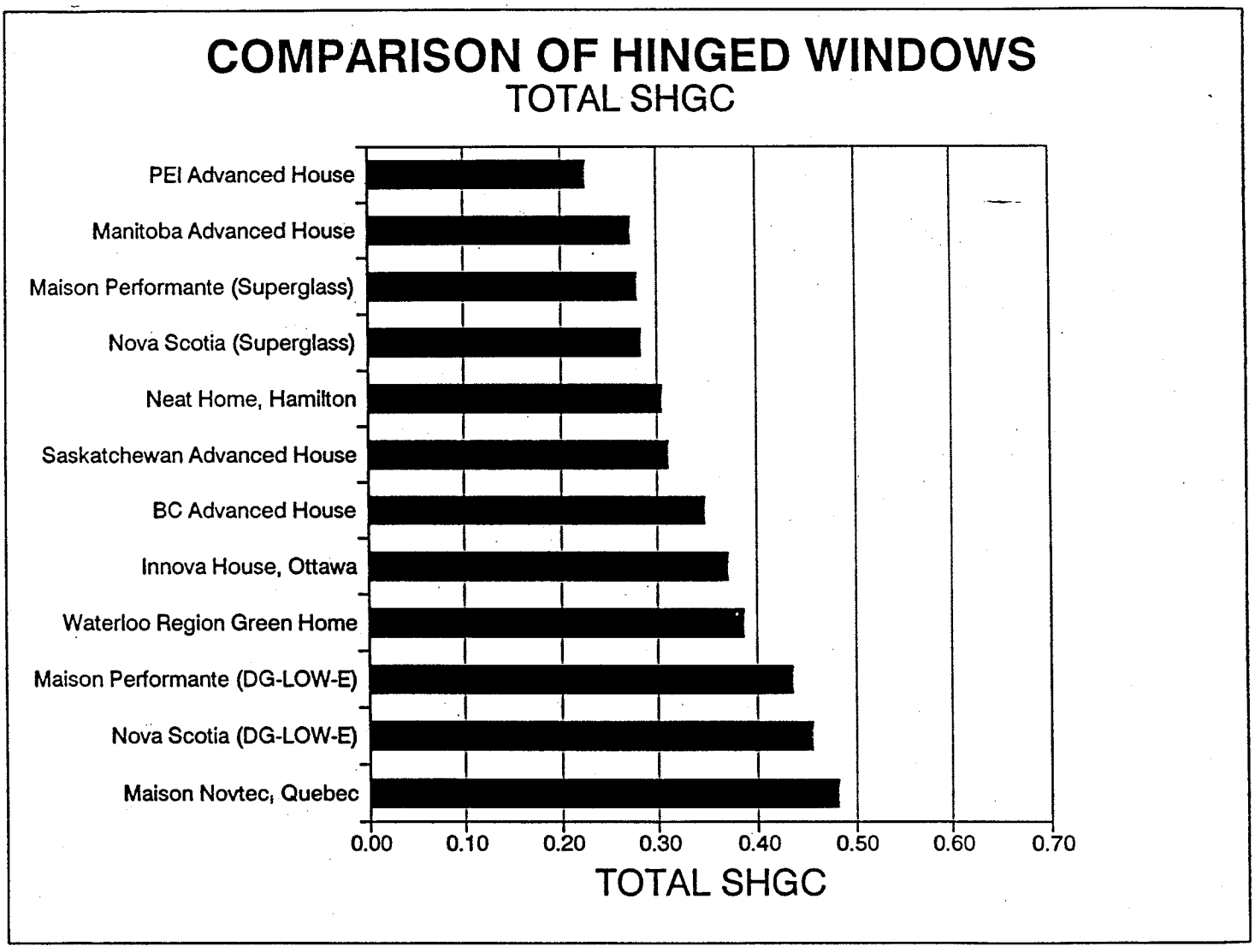

COMPARISON OF HINGED WINDOWS
TOTAL SHGC
PEI Advanced House
Manitoba Advanced House
Maison Performante (Superglass)
Nova Scotia (Superglass)
Neat Home, Hamilton
Saskatchewan Advanced House
BC Advanced House
Innova House, Ottawa
Waterloo Region Green Home
Maison Performante (DG-LOW-E)
Nova Scotia (DG-LOW-E)
Maison Novtec, Quebec
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
TOTAL SHGC

Figure 2.5

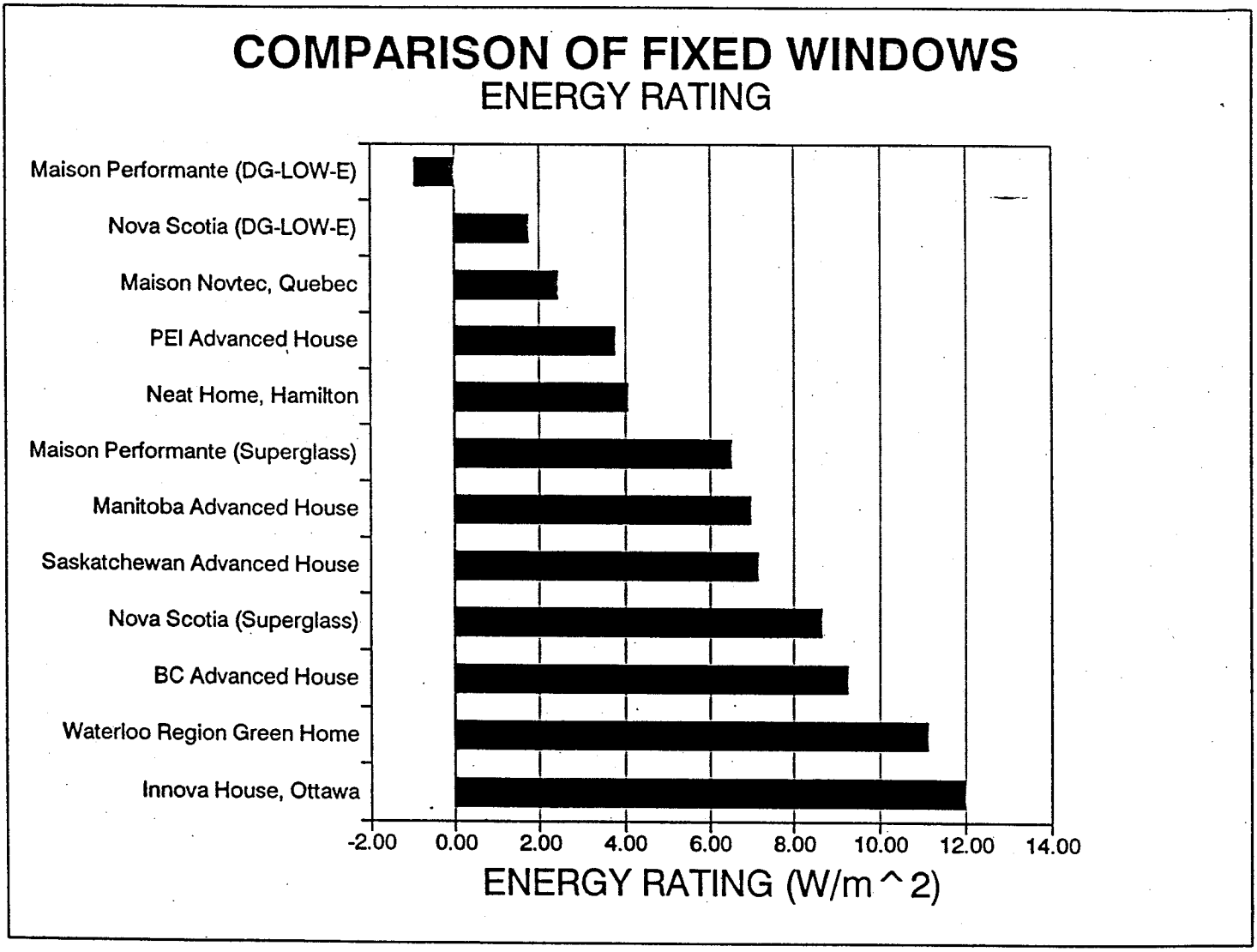
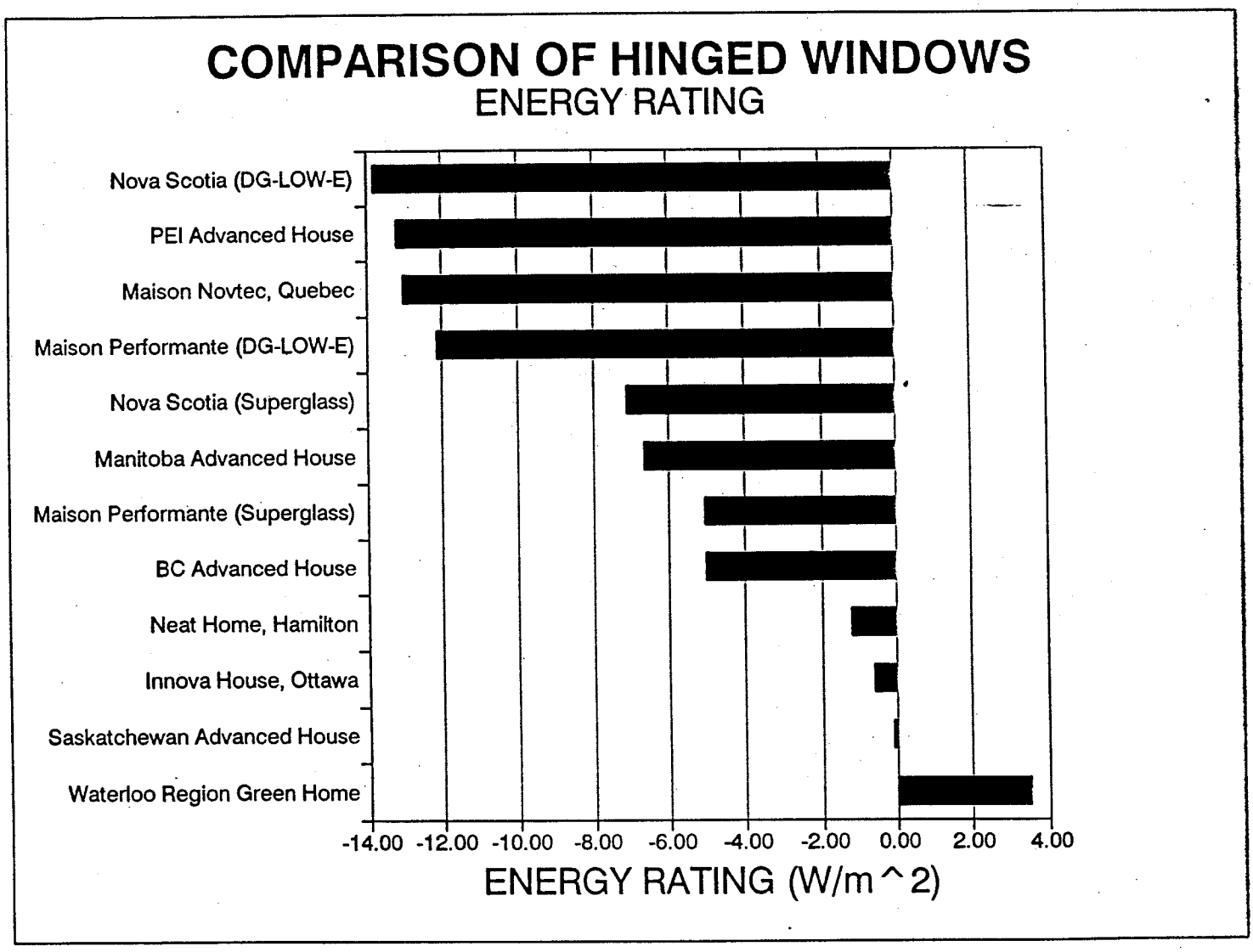

