International Journal of Engineering Sciences & Research Technology

(A Peer Reviewed Online Journal)
Impact Factor: 5.164

IJESRT

RESEARCHERID
THOMSON REUTERS

[Chmurny * *et al*., 8(4): April, 2019]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

THE ENERGY LABEL FOR WINDOWS IN MIDLE EUROPEAN CLIMATIC CONDITIONS

Ivan Chmurny
*[1]Slovak University of Technology in Bratislava, Department of Building Structures, Radlinského 11, 810 05 Bratislava, Slovak Republic

DOI: 10.5281/zenodo.2631155

ABSTRACT

Energy labeling of windows has been introduced in some Member States of European Union - for example Denmark, Finland, Slovakia and the UK. The UK BFRC scheme on window energy labeling has proved very efficient in communicating to the general public about the energy saving properties of high performance products thus contributing to their faster uptake. Slovak labeling system was introduced in 2008. The paper deals with main principles of energy rating system used in SLOVENERGOokno. National system for rating the energy efficiency of windows and is recognized within the Building Regulations as a method to show compliance for your replacement windows installation.

KEYWORDS: Window, Glazing, Frame, Energy performance.

1. INTRODUCTION

All content should be written in English and should be in 1 column. Directive 2010/30/EU on the indication by labeling and standard product information of the consumption of energy and other resources by energy-related products provides a clear framework for the EU to introduce a Window Energy Labeling. The market for energy efficient windows has grown considerably in just 20 years, as has number and sophistication of products available to consumers. The most important technical advances have been new types of thin film coatings for glazings that increase the energy performance of the window. Selecting the right window for a specific building invariably requires trade-offs between different energy performance features, and with other non-energy issues.
New window technologies have increased energy benefits, thermal comfort, and have provided more practical options for consumers. A progression of innovations in recent years in today′s fenestration products are based on these technologies:

a. Multiple glazing unit structure;
b. Low- emissivity coatings;
c. Low-conductance gas fills;
d. Warm edge spacers;
e. Thermally improved sash and frame;
f. Solar control glazings and coatings;
g. Improved weatherstripping.

Low emissivity glasses have been specially developed to provide added insulation when used in double glazing units. New technologies that improve window performance and reduce wasteful energy use could improve local air quality and reduce greenhouse gas emissions. Thus, choosing energy efficient windows can have significance for the society as a whole as well as for the individual.

2. ANALYSIS OF THE REFERENCE BUILDING

In current building designs, energy standards are globally preferred. This means that the attention is paid primarily to the reduction of energy needs for heating and cooling. The task of developing procedure for determining energy performance of fenestration products, in specific climatic environments, is very important.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

In order to stimulate and encourage the use of windows with improved energy performance, there is a need for developing an energy rating system that makes it easier to select the best windows for the actual climate.

The reference building was defined in accordance normalized thermal performance properties required in national thermal performance standard STN 73 0540 [1]. A reference building must be specified according rules in ISO 18292 [2].

3. MIDLE EUROPEAN CLIMATIC CONDITIONS ON THE EXAMPLE OF SLOVAKIA

The average effective solar radiation and average temperature difference can be determined via simulation calculations. Climatic conditions differ so greatly between summer and winter that the single value is not sufficient here. ISO 18292 [2] thus specifies two value for energy performance one for the heating and one for the cooling season. By STN EN ISO 13790 [3] with climatic conditions representing normalized values for Slovakia according national annex [4]:

h. required internal temperature for heating $\theta_{int,set,H}$: 20,0 °C,
i. number of degree days for heating: 3 422 K.day,
j. required internal temperature for cooling $\theta_{int,set,C}$: 26 °C,
k. number of degree days for cooling: 184 K.day,
l. internal heat capacity of the building C_m: medium – 165 000 J/K.

