The future 2015 Danish Building Regulations concerning energy performance of multi framed windows

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The future 2015 Danish Building Regulations concerning energy performance of multi framed windows

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The future Danish Building Regulation BR 2015 will reduce energy consumption within the overall building stock. Regarding the very important field windows, it seems that BR 2015 will be based on the same rules as today, except for a simple reduction of the limits for energy loss. Since a big part of the total amount of energy consumption in buildings is lost through windows, and the regulations concerning multi framed windows are already highly problematic today, there is a risk of the problem getting bigger in the future.

INTRODUCTION

The upcoming Danish Building Regulation BR 2015 [1], hitherto under debate before official implementation, has now stopped the consultation stage. The proposal for the coming BR 2015 will be based on the rules of today's except for an simple reduction of the limits for energy loss. As the regulations already today are highly problematic concerning small or multi framed windows, there is a risk that the problems will be even bigger in the future.

In the current BR 2010 windows with insulating glass units (IG-units) are treated completely different from traditional secondary glazing windows. Secondary glazing windows are rated in relation to the U-value of the whole window in its actual form, size and actual panes used, whereas windows with IG-units are rated in a combination of the U-value and the energy supplement from the sun in the heating season, the so-called energy gain (E).

Furthermore all windows with IG-units should be specified based on the energy gain of a reference window E_{ref} as though they were designed with only one single framed window in a standard size of 1,23 x 1,48 m regardless the actual size of the window which will be used, the number of frames, if it has mullions, transoms and muntins, and if it is provided with noise reduction or solar control panes.

The problem is that all the different parameters have a huge impact on the total energy performance, which makes it very hard or impossible to select the most energy efficient windows, both according to the rules of BR 2010 and the expected BR 2015. It seems that BR 2020 will just push the boundaries further, but will still be based on the same poor conditions. Up to BR 2008, a minimum U-value regarding windows was in effect, however, that requirement disappeared in BR 2010 – except for windows inside houses towards rooms heated to more than 5 Kelvin below the temperature in the room concerned . It is hard to see the logic in having rules for windows placed indoors, but not for windows placed towards the outside?

As the tendency for many new houses is too make them look similar to old houses, the problem will affect new houses too. Since a big part of the total energy consumption in buildings is lost through windows it is a topic of great importance for the total energy consumption.

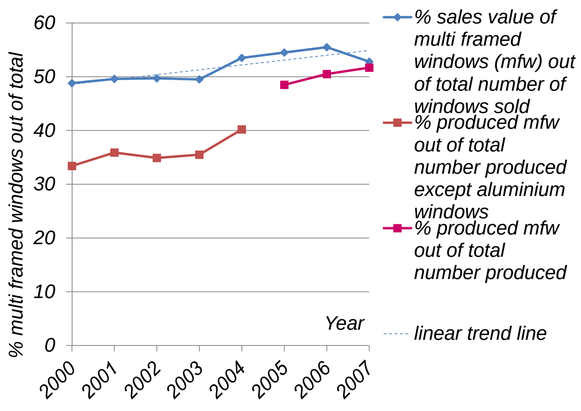

Figure 1. Inventory of multi framed windows compared to total amount of windows produced in Denmark from 2000 – 2007. Data is retrieved from Statistics Denmark. Unfortunately they stopped distinguishing between single- and multi framed windows in 2007.

METHODS

As the Danish Building Regulations concerning windows has been highly problematic since BR 2006 the proposal for BR 2015 was examined to see if there would be changes for the better. It was discovered that the BR 2015 is based on the same rules of previous BR 2010 except for a simple reduction of the limits of E_{ref} minimum ÷ 33 kWh/m^2 year to a minimum loss of ÷ 17.

The background for the decision of using E_{ref} as an energy label of windows was a report from the Technical University of Denmark, DTU Section for building energy (Byg DTU) ordered by the Danish Energy Agency [2]. Byg DTU was asked to examine four different window sizes to see if the best in one size would be the best in all sizes. The result was that it was practically true. The problem was they were never asked to include any windows with secondary glasses. Therefor it seemed reasonable to examine the energy losses from secondary glass windows compared to similar IG-units for windows normally used in Denmark. The source of the energy data is primarily the homepages of window manufactures and Vinduers varmetab [3]

RESULTS

The results are shown in figure 2. The window data are gathered in the spring 2013 and gives information about the energy gain for window systems from manufactures, who have presented their data on their homepages. Unfortunately it seems that all public energy calculators has stopped now, except for windows with secondary glassing, so it has not been possible to get newer data except for the recently introduced Velfac Classic - but only for the E_{ref} and for a cross-window in one size without any muntins.