COMPARISON OF FIXED WINDOWS
ENERGY RATING
Maison Performante (DG-LOW-E)
Nova Scotia (DG-LOW-E)
Maison Novtec, Quebec
PEI Advanced House
Neat Home, Hamilton
Maison Performante (Superglass)
Manitoba Advanced House
Saskatchewan Advanced House
Nova Scotia (Superglass)
BC Advanced House
Waterloo Region Green Home
Innova House, Ottawa
-2.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
ENERGY RATING (W/m^2)

Figure 2.6


COMPARISON OF HINGED WINDOWS
ENERGY RATING
Nova Scotia (DG-LOW-E)
PEI Advanced House
Maison Novtec, Quebec
Maison Performante (DG-LOW-E)
Nova Scotia (Superglass)
Manitoba Advanced House
Maison Performante (Superglass)
BC Advanced House
Neat Home, Hamilton
Innova House, Ottawa
Saskatchewan Advanced House
Waterloo Region Green Home
-14.00 -12.00 -10.00 -8.00 -6.00 -4.00 -2.00 0.00 2.00 4.00
ENERGY RATING (W/m^2)

and high-performance windows were the same as those used in developing the high-performance criteria for the Ontario Hydro Window Incentive Program [Carpenter, 1991]. The standard window is double glazed with 12.7 mm air gap and an aluminum spacer in an average frame (market-weighted average of aluminum, wood and vinyl). The high-performance window is double glazed with a 0.09 emissivity coating, argon gas fill and insulating spacer in a wood frame. Infiltration was assumed to be equal to the values used for the Advanced Houses windows.

The tables include values for the average performance of the Advanced House windows and the best-performing window. The best-performing window varies according to the property: a quad-glazed window has the best U-value, a double-glazed low-e window has the best SHGC and a triple-glazed has the best Energy Rating. The improvement in Energy Rating of best-performing Advanced House window over standard double glazing is almost twice that of what is considered a "high-performance" window. Section 3 will quantify the exact energy savings of the Advanced Houses windows.

Table 2.5: Comparison of Fixed Window Properties

	Standard	High-Performance	Average of Advanced Houses	Best of Advanced Houses
Total U-value	3.03	1.71	1.22	0.83
Total SHGC	0.67	0.55	0.45	0.62
Energy Rating	-18	2	5	12

Table 2.6: Comparison of Hinged Window Properties

	Standard	High-Performance	Average of Advanced Houses	Best of Advanced Houses
Total U-value	2.93	1.81	1.39	0.99
Total SHGC	0.50	0.41	0.35	0.48
Energy Rating	-29	-11	-6	4

3. PASSIVE SOLAR CONTRIBUTION

3.1 Methodology

The passive solar contribution for the ten Advanced Houses was determined using the HOT2000 computer program (Version 6.02 [CHBA, 1991]). In this report the passive solar contribution is based on reduction in heating load and not on reduction in space-heating energy consumption. Comparing savings in energy consumption would be misleading because the heating system efficiency varies significantly from less than one for fossil-fuel equipment to as high as four for ground-source heat pumps. Some reports define passive solar contribution as the usable solar gains, that is, the difference in heating load between the actual design and a design with no solar gain (ie., the windows reflect all solar gains). This definition is not used in this report, because it does not identify the savings from improving the U-value of the windows.

For each house, five simulations were performed. The first simulation was for the actual or "as-designed" configuration. The simulation was performed using the HOT2000 datafile supplied by each of the design teams modified to use the component (i.e., frame, edge and centre) window properties given in Section 2. The component properties were area-weighted according to the actual sizes of window used, and not to the CSA standard sizes. The averaging process and values used in the simulations are given in Appendix A.

For the second simulation, the window properties were changed to values for windows that just meet the requirements of the 1993 Ontario Building Code for electrically heated buildings. In the third simulation, window thermal property values were changed to those for standard double-glazed windows; these property values are given in Appendix A. For the fourth simulation, the standard double-glazed windows were redistributed so that there was equal window area on each of the four sides of the house. A fifth simulation was performed for the two houses that selected window type by orientation. This simulation was performed with all windows having the same properties as the window with the best Energy Rating. This meant replacing the double-glazed windows on the south-side with the quadruple-glazed windows used on the other elevations.

The passive solar contribution to the heating load can be thought of as consisting of two parts. The first part of passive solar contribution is the reduction in heating load due to the use of high-performance windows instead of standard windows. This savings can be found by subtracting the heating load of the third simulation (standard windows) from the first

simulation (actual house). The difference between the first and second simulations shows the benefit of going beyond double-glazed high-performance windows.

The second part of solar contribution is the reduction in heating load due to re-distributing the windows to have the majority of windows on the south side. This savings can be found by subtracting the heating load of the fourth simulation (standard windows equally distributed) from the third simulation (standard windows with actual window distribution).

3.2 General House Descriptions

A full description of the ten houses is beyond the scope of this report. Some information on the house designs is useful, however, in interpreting the results. Although all of the houses are single-family detached, they vary in size and configuration. The house characteristics are summarized in Table 3.1, listed in order of increasing house size.

The table lists two floor areas for each house: finished floor area and equivalent floor area. The finished floor area is the area commonly used in the building and real estate industries and refers to the above-grade usable floor area. With the Waterloo house the lower level, which is partially below-grade, was included in the finished floor area because this level was designed to be usable floor area. Equivalent floor area is the area used in the R-2000 and Advanced House Programs and is defined as the total heated volume (including below-grade portion) divided by 2.5 metres. This is the area that is used to determine whether the houses met the Advanced House energy budget and as such will be the area used to compare the energy performance of the houses.

The P.E.I., Nova Scotia, Saskatchewan, and B.C. houses are quite large: over 330 square metres of equivalent floor area (including any below-grade area). The Maison Performante, at 197 square metres of equivalent floor area, is quite modest. All of the houses are two-storey, with the exception of the raised bungalow used in Waterloo and all have basements, except for the B.C. and Novtec houses.

To meet the strict energy budget of the Advanced Houses program, the ten houses are well-insulated and air-tight (all with some sort of heat-recovery ventilation). Walls are typically insulated to RSI 6 (R35) and ceilings to RSI 10 (R60). Because the building shell heat loss is very low, the length of the heating season is shorter than that for most Canadian houses. A shorter heating season means less opportunity to use solar gains. In other words, the solar contribution from the windows used in the Advanced Houses would be higher when if they were installed in houses that were not so well-insulated.