4. CALCULATION METHOD

The method is a simple energy need balance over the window in reference building for the heating season. The specific window parameters to be used in calculation are:

m. U_W –value of window, based on EN ISO 10077-1 [5],
n. Window solar factor g_w, according equation (ii),
o. Air leakage at 100 Pa according EN 12207 [6] Q in $m^3/(m^2.h)$ recalculated to L_W in kWh/m^2 at mean pressure difference of 6 Pa.

The balance for the window for the heating season is described:

$$q_W = \eta_g \cdot g_W \cdot G_{sol} - (U_W + L_W).(\theta_{int,set} - \theta_e).t \qquad \text{(i)}$$

where q_w is the net heat load in kWh/m^2 of window,
η_g utilization factor for solar gain (-),
g_w solar factor of window (-), based on equation (ii).

$$g_W = \frac{g_g \,.\, A_g}{A_W} \qquad \text{(ii)}$$

g_g solar factor of glazing (-), based on EN 410 [7],
A_g area of glazing (m^2),
A_W area of window (m^2),
G_{sol} total amount of solar radiation for an average orientation during heating season (kWh/m^2),
t duration of the heating season (h).

For orientation of solar radiation an average orientation is used. It is equals average between north, east, south and west. It is possible to specify the building and occupancy parameters for each climate zone. Energy need balance for heating season has the following form:

$$q_W = A \,.\, g_W \; - \; B \,.\, (U_W + L_W) \qquad \text{(iii)}$$

The *A* nad *B* values were derived for the climate data used for 36 locations. For Slovakia was estimated then one climate zone as the average. *A* and *B* parameters were derived for Slovakia:

A = 266,6
B = 96,6

A is a factor for the useable solar radiation, in $kWh/(m^2yr)$,
B is a factor for annual heating degree hours, in 1000 K.h/yr.
Energy need balance for cooling season has the following form:

$$q_W = A \, . \, g_W \; - \; B \, . \left(U_W\right) \qquad \text{(iv)}$$

For Slovakia were estimated parameters for summer season:

A = 36,0
B = 1,0

So Slovakia in this scheme is treated as a single climate zone, the decision was taken to retain single climate zone. The major benefit was that manufacturers and consumers would have wide rating for comparison purposes.

The rating and labeling system will help consumers, dealers, architects and other decision makers to choose the most energy efficient windows for their application. The rating and labeling is used in broadly the same way as the EU labeling for white goods. The labeling and registration process will drive the market to improve the products and reduce overall energy consumption. The project will achieve to improve the introduction of energy efficient windows. The aim is to provide a system for clear and unambiguous guidance to consumers and other purchasers on the most energy efficient product available to them. Provide a system that encourages the technical improvement of window available on the Slovak market to improve energy efficiency.

The result of this is that climate related information can only be relevant for a national or regional area and any window energy rating must be related to the specific area chosen.

The grading of windows by the SLOVENERGOokno [8] is intended to give the consumer a standardized measure to compare various options and materials.

5. A – G ENERGY RATING BOUNDARIES FOR SLOVAKIA

Initial rating scheme was based on values given in *Table 1*. It is based on energy need for heating calculated for reference heating building in standardized climatic conditions. In *Table 2* is rating scheme for summer season. It is based on energy need for cooling calculated for air conditioning building in standardized climatic conditions.

Table 1. Energy rating scale for windows in winter season

Energy class	q_w in [kWh/(m^2.a]	Product - example
A+	More 20	Window for nearly zero energy building (nZEB)
A	From 0 until 20	Window for passive house
B	From -20 until 0	Window which fulfill criteria of national standard from view point of *U*-value in STN 73 0540-2
C	From -40 until -20	
D	From -60 until -40	
E	From -80 until -60	
F	From -100 until -80	
G	> -100	Metal window without thermal break

Table 2. Energy rating scale for windows in summer season

Energy class	q_w in [kWh/(m^2.a)]
A+	Less then 0
A	From 0 until 5
B	From 5 until 10
C	From 10 until 15
D	From 15 until 20
E	From 20 until 30
F	From 30 until 40

The energy rating is a net heat flow calculation procedure and is designed to compare window products for their heating (cooling) season efficiency under average standardized winter (summer) conditions in Slovakia.
Example of energy label used in SLOVENERGOokno [8] is on *Figure 1*. Thermal balance of the windows in the summer season is shown with two labels:

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

- One label shows the evaluation window in the summer, if the window has not been shaded (i.e., window has the same g_w value as was in winter),
- The second label of energy class in summer shows already affect of sun shading. The difference between the two energy class is a measure of the effectiveness of shading.

