

The critical importance of understanding thermal performance of Windows (and Doorsets) in advanced building design.

The days of prescriptive building component design and regulation are gone. We're now in the era of "Whole Building" performance where each and every component has to reach its specified design performance, delivering "whole building" design performance. Energy conservation requirements demand this whether specifying domestic replacement windows or, and most particularly, at the higher levels of compliance with The Code for Sustainable Homes. Energy performance of windows and external doorsets is pivotal to whole building performance and poorly specified products or errors in specification, however caused, can result in substantial loss, not only of energy but also costs and reputation, particularly for those involved in high profile English Partnership's Carbon Challenge, Code Level 6 developments. In this article Ian Purkis considers the issues, looks at the pitfalls and recommends several ways to avoid them.

First, the basics: U value describes the thermal transmittance of the product. This is the major factor but not the only one that needs to be considered. The "g" factor, describing the solar gain can provide valuable additional energy, but can also describe the potential for solar overheating in a building. The air-leakage factor is also vital when considering the demands of Code Level 6 where air-tightness is absolutely critical. The ψ value describing the edge junction effects between window and structure can vary significantly between products and can have a large impact on the finished building.

U values and the importance of "Whole Product" U value:

Looking at U values, these are dominated by the glass used in any glazing unit, single, double or triple glazed. However when describing a window or doorset product, it is vital to understand the difference between the U_g glass and U_w window properties. Some manufacturers are still describing their window products by the U_g "Centre Pane" (CPU) value which is positively misleading. Centre pane U value is referred to in sections of the 2006 Part L Approved Document for replacement windows and those used in extensions. The "Whole Product" U_w value includes the frame and sash effects, and these are substantially higher (worse) than the centre pane U_g value. Unfortunately this doesn't tell the whole story. There are other considerations that must be taken into account before a product can be properly specified.

First, the U value is only meaningful for specification and comparison purposes if it is determined strictly in accordance with the relevant standards, either EN ISO 10077-1 and 2 or full "hot box" testing to EN 12567-1. Anything else can be misleading and if the declared U_w value does not refer to one of these Standards it should be considered meaningless. Nevertheless there are still several ways manufacturers can describe their products. The ISO standard can be applied to any window, so unless the manufacturer declares the U_w value for every window, (which is an obligation from February 2010 if the customer requests) he needs to state which standardised window his declaration refers to. Every minor change in window design changes the U_w value, particularly if an additional opening sash is

added, while “standardised” windows can be selected to give a favourable result. Alternatively the value could be quoted as a particular value “or higher”, ensuring that only the “worst case” is used.

Another pitfall could be by reference to U “effective”, allowed under SAP calculations, where a building designer can adjust the value to account for additional factors, even including the curtains!

Energy Rating of windows in dwellings

However the Standard alone doesn’t tell the whole story. Solar gain, the g factor, determined by the chemistry of the glass used, can provide valuable “free” energy. When combined with the L_{50} air leakage factor, a complete “Energy Rated” window can be determined and the British Fenestration Rating Council (BFRC) uses a “Standardised” window, incorporating all these factors in its Domestic Window Energy Rating (DWER) system, applicable only to domestic properties, and particularly useful in specifying replacements.

Code Level 6 and Super low U value windows:

So why don’t Energy Rated windows work on Code Level 6 housing? To achieve “Zero carbon”, a precise definition of which we are still awaiting, energy consumption must be at lowest possible levels and so energy losses must achieve new lows, beyond anything previously considered realistic. One estimate is that the U_w value within the next decade must go down by approximately 50% to a value between 0.5 and 0.7. As a result, a new generation of extreme low U value windows are now at an advanced stage of development, enabling designers to achieve levels of insulation that require minute energy input. In this situation solar gain can become a serious source of overheating, ruining the low energy building design; it is significantly more expensive in energy to cool a building than it is to heat one. With global warming a reality, prevention of overheating is a challenge that must be faced.

Clad windows:

Another factor to take into account is the effect of window cladding systems. With much current interest in both aluminium or PVC clad timber windows – which appear to offer the best of both worlds – a sustainable timber heart providing strength and beautiful internal appearance whilst a thin recycled external skin minimises long term maintenance. Unfortunately, what many manufacturers fail to explain is that metal cladding is a very poor insulator, so this can be a significant negative effect on the U_w value. Often this is not clearly explained to the specifier and may lead the buyer to assume the U value is no different from a standard window. Currently The Green Guide gives unfavourable ratings to clad windows so these are unlikely to be specified for higher levels under the Code for Sustainable Homes. Nevertheless as clad or composite windows can vary enormously their generic rating is a very broad brush that justifies refinement.

Opportunities from CE Marking

Not mandatory in the UK, the CE mark enables manufacturers to declare the U value against the European norm. The “standardised” window under CE marking rules, differs from the BFRC standardised product so results are not comparable. (In fact, there is no “standardised” CE marked window, it just reads like it!). The availability of CE marking should put UK manufacturers on an equal footing with European manufacturers if they choose to adopt it and this could be very useful for UK manufacturers looking at their competition from across the Channel.

Verification and the trust of Building Professionals.

There is no statutory requirement for independent verification of thermal performance but the BFRC Energy Rating system does demand audit and verification. Any manufacturer making a CE mark declaration is at least declaring based on common standardised criteria but can only declare conformity to mandated characteristics, if these characteristics originate from an Initial Type Test, carried out by a Notified Body. The industry has a potential confidence problem unless we all get this right and the awareness of the issue is rising.

Michael Finn, Chief Architect of Barratt Developments Plc, commented, “U-value evaluation particularly with regard to windows and doors has been very misleading over the last few years, whereby specifiers have not been certain they have been comparing like with like”. He went on to say “As a housebuilder I need to know that when a window and/or door supplier declares a ‘U’ value it does reflect the actual window or door they are supplying or declares the worst case and not the best case to achieve misleading low ‘U’ values.

“Windows and doors are a key to ensuring a building meets the whole building energy performance it has been designed to achieve and so moving forward all manufacturers have to be completely honest with their declared data and expect to have this regularly tested via independent audits.

Ben Cook, Barratt’s Senior Land Manager responsible for the Hanham Hall Eco village development, being built to Code Level 6, added his voice to those concerned highlighting “that the lack of transparency could cause high end Code For Sustainable Homes site to become even harder to deliver. The last thing we possibly want on the early sites is to be faced with a performance loop-hole that means the general public loose confidence in the overall product”

Concluding:

The industry must get its act together and ensure transparency in what they are declaring in relation to their products. The British Woodworking Federation (BWF) and the Glass and Glazing Federation (GGF) are working to support their members in both the accuracy of determining U values and in publicising and promoting the importance of understanding their meaning. In addition, reaching the specifiers and communicating the importance remains a challenge for all the industry. If we succeed, windows and doorsets can play their part in the huge

improvements required to meet the energy and climate challenges of the future. If we fail and substandard building performance results from poor window and doorset specification, our industry will be damaged and hard won reputations lost. The opportunities to make our contribution to a positive future are there; it is for our industry to rise to it and not spend our time destructively sniping at one another on less material issues.

CIP 13.11.08 amended 20.11.08