Table 3.1: Comparison of House Designs

Name	Equiv. Floor Area (m^2)[1]	Finished Floor Area (m^2)[2]	Total Window Area (m^2)	South Window Area (m^2)	Total Window Area + Floor Area (%)	South Window + Floor Area (%)	South Window + Total Window (%)
Maison Performante, Quebec	197	158	31.9	21.5	20	14	67
Waterloo Green Home	240	224	26.4	15.6	12	7	59
Maison Novtec, Quebec	241	237	46.7	26.7	20	11	57
Innova House, Ottawa	273	204	26.3	15.5	13	8	59
Neat Home, Hamilton	273	177	26.6	2.5	15	1	9
Manitoba Advanced House	289	186	26.8	17.4	14	9	65
BC Advanced House	338	256	42.4	23.5	17	9	55
Saskatchewan Advanced House	344	231	30.6	14.5	13	6	47
Envirohome, Nova Scotia	345	198	31.8	17.4	16	9	55
PEI Advanced House	357	209	55.6	22.4	27	11	40
AVERAGE	**290**	**208**	**34.5**	**17.7**	**17**	**9**	**51**

[1] - Calculated as total house volume including below grade portions divided by typical floor-to-ceiling height of 2.5m

[2] - Finished floor area, excluding the basement (except Waterloo House)

Table 3.2 compares the climatic conditions for the ten houses. The houses are listed in order of increasing degree-days. The cold locations (Manitoba and Saskatchewan) have almost twice the number of degree-days as the warmest location (B.C.). The cold Prairie climate is somewhat compensated by the high solar availability.

Table 3.2: Comparison of Climatic Conditions

Name	Location	Degree-Days (°C - Days)	Solar Available (kWh/m^2 south surface Oct. - Apr.)
B.C. Advanced House	Vancouver	3005	478
Neat Home	Hamilton	3952	590
Waterloo Region Green Home	Waterloo	4138	590
Envirohome, N.S.	Halifax	4354	650
Maison Novtec, Quebec	Montreal	4471	640
Maison Performante, Quebec	Montreal	4471	640
PEI Advanced House	Charlottetown	4622	638
Innova House	Ottawa	4673	689
Manitoba Advanced House	Winnipeg	5887	785
Saskatchewan Advanced House	Saskatoon	6077	745

3.3 Solar Contributions for Each House

The simulation results are presented in Table 3.3. House space-heating loads for the houses are tabulated for the set of five simulations. In Table 3.4, the reduction in heating load due to window type is shown. These results have been normalized to the floor area of the house. The high heating load for Maison Novtec and the P.E.I. house is because the house designers chose to trade off energy savings from a high-COP heating system for increased heating load due to lower levels of insulation. The low space-heating load in B.C. is due to the mild climate and high insulation levels (for that climate). It should be remembered that all houses had to meet the same energy budget (which is a function of degree-days, floor area and heating system efficiency).

It is interesting to note that the passive solar contribution (from reduced window heat loss and solar orientation) for five of the houses is approximately equal to the actual house space heating load. In other words, if these houses used standard windows equally distributed on all four sides, the space heating load would double. Clearly, passive solar design is a key component to achieving low energy use. The average passive solar contribution for the ten houses was 19 kWhrs/m^2 of floor area.

For the two houses that selected windows by orientation, Table 3.3 shows that using quadruple-glazed windows for all orientations would have resulted in only a minor reduction in space heating load. Furthermore, it is unlikely that the high extra cost for using quadruple-glazed windows on the south-side could have been justified by the modest savings. Selecting window type by orientation appears to improve the cost-effectiveness of high-performance windows.

Table 3.5 and Figure 3.1 compare the solar contributions per square metre of window area. The Manitoba and Saskatchewan houses have the highest passive solar contributions due to good window selection and a cold, sunny climate. The Manitoba house achieved a higher passive solar contribution than any other house through effective window orientation. P.E.I., on the other hand, achieved no benefit from window orientation and the Hamilton House had negative savings. The B.C. and Novtec houses had the lowest solar contributions. The low solar radiation levels in B.C. limit the potential solar savings in that climate. The low solar contribution on a per unit window area basis for Maison Novtec is a result of choosing windows that are not as good as those required for the 1993 Ontario Building Code for electrically-heated buildings.

Table 3.3: Space Heating Loads for Various Window Designs (kWh)

(listed in order of increasing heat load)

Name	Conventional Design Load[1]	Standard Windows[2]	High Perform-ance[2]	Best Windows on All 4 Sides[2]	Actual Heating Load[2]
B.C. Advanced House	8543	7538	5003	N/A	4173
Waterloo Green Home	10637	9190	6629	N/A	5194
Neat Home, Hamilton	8631	9535	6507	N/A	5526
Innova House, Ottawa	11469	10150	7342	N/A	5898
Maison Performante, Quebec	11083	9912	6725	6095	6354
Manitoba Advanced House	14168	12109	8391	N/A	6811
Saskatchewan Advanced House	16678	16146	12001	N/A	10161
Envirohome, Nova Scotia	16221	15257	11724	10321	10762
Maison Novtec, Quebec	21922	20859	15173	N/A	16486
PEI Advanced House	21514	21555	15708	N/A	14639

[1] - Space heating load for advanced house designs with standard windows equally distributed on four orientations.

[2] - Windows distributed according to actual house design.

Table 3.4: Reduction in Space Heating Load Due to Window Design (kWh/m² of floor area)

(listed in order of increasing savings)

NAME	CONVEN-TIONAL DESIGN LOAD[1]	REDUCTION IN LOAD DUE TO				ACTUAL HEATING LOAD
		ACTUAL WINDOW DISTRI-BUTION	HIGH PERFOR-MANCE WINDOW	ACTUAL WINDOWS	ACTUAL DISTRI-BUTION & WINDOWS	
Neat Home, Hamilton	31	(4)	11	15	11	20
B.C. Advanced House	25	3	7	10	13	12
Envirohome, Nova Scotia	47	3	10	13	16	31
Saskatchewan Advanced House	49	2	12	17	19	30
PEI Advanced House	60	0	16	19	19	41
Innova House, Ottawa	42	4	11	16	20	22
Maison Novtek Quebec	92	5	24	18	23	69
Waterloo Green Home	45	6	11	17	23	22
Maison Performante Quebec	56	6	16	18	24	32
Manitoba Advanced House	50	8	12	18	26	24
AVERAGE	**50**	**3**	**13**	**16**	**19.4**	**30.3**

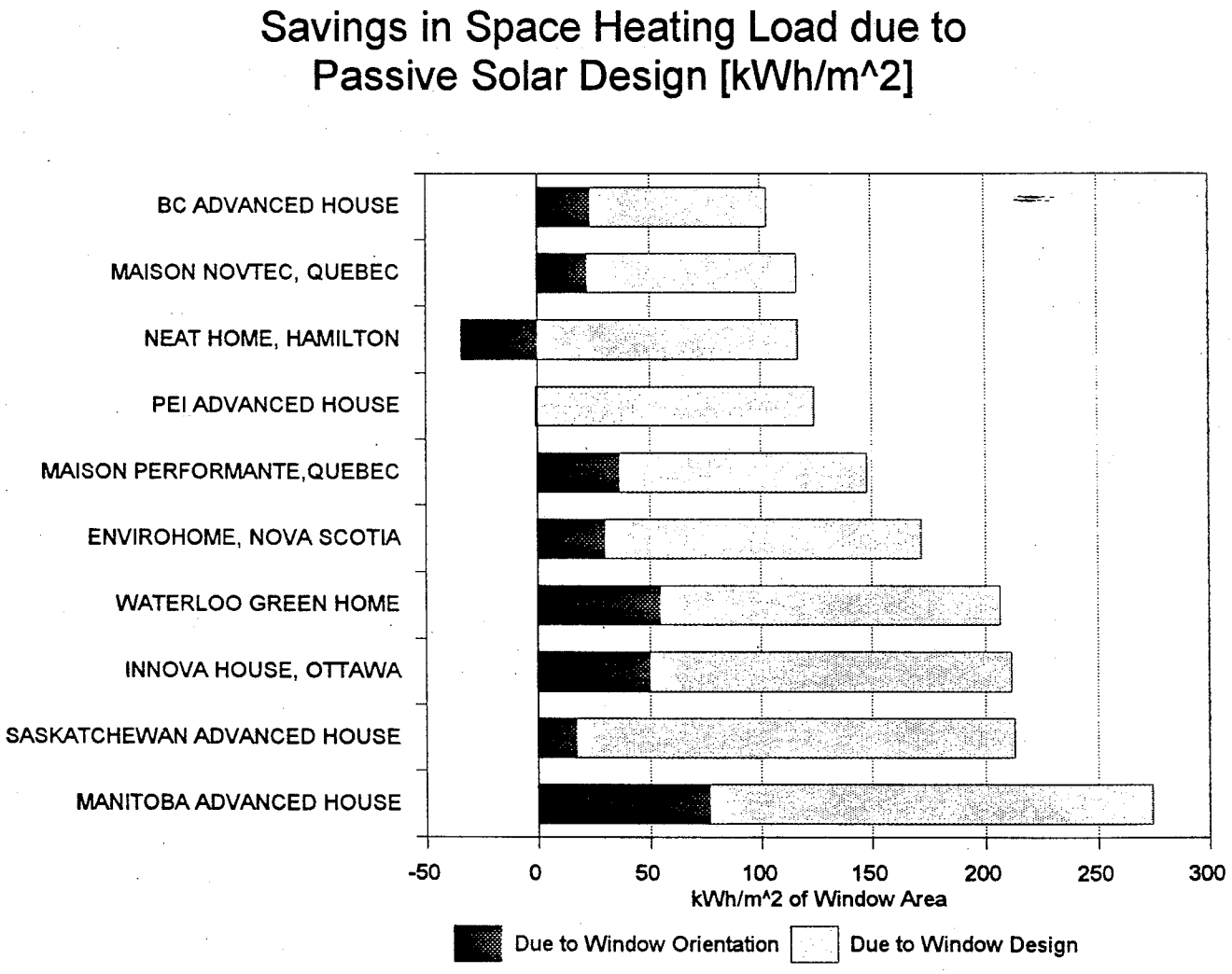
[1] - Space heating load for advanced house designs with standard windows equally distributed on four orientations.