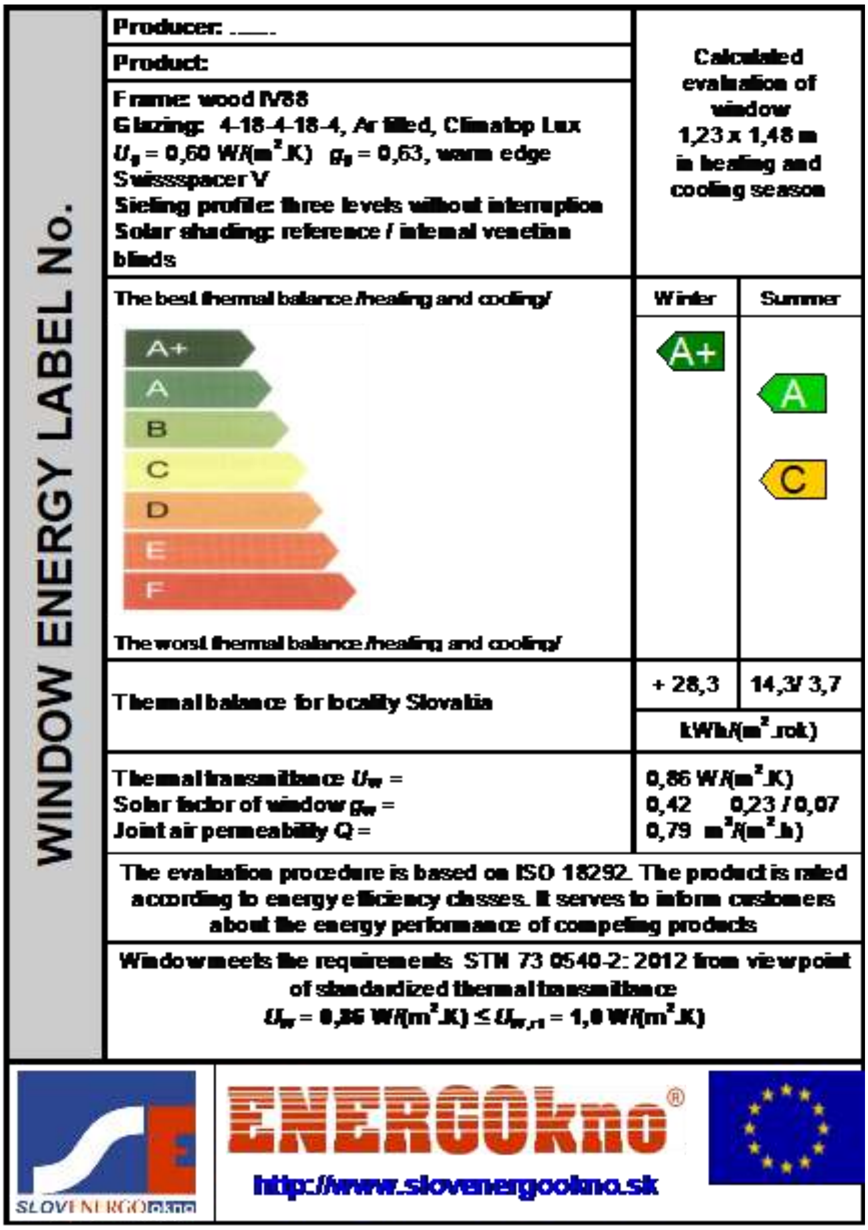

Figure 1. Window energy label used in Slovakia, registered by SLOVENERGOokno [8]

5. OBJECTIVES OF THE ENERGY LABELING

Consumers interested in replacing their old windows are depending on suppliers of windows on information regarding the performance of the products. Currently this information, if present, does not contain an integrated assessment of all relevant window characteristics into an easy understandable energy performance value or rating. The rules set by Regulation 305/2011 (Construction Products Regulation or CPR) only specify that where a window characteristic is required the value is established using harmonised standards. This information, if present, is expressed in a way that is difficult to interpret by laypersons.