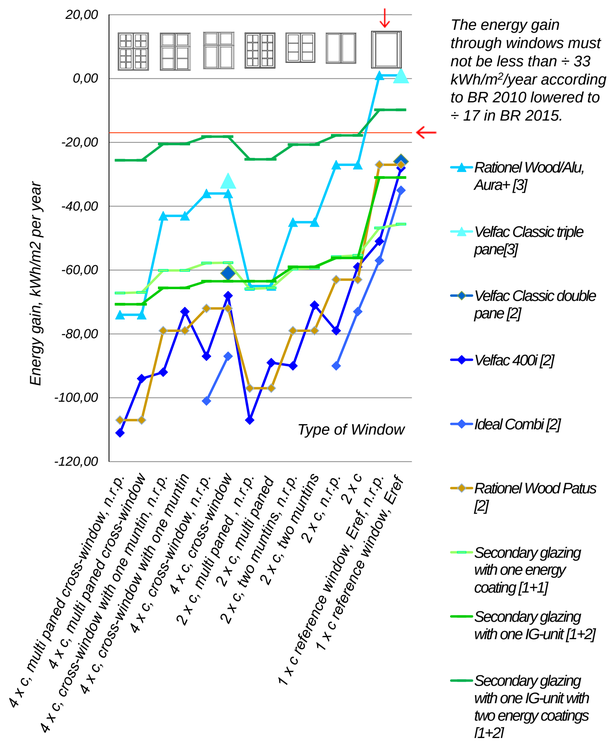

Figure 2. The energy gain E_{ref} is calculated for a single-light opening reference window 1,23 m x 1,48 m with one standard IG-unit, data shown to the far right. 4 x c refers to 4 x casements, n.r.p. refers to noise reducing panes.

The three green curves show windows with double glazing. The two lower are more or less coincident, this indicates that there is only very little obtained with the third layer of glass where the IG-unit in the secondary glazing has only one layer of energy coating [1+2]. The [1+1] window has one hard coated energy glass in the secondary glazing. In contrast the upper green curve is the most energy efficient windows for all sizes, except for the E_{ref}. This [1+2] window is composed with two layers of coating in the IG-unit, one soft and one hard.

The blue curves show different wood/aluminium windows and the yellow is a wooden window, all of them designed with IG-units. Triangular labels are windows with three layer high efficient energy IG-units [3] and diamond labels are two layer IG-units [2]

It is clearly seen from figure 2 that the traditional wooden windows provided with secondary glazing have almost the same energy performance regardless of the window design. The curves are rather horizontal meaning that they are relatively poor for $E_{ref,}$ compared to windows with IG-units, but much better for divided windows with mullions, noggin and transom – and for noise reducing panes. The main reason why they are a little worse with mullions is due to the shadows cast by the mullions.

On the other hand the IG-unit windows have good energy performance for E_{ref} and with a three layer IG-unit even are excellent A-labelled, plus energy windows (E_{ref} > 0). However concerning the windows with two casements or more the energy performances are poorer than windows with secondary glazing. It can be seen that the Rationel Aura + [3] is even poorer than a simple [1+1] secondary glazing for multi paned windows. In fairness it should be mentioned that the producer of Aura + said that it was not possible to produce such a window. It seems that it might be a problem using three layer panes for small casements, especially if they are provided with mullions.

The recently introduced A-labeled triple pane Velfac Classic [3] has 75 % bigger energy loss than the [1+2] secondary glazing with double coating (energy gain ÷32 compared to ÷18,2) an has only ÷25,7 kWh/m^{2}year better energy gain than the traditional secondary glazing with one hard coated energy pane ÷57,7 [1+1]. The C-labeled Velfac Classic double paned [2] has a energy gain of only ÷61.

DISCUSSION

It is probably only possible to follow the new rules of BR 2015 using a triple glassed IG-unit. There are apparently considerable difficulties in constructing these kinds of windows for small size frames. This could mean the end of the use of multi framed windows, windows with small narrow frames and specially windows with muntins. It should not be forgotten that the trend is to use windows looking old-fashioned, even in completely new houses where these windows do not belong.

It has been examined that it is highly unsustainable to change windows [4] when compared with the energy improvement of the original windows. In addition windows with secondary glazing are much better noise reducing than IG unit windows due to the bigger distance between the glasses [5].

As the majority of existing buildings are provided with multi framed windows it seems far more important to make them as energy efficient as possible, and not as the practice has been the last 35 years where new windows have had very low energy efficiency. This might have a big impact on the total energy consumption and properly it is far more sustainable to improve energy efficiency of existing houses than building new ones.

Furthermore one could fear that the Danish way of using a Reference window might be used as an inspiration for former EU legislation and therefore be widespread in the whole region. [6, 7]

The lack of energy calculators on the manufactures websites is a very big problem. Today, they are obliged to present data, but only when you ask for it in connection with an offer.

CONCLUSIONS

The BR 2015 can be of good use for choosing between single-light windows with IG-units, but if the windows have more than one frame it is not suitable, instead double glazing must be used.

Therefore, the BR 2020 should be changed concerning windows, not least put in perspective of the fact that 50 % of the windows being used are multi framed. The use of E_{ref} should stop while all windows, including windows with secondary glazing, should be rated from the energy gain of the actual window in the actual design. Furthermore energy labelling should follow the same rules, instead of as today, where windows with secondary glazing cannot be labelled, and where they are using the E_{ref} for IG-unit windows.

All companies should have a public energy calculator in order to achieve the energy label, so one could find the right energy data before asking for an offer. There should be a minimum U-value limit of 1,80 W/m^{2}K for windows facing the outside, and not as today where there are only limits for windows facing rooms being heated to 5 K less than the heated room - but with no limits against the outside. All future analyses should include windows with secondary glazing. There need to be an independent website regarding sustainability, maintenance, noise reduction, total economic and energy performance of windows in typically design and sizes.

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