Table 3.5: Savings in Space Heating Load due to Passive Solar Design (kWh/m² of window area)

(listed in order of increasing savings)

NAME	DUE TO WINDOW ORIENTATION	DUE TO WINDOW DESIGN	TOTAL PASSIVE SOLAR SAVINGS
B.C. Advanced House	24	79	103
Maison Novtec, Quebec	22	94	116
Neat Home, Hamilton	(34)	151	117
PEI Advanced House	0	124	124
Maison Performante, Quebec	37	111	148
Envirohome, Nova Scotia	31	141	172
Waterloo Green Home	54	152	206
Innova House, Ottawa	50	162	212
Saskatchewan Advanced House	17	196	213
Manitoba Advanced House	77	197	274
Average	**27.8**	**140.7**	**168.5**

Figure 3.1


Savings in Space Heating Load due to Passive Solar Design [kWh/m^2]
BC ADVANCED HOUSE
MAISON NOVTEC, QUEBEC
NEAT HOME, HAMILTON
PEI ADVANCED HOUSE
MAISON PERFORMANTE,QUEBEC
ENVIROHOME, NOVA SCOTIA
WATERLOO GREEN HOME
INNOVA HOUSE, OTTAWA
SASKATCHEWAN ADVANCED HOUSE
MANITOBA ADVANCED HOUSE
-50
0
50
100
150
200
250
300
kWh/m^2 of Window Area
Due to Window Orientation
Due to Window Design

On average, the windows used in the Advanced Houses were able to reduce the space heating load by 169 kWhrs per square metre of window area. Over 80% of this reduction (or 140 kWhrs/m^2 of window) came from using windows superior to conventional practice. The remaining savings (28 kWhrs/m^2 of window) came from locating the majority of the windows on the south-side of the house. The largest solar contribution achieved by the ten houses was 274 kWhrs/m^2 of window area.

4. CONCLUSIONS

Based on the results from this study, the following conclusion can be made:

- all of the houses use low heat loss windows, with nine of the ten houses having fixed window U-values of 1.0 W/m^2°C or less. In general, this low value is achieved by using triple or quadruple glazings, multiple low-e coatings, insulating spacers, krypton or argon gas fills and non-metal framing systems;

- the principal windows in all of the houses exceed the high-performance window requirements of Ontario Hydro and the 1993 Ontario Building Code for electrically heated houses. Many specialty products (e.g. skylights, solaria) however, have much lower Energy Ratings;

- the average reduction in space heating load due to passive solar for the houses is 19 kWh per square metre of floor area, of which over 80% is from high-performance windows and the remainder is from solar orientation; and

- had passive solar features (of high-performance windows and orientation) not been used, the space heating load would have doubled in five of the houses.

5. REFERENCES

Carpenter, 1991. "Energy and Cost Savings of High-Performance Windows", report prepared by Enermodal Engineering Limited for Ontario Hydro.

CHBA, 1991. HOT2000 User's Manual, prepared by Canadian Home Builders Association for CANMET.

CSA, 1993. CSA A440.2-93 Energy Performance Evaluation of Windows and Sliding Glass Doors.

Enermodal Engineering Limited, 1992. "FRAME: A Computer Program to Evaluate the Thermal Performance of Window Frame Systems - Version 3.0", prepared for CANMET.

University of Waterloo, 1993. VISION3 Users Manual, prepared by the Advanced Glazing Simulation Laboratory for CANMET.

APPENDIX A

WINDOW DETAILS FOR EACH HOUSE

PEI ADVANCED HOUSE

AWNING	NO.	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
1	1	S	1.96	1.65	3.23	0.114	0.77	0.38	2.08
2	2	S	0.98	1.64	3.21	0.114	1.09	0.52	1.61
4	1	S	1.29	2.30	2.97	0.114	0.77	0.38	1.82
5	1	S	1.29	1.65	2.13	0.114	0.62	0.30	1.21
1	1	SE	1.29	2.30	2.97	0.114	0.77	0.38	1.82
2	1	SE	1.29	1.65	2.13	0.114	0.62	0.30	1.21
3	1	SE	0.78	1.24	0.97	0.114	0.41	0.18	0.38
1	1	E	0.83	2.05	1.70	0.114	0.60	0.29	0.81
2	1	E	1.95	1.95	3.80	0.114	0.84	0.42	2.54
3	1	E	0.78	1.23	0.96	0.114	0.41	0.18	0.37
4	1	E	0.99	0.99	0.97	0.114	0.40	0.18	0.40
6	1	E	0.99	0.99	0.97	0.114	0.40	0.18	0.40
7	1	E	1.95	1.64	3.20	0.114	0.77	0.38	2.05
8	1	E	0.99	0.99	0.97	0.114	0.40	0.18	0.40
1	1	N	0.99	0.99	0.97	0.114	0.40	0.18	0.40
2	1	N	0.83	0.83	0.69	0.114	0.33	0.14	0.23
3	1	N	0.99	1.64	1.62	0.114	0.55	0.26	0.81
2	1	W	1.95	1.64	3.20	0.114	0.77	0.38	2.05
4	1	W	1.95	1.64	3.20	0.114	0.77	0.38	2.05
1	1	SW	1.29	2.30	2.96	0.114	0.77	0.38	1.82
2	1	SW	1.29	1.64	2.11	0.114	0.62	0.30	1.20
1	1	NE	0.78	1.23	0.96	0.114	0.41	0.18	0.37
WINDOW TOTAL:					45.89		13.44	6.45	26.00
PERCENT :							29.28	14.05	56.66

AWNING	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	114	78	78
FRAME U-VALUE:	1.7	2.09	2.82
EDGE U-VALUE:	1.05	1.81	3.27
CENTER U-VALUE:	0.83	1.56	2.82
U-VALUE TOT:	1.12	1.71	2.89
RSI-VALUE TOT:	0.90	0.59	0.35
SHGC GLAZING:	0.44	0.63	0.76
TOT. SHGC	0.31	0.50	0.60

ACTUAL WINDOWS

FIXED	NO.	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
5	1	E	0.61	0.98	0.59	0.057	0.17	0.16	0.27
1	1	W	0.61	0.98	0.59	0.057	0.17	0.16	0.27
3	1	W	0.98	1.95	1.92	0.057	0.32	0.33	1.27
WINDOW TOTAL:					3.11		0.66	0.64	1.81
PERCENT :							21.13	20.58	58.29

FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	57	39.3	39.3
FRAME U-VALUE:	1.7	2.37	3.88
EDGE U-VALUE:	1.05	1.81	3.27
CENTER U-VALUE:	0.83	1.56	2.82
U-VALUE TOT:	1.06	1.73	3.07
RSI-VALUE TOT:	0.94	0.58	0.33
SHGC GLAZING:	0.44	0.63	0.76
TOT. SHGC	0.35	0.54	0.65

SKYLIGH	NO.	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
3	4	S	0.85	0.86	2.94	0.023	0.31	0.76	1.88
9	1	E	0.85	1.73	1.47	0.023	0.12	0.30	1.06
10	1	E	0.85	1.73	1.47	0.023	0.12	0.30	1.06
4	1	N	0.67	1.10	0.74	0.023	0.08	0.20	0.46
WINDOW TOTAL:					6.63		0.62	1.56	4.45
PERCENT :							9.35	23.49	67.15

SKYLIGHT	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	23	23	23
FRAME U-VALUE:	13.1	13.1	13.1
EDGE U-VALUE:	2.92	2.92	3.68
CENTER U-VALUE:	2.1	2.1	3.17
U-VALUE TOT:	3.32	3.32	4.22
RSI-VALUE TOT:	0.30	0.30	0.24
SHGC GLAZING:	0.62	0.62	0.76
TOT. SHGC	0.56	0.56	0.69

TOTAL WINDOW SURFACE:					55.63		14.72	8.65	32.26
PERCENT :							26.45	15.54	58.00

NOVA SCOTIA- ENVIRO HOME

DG-LOW-E CASEMENT	NUMB	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	ACTUAL WINDOWS Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
2	1	S	0.716	1	0.72	0.080	0.25	0.16	0.31
4	1	S	0.62	1.60	1.00	0.080	0.33	0.23	0.44
6	1	S	0.72	1.00	0.72	0.080	0.25	0.16	0.31
8	1	S	0.62	1.40	0.87	0.080	0.30	0.20	0.37
WINDOW TOTAL:					3.29		1.12	0.75	1.42
PERCENT :							34.16	22.69	43.15

DG-CASEMENT	ACTUAL	HI-PERF	STD
FRAME HEIGHT(m	80	78	78
FRAME U-VALUE:	2.1	2.09	2.82
EDGE U-VALUE:	2.66	1.81	3.27
CENTER U-VALUE:	1.76	1.56	2.82
U-VALUE TOT:	2.08	1.79	2.92
RSI-VALUE TOT:	0.48	0.56	0.34
SHGC GLAZING:	0.71	0.63	0.76
TOT. SHGC	0.47	0.42	0.51

PATIO DOO	NUMB	ORIEN	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
3	2	SW	0.91	2.04	3.73	0.121	1.31	0.60	1.82
TOTAL:					3.73		1.31	0.60	1.82
PERCENT:							35.19	15.95	48.86

