

SECONDARY GLAZING – HOW WELL DOES IT WORK?

Want the benefits of double glazing but without the high price tag? A recent research project assessed secondary glazing to see whether it is a cost-effective alternative to replacing existing single glazing in older houses.

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The vast majority of the current housing stock has single glazing, and although recent changes to the New Zealand Building Code Clause H1 *Energy efficiency* effectively require higher glazing thermal performance in new homes, there are no similar requirements for older homes. However, it is likely that people will increasingly see what is possible in new homes and want the same improved acoustic and thermal insulation in their older homes.

Four systems tested and modelled

A research project as part of a Master of Building Science examined the effectiveness and costs and benefits of a variety of secondary glazing systems under New Zealand conditions. Four secondary glazing systems were tested under laboratory conditions and then modelled using specialist software. The results were used to explore the costs and benefits of the different systems and develop recommendations for future retrofitting of existing single glazed houses.

The BRANZ Guarded Hot Box was firstly used to make thermal resistance measurements on a typical single glazed aluminium window with a timber reveal. The four common secondary glazing systems then retrofitted were:

- double-sided, adhesive tape-attached, heat-shrinkable thin plastic film
- magnetically attached acrylic sheet
- aluminium framed, sliding sash secondary glazing
- aluminium framed, sliding sash, low emissivity (low-E) secondary glazing.

The windows were also modelled using the thermal simulation programs Window 6 and Therm 6 in order to calculate the thermal performance of the window.

Significant increases in thermal resistance

All the secondary glazing systems tested provided a significant increase to the thermal resistance of the window (see Table 1). The low-E aluminium framed secondary glazing provided the largest improvement. The magnetically attached acrylic, the thin plastic film and the aluminium framed clear secondary glazing all produced similar R-values.

Energy savings calculated

With the whole window R-values known, it was possible to simulate the heating energy savings a secondary glazing retrofit would provide to a typical house. Ten ordinary pre-1978 uninsulated New Zealand houses were modelled in the computer program ALF in four specific climates: Auckland, Wellington, Christchurch and Dunedin. The space heating



The BRANZ Guarded Hot Box open with the aluminium framed secondary glazing installed in the window.

energy was found using a typical full winter heating schedule of heating in the morning (7–9 am) and evening (5–11 pm) at a set point of 18°C.

Each of the 10 houses was modelled five times, once with the single glazed windows installed and then four more times with each of the secondary glazing systems. This resulted in a total of 50 different models. These models were each then simulated in the four different climates resulting in a total of 200 heating energy simulations.

It was assumed that the heating for the houses was provided by electric resistance heating distributed around the houses and operating at 100% efficiency. The cost to provide the heating energy was calculated by multiplying the current regional price of electricity (\$/kWh) by the annual amount of energy required to heat the house.

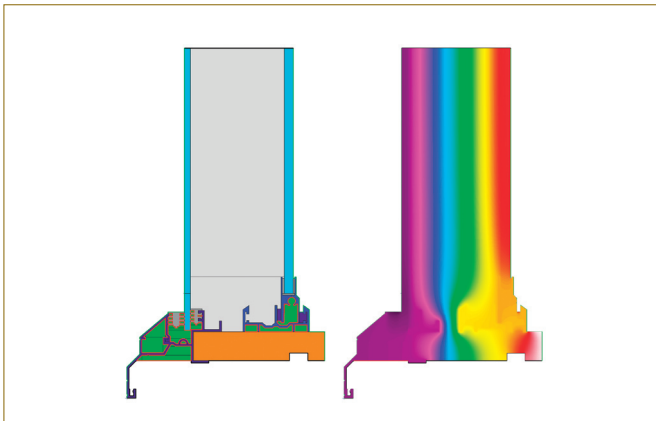
As the thin plastic film is marketed as do-it-yourself, there are no installation costs, but since the kit is designed to last only one heating season, the cost-benefit calculation is based on the annual saving made by installing the film. The result was the household annual energy cost savings for the year minus the cost of the window kits for that household. The three remaining systems had the pay-back period calculated by finding the number of years required for the annual heating energy savings to match the cost of purchasing and installing the units.

Good savings in cold climates

The average pay-back period for these products ranged from between 40 years for Auckland down to only 15 years in Dunedin (see Table 2). A 40-year payback is a significant amount of time to seek a return on an

Table 1: Thermal performance of secondary glazing.

Fenestration unit	R-value (m ² K/W)	Improvement (%)
Base window	0.15 ± 0.02	
Thin plastic film	0.35 ± 0.05	140%
Magnetically attached acrylic	0.36 ± 0.05	150%
Aluminium	0.34 ± 0.05	130%
Aluminium low-E	0.57 ± 0.08	290%



Aluminium framed secondary glazing modelled in Therm 6. The picture on the right illustrates the heat loss across the frame from the warm inside (right) to the cold outside (left).

investment of around \$7,000. Of the tested products, the higher cost low-E secondary glazing produced the largest cost benefits.

At current energy and material costs, secondary glazing was found to not be a financially viable solution in warmer climates such as Auckland. In cooler climates such as Christchurch and Dunedin, secondary glazing was found to be a cost-effective, practical retrofit alternative to replacing single glazing with insulated glazing systems in existing houses.

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Table 2: Cost-benefit analysis of the secondary glazing systems.

System	Auckland pay-back	Wellington pay-back	Christchurch pay-back	Dunedin pay-back
Thin plastic film (annual savings)	-\$79	\$71	\$123	\$187
Magnetically attached acrylic	39.9 years	21.0 years	18.4 years	15.4 years
Aluminium	42.5 years	22.3 years	19.6 years	16.4 years
Aluminium low-E	37.6 years	19.6 years	17.2 years	14.4 years