Energy label for windows is based on window performance rating according the principles of the energy balance defined in international standards [2, 3, 5]. The inputs for the calculation of energy performance are aligned with applicable harmonised standards, so that administrative burdens are generally not increased.

The added value of a window energy label compared to information possibly presented under CE marking is that labeling allows a relative comparison. Where consumers are confronted with CE information only, this requires thorough understanding of U_W values (thermal transmittance), g values (total solar energy transmittance), and the class of the air leakage in order to discern the better performing window. It is generally believed, also by many stakeholders that have contributed to the preparatory study, that residential home-owners looking for replacement windows do not possess the knowledge to do so. A simple A-G rating of overall window performance would alleviate this gap in knowledge.

6. CONCLUSION

The window has a long technical lifetime. The greatest environmental impact in a window's life stems from energy losses from the heated building in which the window is fitted. Described method based on EWERS method [6] for Slovak climate conditions integrate the energy performance assessment methodology for windows. While thermal insulation and more attention for reducing infiltration and controlled ventilation have helped to already strongly reduce fossil energy needs, the impact of windows and facades is becoming more and more important.

Window energy performance in heating season is dependent on three factors: heat loss (U-value), solar gain (shading coefficient or solar factor), and air infiltration. Having these essential window performance numbers, the net heat flow through a glazing can be calculated.

The designer has to produce a building, and that scale is the relevant one for assessing the (expected or actual) environmental performance. So the tools developed for that purpose address the whole construction work, requiring data from the products only for some of the targets or criteria. The inhabitant, or final user, is also using a house, not a building product: as he seldom acts as a product specialist, he should be more interested by the environmental quality of the house than of the products. But his interest for products is enhanced when health issues are concerned, and also because it is easier to highlight product performance than building performance.

In order to stimulate and encourage the use of windows with improved energy performance, there is a need for developing an energy rating system that makes it easier to select the best windows for the actual climate.

The added value of a window energy label compared to information possibly presented under CE marking is that labeling allows a relative comparison. Where consumers are confronted with CE information only, this requires thorough understanding of U_W values (thermal transmittance), g values (total solar energy transmittance), and the class of the air leakage in order to discern the better performing window. It is generally believed, also by many stakeholders that have contributed to the preparatory study, that residential home-owners looking for replacement windows do not possess the knowledge to do so. A simple A-G rating of overall window performance would alleviate this gap in knowledge.

7. ACKNOWLEDGEMENTS

This work was supported by the Slovak Research and Development Agency under the contract No. APVV-16-0126. This work was supported by the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences in the project VEGA 1/0113/19.

REFERENCES

[1] STN 73 0540-2:2012 Thermal protection of building. Thermal performance of building and components. Part 2: Functional requirements. Bratislava: Slovak Office of Technical Standards, 2012.

[2] ISO 18292 Energy performance of fenestration systems — Calculation procedure

[3] EN ISO 13790:2008 Energy performance of buildings. Calculation of energy use for space heating and cooling. (ISO 13790: 2008)

[4] STN EN ISO 13790/NA:2008 Energy performance of buildings. Calculation of energy use for space heating and cooling. Bratislava: Slovak Office of Technical Standards, 2010

[5] EN ISO 10077-1 Thermal performance of windows, doors and shutters. Calculation of thermal transmittance. Part 1: General (ISO 10077-1: 2017)

[6] EN 12207 Windows and doors. Air permeability. Classification

[7] EN 410 Glass in building. Determination of luminous and solar characteristics of glazing

[8] Information on http://www.slovenergookno.sk