PATIO DOOR	ACTUAL	HI-PERF	STD
FRAME HEIGHT(m	121	121	121
FRAME U-VALUE:	1.66	3.06	3.96
EDGE U-VALUE:	2.66	1.81	3.27
CENTER U-VALUE:	1.76	1.56	2.82
U-VALUE TOT:	1.87	2.13	3.29
RSI-VALUE TOT:	0.54	0.47	0.30
SHGC GLAZING:	0.71	0.63	0.76
TOT. SHGC	0.46	0.41	0.49

DG-LOW-E FIXED	NO.	ORIENTA	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
1	1	S	0.716	1.000	0.72	0.040	0.13	0.18	0.40
3	1	S	0.622	1.600	1.00	0.040	0.17	0.25	0.58
5	1	S	0.716	1.000	0.72	0.040	0.13	0.18	0.40
7	1	S	0.622	1.396	0.87	0.040	0.16	0.22	0.49
3	2	SE	0.24	2.040	0.98	0.040	0.35	0.51	0.12
3	1	NW	0.53	0.914	0.48	0.040	0.11	0.15	0.23
TOTAL:					4.76		1.05	1.48	2.23
PERCENT :							22.05	31.13	46.82

DG-FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(m	40	39.3	39.3
FRAME U-VALUE:	2.1	2.37	3.88
EDGE U-VALUE:	2.66	1.81	3.27
CENTER U-VALUE:	1.76	1.56	2.82
U-VALUE TOT:	2.12	1.81	3.19
RSI-VALUE TOT:	0.47	0.55	0.31
SHGC GLAZING:	0.71	0.63	0.76
TOT. SHGC	0.55	0.49	0.60

SUPERGLASS

CASEMENT	NO.	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
2	2	SE	0.786	1.390	2.19	0.080	0.65	0.44	1.10
5	2	SE	0.817	1.195	1.95	0.080	0.59	0.40	0.96
6	1	SE	0.939	1.190	1.12	0.080	0.32	0.21	0.59
2	2	NW	0.622	1.195	1.49	0.080	0.53	0.35	0.61
4	4	NW	0.622	1.600	3.98	0.080	1.32	0.90	1.76
6	1	NW	0.620	1.195	0.74	0.080	0.26	0.17	0.30
7	1	NW	0.710	1.000	0.71	0.080	0.25	0.16	0.30
1	2	SW	0.997	0.518	1.03	0.080	0.43	0.27	0.33
2	1	SW	0.698	0.622	0.43	0.080	0.19	0.11	0.14
4	2	SW	0.620	1.390	1.72	0.080	0.59	0.40	0.73
WINDOW TOTAL:					15.36		5.13	3.41	6.82
PERCENT :							33.37	22.22	44.42

SUPER-CASEMEN	ACTUAL	HI-PERF	STD
FRAME HEIGHT(m	80	78	78
FRAME U-VALUE:	2.1	2.09	2.82
EDGE U-VALUE:	0.84	1.81	3.27
CENTER U-VALUE:	0.66	1.56	2.82
U-VALUE TOT:	1.18	1.79	2.92
RSI-VALUE TOT:	0.85	0.56	0.34
SHGC GLAZING:	0.44	0.63	0.76
TOT. SHGC	0.29	0.42	0.51

SUPERGLASS

FIXED	NO.	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
1	1	SE	0.817	1.396	1.14	0.040	0.17	0.24	0.73
4	1	SE	0.817	1.195	0.98	0.040	0.15	0.22	0.60
1	1	NE	0.36	0.55	0.20	0.040	0.07	0.08	0.05
1	2	NW	0.62	1.195	1.48	0.040	0.28	0.39	0.82
5	1	NW	0.622	1.195	0.74	0.040	0.14	0.19	0.41
TOTAL:					4.54		0.81	1.13	2.61
PERCENT :							17.80	24.78	57.41

SUPER-FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(m	40	39.3	39.3
FRAME U-VALUE:	2.1	2.37	3.88
EDGE U-VALUE:	0.84	1.81	3.27
CENTER U-VALUE:	0.66	1.56	2.82
U-VALUE TOT:	0.96	1.76	3.12
RSI-VALUE TOT:	1.04	0.57	0.32
SHGC GLAZING:	0.44	0.63	0.76
TOT. SHGC	0.36	0.52	0.63

TOTAL WINDOW SURFACE:	31.69	9.42	7.36	14.90

QUEBEC-NOVTEC HOUSE

SOLARIUM

WINDOW	NUMBER	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
1	3	S	1.26	1.51	5.71	0.032	0.52	0.96	4.23
2	2	S	0.72	1.51	2.17	0.032	0.28	0.50	1.40
3	3	S	1.26	1.25	4.73	0.032	0.47	0.86	3.40
4	2	S	0.72	1.25	1.80	0.032	0.24	0.44	1.12
SOLARIUM WINDOW TOTAL:					14.41		1.51	2.75	10.14
SOLARIUM WINDOW %							10.48	19.12	70.40

SOL-WINDOW	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	32	39.3	39.3
FRAME U-VALUE:	6.6	2.37	3.88
EDGE U-VALUE:	2.33	1.81	3.27
CENTER U-VALUE:	1.32	1.56	2.82
U-VALUE TOT:	2.07	1.71	3.04
RSI-VALUE TOT:	0.48	0.58	0.33
SHGC GLAZING:	0.57	0.63	0.76
TOT. SHGC	0.51	0.55	0.66

SOLARIUM

ROOF	NUMBER	ORIENTA	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
5	3	S	1.50	0.70	3.15	0.03	0.41	0.74	2.00
TOTAL:					3.15		0.41	0.74	2.00
PERCENT:							13.02	23.53	63.46

SOL-ROOF	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	32	39.3	39.3
FRAME U-VALUE:	6.6	2.37	3.88
EDGE U-VALUE:	2.26	1.81	3.27
CENTER U-VALUE:	1.23	1.56	2.82
U-VALUE TOT:	2.17	1.75	3.09
RSI-VALUE TOT:	0.46	0.57	0.32
SHGC GLAZING:	0.31	0.63	0.76
TOT. SHGC	0.27	0.53	0.64

AWNING	NUMBER	ORIENTA	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
6	2	S	1.80	0.58	2.09	0.071	0.64	0.50	0.95
6	3	E	1	0.58	1.74	0.071	0.61	0.45	0.68
2	4	N	1	0.58	2.32	0.071	0.82	0.59	0.91
2	2	W	1	0.58	1.16	0.071	0.41	0.30	0.45
TOTAL:					7.31		2.47	1.84	3.00
PERCENT :							33.84	25.13	41.03

AWNING	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	71	78	78
FRAME U-VALUE:	2.6	2.09	2.82
EDGE U-VALUE:	2.24	1.81	3.27
CENTER U-VALUE:	1.76	1.56	2.82
U-VALUE TOT:	2.16	1.82	2.93
RSI-VALUE TOT:	0.46	0.55	0.34
SHGC GLAZING:	0.71	0.63	0.76
TOT. SHGC	0.47	0.40	0.48

FIXED	NUMBER	ORIEN	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
7	3	S	1.22	0.61	2.23	0.041	0.43	0.59	1.22
8	3	S	1	0.58	1.74	0.041	0.37	0.49	0.88
1	1	E	0.457	0.457	0.21	0.041	0.07	0.08	0.06
2	1	E	0.914	0.457	0.42	0.041	0.11	0.14	0.17
3	1	E	0.457	1.22	0.56	0.041	0.13	0.18	0.25
4	1	E	0.457	1.22	0.56	0.041	0.13	0.18	0.25
5	1	E	1.22	0.85	1.04	0.041	0.16	0.23	0.65
7	5	E	1	0.58	2.90	0.041	0.61	0.82	1.47
1	6	N	1	0.58	3.48	0.041	0.74	0.98	1.76
3	1	N	1.3	0.955	1.24	0.041	0.18	0.25	0.81
4	1	N	1.3	0.755	0.98	0.041	0.16	0.22	0.60
1	3	W	1	0.58	1.74	0.041	0.37	0.49	0.88
3	3	W	0.61	0.914	1.67	0.041	0.35	0.47	0.85
TOTAL:					18.77		3.81	5.11	9.85
PERCENT :							20.31	27.21	52.48

FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	41	39.3	39.3
FRAME U-VALUE:	2.4	2.37	3.88
EDGE U-VALUE:	2.24	1.81	3.27
CENTER U-VALUE:	1.76	1.56	2.82
U-VALUE TOT:	2.02	1.79	3.15
RSI-VALUE TOT:	0.49	0.56	0.32
SHGC GLAZING:	0.71	0.63	0.76
TOT. SHGC	0.57	0.51	0.61

PAT. DO	NUMBER	ORIEN	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
9	1	S	1.49	2.06	3.07	0.121	0.80	0.37	1.90
TOTAL:					3.07		0.80	0.37	1.90
PERCENT :							26.08	12.16	61.76

PATIO DOOR	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	121	121	121
FRAME U-VALUE:	1.66	3.06	3.96
EDGE U-VALUE:	2.24	1.81	3.27
CENTER U-VALUE:	1.76	1.56	2.82
U-VALUE TOT:	1.79	1.98	3.17
RSI-VALUE TOT:	0.56	0.50	0.32
SHGC GLAZING:	0.71	0.63	0.76
TOT. SHGC	0.52	0.47	0.56

