DESIGN RIGHT

Solar heat gain coefficient for windows

BY JOHN BURGESS,
BRANZ SENIOR SCIENTIST

Summer overheating is becoming a problem in many of our houses. Designers should consider the solar heat gain coefficient when selecting glazing to help reduce this risk.

MBIE RECENTLY modified New Zealand Building Code clause H1 *Energy efficiency* to increase the amount of insulation used in the roof, walls, windows and floors of new homes.

Following a transition period, these changes come into force in November 2022 and November 2023 (see *Building Code changes 2021* in *Build* 188).

No regulation of heat flow by radiation

The R-value of insulation measures heat flow by conduction. Another significant method of heat flow is by radiation, and the most significant source of radiation is the sun.

While the increase in R-values for insulation addresses conductive heat flow, there is currently no regulation around radiation of heat through glazing into homes from the sun. The amount of heat that can pass through glazing by radiation is measured by the solar heat gain coefficient (SHGC).

BRANZ helped create Table E.1.1.1 in the 5th edition of clause H1/AS1, which contains a range of R-values for typical glazing systems used in New Zealand homes. These figures show what

Table 1: Construction R-values for generic vertical window systems in H1 5th edition and solar heat gain coefficient (SHGC).

The glazing unit R-values are based on IGUs available from large New Zealand suppliers (some may not be readily available currently)						Generic frame types			
						Aluminium	Thermally broken	uPVC	Timber – 56 mm
					Average frame %	23%	27%	34%	41%
Generic IGU description		Gas fill (90% pure)	Spacer	R_{cog} (m^2K/W)	**SHGC**	R_{window} (m^2K/W)			
Double glazing	4 Clear / 16 / 4 Clear	Air	Aluminium	0.38	**0.77**	0.26	0.32	0.40	0.44
	Clear / Low-E1	Argon	Aluminium	0.53	**0.56**	0.30	0.39	0.50	0.56
	Clear / Low-E2	Argon	Improved	0.63	**0.55**	0.33	0.42	0.56	0.63
	Clear / Low-E3	Argon	Improved	0.77	**0.57**	0.35	0.46	0.63	0.71
	Clear / Low-E4	Argon	Improved	0.91	**0.54**	0.37	0.50	0.69	0.77
	Clear / Low-E4	Krypton	Improved	1.11	**0.37**	0.40	0.54	0.76	0.85
Triple glazing	Clear / Clear / Clear	Air	Improved	0.53	**0.69**	Not available	0.38	0.50	0.56
	Low-E2 / Clear / Clear	Argon	Improved	0.83	**0.50**	Not available	0.48	0.66	0.74
	Low-E3 / Clear / Clear	Argon	Improved	1.00	**0.52**	Not available	0.52	0.73	0.81
	Low-E3 / Low-E3 / Clear	Argon	Improved	1.43	**0.47**	Not available	0.59	0.86	0.95
	Low-E4 / Low-E4 / Clear	Argon	Improved	1.67	**0.43**	Not available	0.62	0.91	1.01

sort of window and glazing systems are required to meet the increased R-values for windows.

However, Table E.1.1.1 does not include the SHGC values. MBIE is working to determine the SHGC values of glazing systems that will work with the increased R-values to reduce space conditioning needs for New Zealand homes.

Coefficients and R-values for windows

BRANZ has calculated the relevant generic SHGC and R-values for window systems referenced in H1/AS1 (see Table 1). Manufacturers may calculate the performance of their own systems in similar tables.

The first full line in Table 1 shows a double-glazed IGU with centre of glazing R-value (R_{cog}) of 0.38 m²K/W and whole-house average window R-value (R_{window}) of 0.26 with generic aluminium framing. The SHGC for this window is 0.77 – indicating that 77% of the solar energy incident on the glazing will pass through to the inside.

This SHGC could be large enough to result in summer overheating, given the increased R-values of the other building envelope elements.

Design to reduce overheating

Until MBIE provides regulatory guidance, BRANZ encourages designers of new homes to consider the SHGC to reduce the risk of overheating in our better-insulated homes of the future.

Choosing the appropriate R-value and SHGC of a glazing system from Table 1 can help manage the risk of overheating. Passive solar design concepts should also be considered (see www.level.org.nz/passive-design) and features such as:

- exterior shading from eaves, fixed or movable shutters, blinds or shade sails
- altering the size, position and orientation of glazing
- adding trees and other structures to reduce solar radiation into houses.

Currently, whole-house thermal simulation models are not required for compliance, but when used, they provide a good understanding of the impact of both R-values and SHGC on the year-round thermal comfort of houses.

For more See BRANZ Bulletin 670 *Specifying windows and doors under H1*, available to download free from www.branz.co.nz/pubs.