TOTAL WINDOW SURFACE:					46.70		9.01	10.81	26.88

QUEBEC-MAISON PERFORMANTE

DG-LOW-E

CASEMENT	NUMBER	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazi (m2)
1	1	SE	1.68	2.13	3.58	0.082	0.60	0.43	2.55
2	1	SE	1.68	1.52	2.55	0.082	0.50	0.35	1.71
3	1	SE	0.76	1.37	1.05	0.082	0.32	0.21	0.51
3	1	E	1.83	0.46	0.84	0.082	0.35	0.23	0.26
2	1	SW	1.311	2.13	2.79	0.082	0.54	0.38	1.88
3	1	SW	0.305	2.134	0.65	0.082	0.37	0.25	0.03
4	1	SW	0.762	1.372	1.05	0.082	0.32	0.21	0.51
5	1	SW	0.914	1.372	1.25	0.082	0.35	0.23	0.67
WINDOW TOTAL:					13.75		3.35	2.30	8.11
PERCENT:							24.34	16.70	58.95

DG-CASEMENT	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	82	78	78
FRAME U-VALUE:	1.78	2.09	2.82
EDGE U-VALUE:	2.63	1.81	3.27
CENTER U-VALUE:	1.72	1.56	2.82
U-VALUE TOT:	1.89	1.73	2.90
RSI-VALUE TOT:	0.53	0.58	0.35
SHGC:	0.69	0.63	0.76
TOT. SHGC	0.52	0.48	0.58

DG-LOW-E

FIXED	NUMBER	ORIENTA	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazi (m2)
2	1	S	2.29	1.07	2.44	0.04	0.27	0.39	1.78
3	1	S	1.07	1.37	1.46	0.04	0.19	0.27	1.00
1	1	E	1.829	0.457	0.84	0.04	0.18	0.25	0.40
2	1	E	0.46	0.76	0.35	0.04	0.09	0.12	0.14
6	1	SW	0.914	1.372	1.25	0.04	0.18	0.25	0.82
TOTAL:					6.34		0.92	1.29	4.14
PERCENT:							14.45	20.28	65.27

DG-FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	41	39.3	39.3
FRAME U-VALUE:	2.8	2.37	3.88
EDGE U-VALUE:	2.63	1.81	3.27
CENTER U-VALUE:	1.72	1.56	2.82
U-VALUE TOT:	2.06	1.72	3.06
RSI-VALUE TOT:	0.49	0.58	0.33
SHGC:	0.69	0.63	0.76
TOT. SHGC	0.59	0.54	0.65

SUPERGLASS

CASEMENT	NUMBER	ORIENTA	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazi (m2)
1	1	N	1.83	0.46	0.84	0.08	0.35	0.23	0.26
3	1	N	0.61	0.61	0.37	0.08	0.17	0.10	0.10
TOTAL:					1.21		0.52	0.33	0.36
PERCENT :							43.15	27.29	29.56

SUPER-CASEMENT	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	82	78	78
FRAME U-VALUE:	1.78	2.09	2.82
EDGE U-VALUE:	0.84	1.81	3.27
CENTER U-VALUE:	0.66	1.56	2.82
U-VALUE TOT:	1.19	1.85	2.94
RSI-VALUE TOT:	0.84	0.54	0.34
SHGC:	0.44	0.63	0.76
TOT. SHGC	0.25	0.37	0.45

SUPERGLASS

FIXED	NUMBER	ORIEN	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazi (m2)
2	1	N	0.61	1.22	0.74	0.04	0.14	0.20	0.41
1	1	NW	0.762	1.433	1.09	0.04	0.17	0.24	0.68
TOTAL:					1.84		0.32	0.44	1.08
PERCENT :							17.24	23.82	58.94

SUPER-FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	41	39.3	39.3
FRAME U-VALUE:	2.8	2.37	3.88
EDGE U-VALUE:	0.84	1.81	3.27
CENTER U-VALUE:	0.66	1.56	2.82
U-VALUE TOT:	1.07	1.75	3.10
RSI-VALUE TOT:	0.93	0.57	0.32
SHGC:	0.44	0.63	0.76
TOT. SHGC	0.36	0.53	0.63

DG-LOW-E

PAT. DOOR	NUMBER	ORIEN	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazi (m2)
1	1	S	2.29	2.13	4.88	0.121	1.01	0.48	3.38
TOTAL:					4.88		1.01	0.48	3.38
PERCENT :							20.73	9.92	69.36

DG-PATIO DOOR	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	121	121	121
FRAME U-VALUE:	1.66	3.06	3.96
EDGE U-VALUE:	2.63	1.81	3.27
CENTER U-VALUE:	1.72	1.56	2.82
U-VALUE TOT:	1.80	1.90	3.10
RSI-VALUE TOT:	0.56	0.53	0.32
SHGC:	0.69	0.63	0.76
TOT. SHGC	0.55	0.50	0.60

SUPERGLASS

PAT. DOOR	NUMBER	ORIEN	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazi (m2)
1	1	SW	1.829	2.134	3.90	0.12	0.90	0.43	2.58
TOTAL:					3.90		0.90	0.43	2.58
PERCENT :							23.07	10.91	66.02

SUPERGLASS-P. DOO	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	121	121	121
FRAME U-VALUE:	1.66	3.06	3.96
EDGE U-VALUE:	0.84	1.81	3.27
CENTER U-VALUE:	0.66	1.56	2.82
U-VALUE TOT:	0.91	1.93	3.13
RSI-VALUE TOT:	1.10	0.52	0.32
SHGC:	0.44	0.63	0.76
TOT. SHGC	0.34	0.48	0.58

TOTAL WINDOW AREA (m2):	31.92	7.01	5.26	19.65

ONTARIO-INNOVA HOUSE

CASEMENT	NUMB	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
1	2	S	0.635	1.194	1.52	0.075	0.50	0.36	0.66
3	2	S	0.64	1.50	1.90	0.075	0.60	0.43	0.87
5	1	S	0.74	1.19	0.88	0.075	0.27	0.19	0.42
8	1	S	1.19	0.43	0.52	0.075	0.22	0.15	0.14
9	1	S	1.35	0.43	0.58	0.075	0.24	0.17	0.17
1	1	SE	0.89	1.50	1.33	0.075	0.34	0.25	0.75
1	2	E	0.737	1.194	1.76	0.075	0.53	0.38	0.84
1	2	N	0.533	1.194	1.27	0.075	0.47	0.33	0.47
3	1	N	0.889	1.499	1.33	0.075	0.34	0.25	0.75
1	1	W	0.737	1.194	0.88	0.075	0.27	0.19	0.42
2	1	W	0.737	1.499	1.10	0.075	0.31	0.23	0.56
1	1	SW	0.899	1.499	1.35	0.075	0.34	0.25	0.76
WINDOW TOTAL:					14.43		4.43	3.19	6.81
PERCENT :							30.69	22.08	47.23

CASEMENT	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	75	78	78
FRAME U-VALUE:	1.67	2.09	2.82
EDGE U-VALUE:	1.13	1.81	3.27
CENTER U-VALUE:	0.89	1.56	2.82
U-VALUE TOT:	1.18	1.78	2.92
RSI-VALUE TOT:	0.85	0.56	0.34
SHGC GLAZING:	0.56	0.63	0.76
TOT. SHGC	0.39	0.43	0.52

PATIO DOOR	NUM.	ORIENTA	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
10	1	S	1.59	2.09	3.32	0.088	0.62	0.41	2.30
TOTAL:					3.32		0.62	0.41	2.30
PERCENT:							18.56	12.24	69.20

PATIO DOOR	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	88	88	88
FRAME U-VALUE:	2.3	3.06	3.96
EDGE U-VALUE:	1.13	1.81	3.27
CENTER U-VALUE:	0.89	1.56	2.82
U-VALUE TOT:	1.18	1.87	3.09
RSI-VALUE TOT:	0.85	0.54	0.32
SHGC:	0.56	0.63	0.76
TOT. SHGC	0.46	0.51	0.62

FIXED	NUM.	ORIENTA	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
2	1	S	0.692	1.194	0.83	0.046	0.17	0.20	0.46
4	1	S	0.692	1.499	1.04	0.046	0.19	0.24	0.61
6	1	S	0.737	1.194	0.88	0.046	0.17	0.21	0.51
7	2	S	0.737	1.499	2.21	0.046	0.39	0.49	1.33
2	1	E	0.737	1.194	0.88	0.046	0.17	0.21	0.51
2	1	N	0.896	1.194	1.07	0.046	0.18	0.23	0.66
4	1	N	0.889	1.499	1.33	0.046	0.21	0.26	0.86
5	1	N	0.200	1.525	0.31	0.046	0.15	0.18	-0.02
TOTAL:					8.54		1.64	2.01	4.90
PERCENT :							19.16	23.52	57.32

FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	46	39.3	39.3
FRAME U-VALUE:	1.58	2.37	3.88
EDGE U-VALUE:	1.13	1.81	3.27
CENTER U-VALUE:	0.89	1.56	2.82
U-VALUE TOT:	1.08	1.75	3.10
RSI-VALUE TOT:	0.93	0.57	0.32
SHGC:	0.56	0.63	0.76
TOT. SHGC	0.45	0.53	0.63

WINDOW TOTAL AREA	26.29	6.68	5.60	14.01
PERCENT		25.41	21.30	53.28

WATERLOO GREEN HOME

AWNING & CASEMENT	NUMB	ORIEN	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
1	1	S	0.60	1.40	0.84	0.068	0.25	0.20	0.38
2	1	S	0.60	1.40	0.84	0.068	0.25	0.20	0.38
3	1	S	0.60	1.40	0.84	0.068	0.25	0.20	0.38
4	1	S	0.60	1.40	0.84	0.068	0.25	0.20	0.38
5	1	S	0.60	1.40	0.84	0.068	0.25	0.20	0.38
6	1	S	0.60	1.40	0.84	0.068	0.25	0.20	0.38
7	1	S	1.23	0.72	0.89	0.068	0.25	0.20	0.44
8	1	S	1.23	0.72	0.89	0.068	0.25	0.20	0.44
12	1	E	0.45	1.25	0.56	0.068	0.21	0.17	0.18
13	1	E	0.45	1.25	0.56	0.068	0.21	0.17	0.18
19	1	W	0.45	1.00	0.45	0.068	0.18	0.13	0.14
20	1	W	0.45	1.00	0.45	0.068	0.18	0.13	0.14
24	1	S	0.60	0.90	0.54	0.068	0.19	0.14	0.21
25	1	S	0.60	0.90	0.54	0.068	0.19	0.14	0.21
26	1	S	0.60	0.90	0.54	0.068	0.19	0.14	0.21
27	1	S	0.60	0.90	0.54	0.068	0.19	0.14	0.21
28	1	S	0.60	0.90	0.54	0.068	0.19	0.14	0.21
29	1	S	0.60	0.90	0.54	0.068	0.19	0.14	0.21
CASEMENT TOTAL:					12.08		3.91	3.05	5.12
CASEMENT %							32.38	25.26	42.36

CASEMENT + AWNI	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	68	78	78
FRAME U-VALUE:	1.25	2.09	2.82
EDGE U-VALUE:	1.21	1.81	3.27
CENTER U-VALUE:	0.95	1.56	2.82
U-VALUE TOT:	1.11	1.82	2.93
RSI-VALUE TOT:	0.90	0.55	0.34
SHGC GLAZING:	0.56	0.63	0.76
TOT. SHGC	0.38	0.40	0.48

FIXED	NUMB	ORIEN	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
9	1	S	0.60	1.40	0.84	0.056	0.21	0.21	0.42
10	1	S	0.60	1.40	0.84	0.056	0.21	0.21	0.42
11	1	S	1.20	1.40	1.68	0.056	0.28	0.29	1.12
14	1	E	0.95	1.25	1.19	0.056	0.23	0.23	0.72
15	1	E	0.55	0.85	0.47	0.056	0.14	0.13	0.19
16	1	E	0.44	2.50	1.10	0.056	0.32	0.33	0.45
17	1	E	0.44	2.50	1.10	0.056	0.32	0.33	0.45
18	1	E	0.97	0.48	0.47	0.056	0.15	0.14	0.18
21	1	W	0.55	0.85	0.47	0.056	0.14	0.13	0.19
22	1	W	0.44	2.00	0.88	0.056	0.26	0.27	0.35
23	1	W	0.44	2.00	0.88	0.056	0.26	0.27	0.35
30	1	S	0.60	0.90	0.54	0.056	0.16	0.15	0.24
31	1	S	0.60	0.90	0.54	0.056	0.16	0.15	0.24
32	1	S	1.20	0.90	1.08	0.056	0.22	0.22	0.64
33	1	E	0.55	0.85	0.47	0.056	0.14	0.13	0.19
34	1	E	0.44	2.00	0.88	0.056	0.26	0.27	0.35
34	1	E	0.44	2.00	0.88	0.056	0.26	0.27	0.35
FIXED TOTAL:					14.30		3.73	3.71	6.86
FIXED %							26.08	25.96	47.96

FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	56	39.3	39.3
FRAME U-VALUE:	1.07	2.37	3.88
EDGE U-VALUE:	1.21	1.81	3.27
CENTER U-VALUE:	0.95	1.56	2.82
U-VALUE TOT:	1.05	1.78	3.14
RSI-VALUE TOT:	0.95	0.56	0.32
SHGC GLAZING:	0.56	0.63	0.76
TOT. SHGC	0.41	0.51	0.62

HOUSE TOTAL	26.37	7.64	6.76	11.97
HOUSE %		28.96	25.64	45.40

HAMILTON NEAT HOME

AWNING & CASEMENT	NUMBE	ORIEN	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
1	1	S	1.00	1.01	1.01	0.075	0.28	0.20	0.53
2	1	S	0.60	0.81	0.49	0.075	0.19	0.12	0.17
4	1	S	0.60	0.81	0.49	0.075	0.19	0.12	0.17
2	2	W	0.69	1.01	1.38	0.075	0.46	0.32	0.60
5	2	W	0.69	1.01	1.38	0.075	0.46	0.32	0.60
8	1	W	0.70	1.61	1.13	0.075	0.32	0.24	0.56
9	2	W	1.20	1.01	2.42	0.075	0.62	0.45	1.35
1	1	NW	0.60	1.31	0.79	0.075	0.26	0.19	0.33
4	1	N	0.60	0.40	0.24	0.075	0.13	0.07	0.04
2	1	E	0.70	1.61	1.13	0.075	0.32	0.24	0.56
4	1	E	0.60	1.21	0.73	0.075	0.25	0.18	0.30
5	1	E	0.60	0.40	0.24	0.075	0.13	0.07	0.04
CASEMENT TOTAL:					11.42		3.62	2.54	5.27
CASEMENT %							31.68	22.20	46.11

CASEMENT + AWNING	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	75	78	78
FRAME U-VALUE:	1.47	2.09	2.82
EDGE U-VALUE:	0.91	1.81	3.27
CENTER U-VALUE:	0.72	1.56	2.82
U-VALUE TOT:	1.00	1.79	2.92
RSI-VALUE TOT:	1.00	0.56	0.34
SHGC GLAZING:	0.46	0.63	0.76
TOT. SHGC	0.31	0.42	0.51

FIXED	NUMBE	ORIEN	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
3	1	S	0.60	0.90	0.54	0.075	0.20	0.14	0.20
1	2	W	1.01	1.01	2.04	0.075	0.56	0.40	1.07
3	1	W	0.60	1.83	1.10	0.075	0.34	0.25	0.50
4	2	W	1.01	1.01	2.04	0.075	0.56	0.40	1.07
6	1	W	0.60	1.83	1.10	0.075	0.34	0.25	0.50
7	1	W	0.60	1.31	0.79	0.075	0.26	0.19	0.33
1	1	E	0.40	1.86	0.74	0.075	0.32	0.23	0.19
3	1	E	0.60	1.21	0.73	0.075	0.25	0.18	0.30
6	5	E	0.60	0.40	1.20	0.075	0.64	0.36	0.20
1	1	N	0.60	1.31	0.79	0.075	0.26	0.19	0.33
2	3	N	0.80	0.81	1.94	0.075	0.66	0.45	0.84
3	1	N	0.60	1.61	0.97	0.075	0.31	0.23	0.43
5	5	N	0.60	0.40	1.20	0.075	0.64	0.36	0.20
FIXED TOTAL:					15.17		5.34	3.64	6.18
FIXED %							35.22	24.03	40.75

FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	75	39.3	39.3
FRAME U-VALUE:	1.63	2.37	3.88
EDGE U-VALUE:	0.91	1.81	3.27
CENTER U-VALUE:	0.72	1.56	2.82
U-VALUE TOT:	1.09	1.78	3.15
RSI-VALUE TOT:	0.92	0.56	0.32
SHGC GLAZING:	0.46	0.63	0.76
TOT. SHGC	0.30	0.51	0.61

HOUSE TOTAL	26.59	8.96	6.18	11.45
HOUSE %		33.70	23.24	43.05

MANITOBA ADVANCED HOUSE

AWNINGS & CASEME	NUMBER	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazi (m2)
1	2	S	0.72	0.81	1.17	0.071	0.39	0.28	0.49
5	1	S	0.72	0.81	0.58	0.071	0.20	0.14	0.24
6	1	S	0.72	1.03	0.74	0.071	0.23	0.17	0.34
8	1	S	0.72	0.81	0.58	0.071	0.20	0.14	0.24
3	1	E	0.73	1.52	1.10	0.071	0.30	0.23	0.57
1	2	N	1.22	1.03	2.52	0.071	0.60	0.47	1.45
2	1	N	2.02	0.81	1.64	0.071	0.38	0.31	0.95
1	1	W	0.37	0.37	0.14	0.071	0.08	0.04	0.01
1	2	SW	0.62	1.22	1.50	0.071	0.48	0.36	0.66
TOTAL:					9.97		2.86	2.15	4.96
PERCENT:							28.70	21.56	49.75

AWNING + CMT	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	71	78	78
FRAME U-VALUE:	2.2	2.09	2.82
EDGE U-VALUE:	0.77	1.81	3.27
CENTER U-VALUE:	0.61	1.56	2.82
U-VALUE TOT:	1.10	1.78	2.92
RSI-VALUE TOT:	0.91	0.56	0.34
SHGC:	0.4	0.63	0.76
TOT. SHGC	0.29	0.43	0.52

FIXED	NUMBER	ORIENTA	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazi (m2)
3	1	S	0.67	1.80	1.22	0.041	0.20	0.28	0.74
4	2	S	0.74	1.80	2.66	0.041	0.40	0.57	1.69
10	3	S	0.72	0.61	1.31	0.041	0.31	0.39	0.61
9	1	S	0.72	1.02	0.73	0.041	0.14	0.18	0.41
6	2	S	0.72	1.03	1.48	0.041	0.27	0.37	0.84
2	4	S	0.76	0.61	1.84	0.041	0.42	0.55	0.88
1	2	S	0.72	0.81	1.17	0.041	0.24	0.31	0.61
7	4	S	0.51	0.81	1.66	0.041	0.41	0.53	0.73
5	2	S	0.72	0.81	1.17	0.041	0.24	0.31	0.61
3	1	N	2.02	1.22	2.46	0.041	0.26	0.37	1.83
1	1	E	0.37	0.37	0.14	0.041	0.05	0.06	0.03
2	2	E	0.82	0.62	1.02	0.041	0.22	0.29	0.50
FIXED TOTAL:					16.85		3.15	4.22	9.48
FIXED %							18.72	25.05	56.24

FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	41	39.3	39.3
FRAME U-VALUE:	2.1	2.37	3.88
EDGE U-VALUE:	0.77	1.81	3.27
CENTER U-VALUE:	0.61	1.56	2.82
U-VALUE TOT:	0.93	1.77	3.13
RSI-VALUE TOT:	1.08	0.56	0.32
SHGC:	0.4	0.63	0.76
TOT. SHGC	0.33	0.51	0.62

HOUSE TOTAL	26.83	6.02	6.37	14.44
HOUSE %		22.43	23.75	53.82

SASKATCHEWAN-ADVANCED HOUSE

CASEME	ORIEN.	NUMBER	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
1	S	2	0.61	1.03	1.25	0.07	0.41	0.31	0.53
2	S	2	0.61	1.22	1.49	0.07	0.46	0.36	0.66
3	S	1	1.02	1.02	1.05	0.07	0.26	0.21	0.58
5	S	2	0.61	1.02	1.25	0.07	0.41	0.31	0.53
6	S	1	1.22	1.02	1.25	0.07	0.29	0.23	0.73
7	S	1	1.52	1.02	1.56	0.07	0.33	0.27	0.96
1	E	1	1.52	1.22	1.86	0.07	0.35	0.30	1.21
2	E	1	1.52	1.02	1.56	0.07	0.33	0.27	0.96
1	N	2	0.52	1.83	1.92	0.07	0.60	0.50	0.82
4	N	1	0.85	2.11	1.79	0.07	0.38	0.33	1.08
6	N	1	1.02	0.80	0.82	0.07	0.23	0.18	0.41
CASEMENT TOTAL:					15.79		4.05	3.28	8.46
CASEMENT %							25.64	20.77	53.59

CASEMENT	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	68	78	78
FRAME U-VALUE:	1.25	2.09	2.82
EDGE U-VALUE:	1.02	1.81	3.27
CENTER U-VALUE:	0.8	1.56	2.82
U-VALUE TOT:	0.96	1.77	2.91
RSI-VALUE TOT:	1.04	0.57	0.34
SHGC GLAZING:	0.45	0.63	0.76
TOT. SHGC	0.33	0.45	0.54

FIXED	ORIEN	NUMBER	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
1	S	1	1.19	1.03	1.22	0.056	0.24	0.24	0.75
2	S	1	1.19	1.22	1.45	0.056	0.26	0.26	0.93
4	S	2	0.50	1.61	1.60	0.056	0.45	0.45	0.70
5	S	1	1.19	1.02	1.22	0.056	0.24	0.24	0.75
1	SE	1	0.52	1.52	0.80	0.056	0.22	0.22	0.37
2	N	1	1.52	1.83	2.79	0.056	0.36	0.38	2.04
3	N	1	1.52	0.60	0.91	0.056	0.23	0.23	0.46
5	N	1	1.38	0.88	1.21	0.056	0.24	0.24	0.72
7	N	1	1.00	0.39	0.39	0.056	0.14	0.13	0.12
1	W	2	1.23	0.53	1.29	0.056	0.37	0.36	0.56
2	W	1	1.02	1.02	1.05	0.056	0.22	0.22	0.62
1	SW	1	0.52	1.52	0.80	0.056	0.22	0.22	0.37
FIXED TOTAL:					14.72		3.16	3.16	8.39
FIXED %							21.50	21.49	57.01

FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm	56	39.3	39.3
FRAME U-VALUE:	1.15	2.37	3.88
EDGE U-VALUE:	1.02	1.81	3.27
CENTER U-VALUE:	0.8	1.56	2.82
U-VALUE TOT:	0.92	1.74	3.08
RSI-VALUE TOT:	1.08	0.57	0.32
SHGC GLAZING:	0.45	0.63	0.76
TOT. SHGC	0.35	0.53	0.64

HOUSE TOTAL	30.51	7.21	6.44	16.85
HOUSE %		23.64	21.12	55.24

BRITISH COLUMBIA - ADVANCED HOUSE

CASEMENT	NO.	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
3	1	S	1.52	1.07	1.63	0.071	0.35	0.28	1.00
5	1	S	1.83	0.91	1.67	0.071	0.37	0.30	1.01
9	2	S	1.52	1.13	3.44	0.071	0.71	0.57	2.16
1	1	E	0.61	1.52	0.93	0.071	0.28	0.22	0.43
2	1	E	1.22	0.61	0.74	0.071	0.24	0.18	0.32
3	1	E	1.22	0.61	0.74	0.071	0.24	0.18	0.32
4	1	E	0.61	0.61	0.37	0.071	0.15	0.10	0.12
2	1	N	0.61	1.22	0.74	0.071	0.24	0.18	0.32
7	1	N	1.22	1.22	1.49	0.071	0.33	0.26	0.90
2	1	W	0.61	1.52	0.93	0.071	0.28	0.22	0.43
4	1	W	0.61	0.61	0.37	0.071	0.15	0.10	0.12
5	1	W	1.22	0.61	0.74	0.071	0.24	0.18	0.32
6	1	W	1.22	0.61	0.74	0.071	0.24	0.18	0.32
WINDOW TOTAL:					14.54		3.83	2.94	7.77
PERCENT :							26.31	20.24	53.45

CASEMENT	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	71	78	78
FRAME U-VALUE:	2.2	2.09	2.82
EDGE U-VALUE:	1.07	1.81	3.27
CENTER U-VALUE:	0.84	1.56	2.82
U-VALUE TOT:	1.24	1.76	2.91
RSI-VALUE TOT:	0.80	0.57	0.34
SHGC GLAZING:	0.51	0.63	0.76
TOT. SHGC	0.38	0.45	0.54

FIXED	NUMB.	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
1	2	S	1.22	1.52	3.72	0.041	0.44	0.62	2.66
2	1	S	1.22	1.52	1.86	0.041	0.22	0.31	1.33
4	1	S	1.83	1.83	3.34	0.041	0.29	0.43	2.62
7	2	S	1.52	0.46	1.39	0.041	0.31	0.43	0.65
8	2	S	1.22	0.61	1.49	0.041	0.29	0.39	0.81
5	1	E	0.91	0.46	0.42	0.041	0.11	0.14	0.18
1	2	N	0.46	1.52	1.39	0.041	0.31	0.43	0.65
3	1	N	0.61	1.22	0.74	0.041	0.14	0.20	0.40
4	1	N	1.22	1.22	1.49	0.041	0.19	0.27	1.02
5	1	N	0.76	1.22	0.93	0.041	0.16	0.21	0.56
6	1	N	1.22	0.30	0.37	0.041	0.12	0.16	0.10
8	1	N	1.22	1.07	1.30	0.041	0.18	0.25	0.87
1	1	W	0.61	1.22	0.74	0.041	0.14	0.20	0.40
WINDOW TOTAL:					19.18		2.90	4.04	12.25
PERCENT :							15.10	21.04	63.86

FIXED	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	41	39.3	39.3
FRAME U-VALUE:	2.1	2.37	3.88
EDGE U-VALUE:	1.07	1.81	3.27
CENTER U-VALUE:	0.84	1.56	2.82
U-VALUE TOT:	1.08	1.73	3.07
RSI-VALUE TOT:	0.93	0.58	0.33
SHGC GLAZING:	0.51	0.63	0.76
TOT. SHGC	0.43	0.54	0.65

SKYLIGHT	NO.	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
10	1	S	0.91	1.31	1.20	0.023	0.10	0.25	0.84
WINDOW TOTAL:					1.20		0.10	0.25	0.84
PERCENT :							8.37	21.26	70.37

SKYLIGHT	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	23	23	23
FRAME U-VALUE:	13.1	13.1	13.1
EDGE U-VALUE:	2.92	2.92	3.68
CENTER U-VALUE:	2.1	2.1	3.17
U-VALUE TOT:	3.19	3.19	4.11
RSI-VALUE TOT:	0.31	0.31	0.24
SHGC GLAZING:	0.62	0.62	0.76
TOT. SHGC	0.57	0.57	0.70

PATIO DOO	NUMB	ORIEN.	Width (m)	Height (m)	Total Area (m2)	Frame ht (m)	Area Frame (m2)	Area Edge (m2)	Area glazing (m2)
3	1	W	1.83	2.04	3.73	0.088	0.65	0.43	2.65
6	1	S	1.83	2.04	3.73	0.088	0.65	0.43	2.65
WINDOW TOTAL:					7.47		1.30	0.86	5.30
PERCENT :							17.42	11.54	71.05

PATIO DOOR	ACTUAL	HI-PERF	STD
FRAME HEIGHT(mm)	88	88	88
FRAME U-VALUE:	2.5	3.06	3.96
EDGE U-VALUE:	2.06	1.81	3.27
CENTER U-VALUE:	1.62	1.56	2.82
U-VALUE TOT:	1.82	1.85	3.07
RSI-VALUE TOT:	0.55	0.54	0.33
SHGC GLAZING:	0.7	0.62	0.76
TOT. SHGC	0.58	0.51	0.63

TOTAL AREA (m2) :					42.39		8.12	8.10	26.17