Velfac Windows

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CPD Article

Published on 11 December 2018 10:34

Window Performance and Specification: Cause and Effect

Key Learning outcomes

- The practical impact of a low thermal performance target (U-Value).
- Understanding the measure of solar gain and how it can impact on design.
- Understanding acoustic terminology and how it can impact on design.
- How each of the above can conflict with the architectural intent.

So, a window. It's easy? A hole in the wall in which the occupants can see out of, whilst allowing light into the building and providing protection from the elements. Unfortunately, not.

Window specification can be complex, there is more to it than just keeping the cold out and the warmth in. We need to consider the levels of light required in a room, the need to create a safe and secure environment, all whilst protecting against the Earth's natural elements and other man-made factors such as noise pollution.

There are many aspects of window specification that we are asked about as a window manufacturer, however three of the most common criteria that we are asked to comment on are: Thermal Performance, Solar Control and Acoustic Performance, as such we will focus on these throughout this article.

This article will identify how we finalise the specification of a window system, considering building regulations but also the additional requirements of third parties such as M&E consultants, acousticians or employers requirements, all of which can influence the overall design and cost of your building.

1.0 Thermal Performance – U-Value

Thermal performance is the measure of the flow of heat through a material. It is referred to as a U-Value which is measured in a unit shown as W/m²K (Watts/metre squared Kelvin). In the context of a window it allows you to understand how well a product can keep the cold out of a building whilst retaining the heat inside.

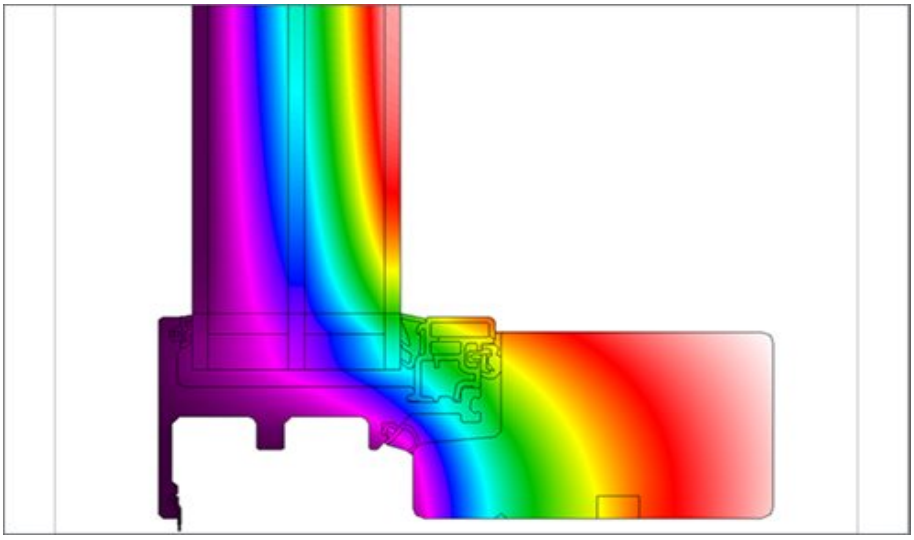
When you look at the U-value of a material it tells you the amount of energy lost every second, for each square meter of material, for every degree of temperature difference between the inside and outside of a building. The lower the U-value, the less energy is being lost, and so the better that material or product is as an insulator.

UK Building Regulations define the maximum U-Value that certain building components need to achieve. For windows and patio doors Part L of the Building Regulations set out the target requirements for new build and refurbishment projects which typically have U-Value targets in the range of 1.4 W/m2K to 1.6W/m2K.

Whilst U-values are still used in the Building Regulations to set limiting standards for the elements of a building's fabric, the overall thermal performance of buildings are now assessed using more complex modelling procedures.

For non-domestic buildings, the Simplified Building Energy Model (SBEM) developed by the BRE determines the energy performance of a proposed building by comparing its annual energy use with that of a comparable notional building. For dwellings, energy performance is assessed using the Government's Standard Assessment Procedure (SAP).

Discussions should be had with manufacturers with regards to the energy performances achievable within their product range. Choosing windows with an enhanced thermal performance (lower U-Value) may allow you to make savings in the cost and performance of other materials used within the construction of that particular building.



Thermal image of a composite window to show the flow of heat through the material

2.0 Solar Control – G-Value / LT Value

Solar control is about understanding the Suns Solar Transmittance through translucent and transparent materials such as glass, it is important for determining the solar heat gain into the space windows enclose during sunny conditions. Solar heat gain can be beneficial in the winter, as it reduces the need for heating, but in the summer, can cause overheating.

The total measurement of solar heat transmittance through glazing is equal to the solar heat that is transmitted through the material directly, plus the solar heat that is absorbed by the material and then re-emitted into the enclosed space. This measurement is referred to as a G-Value.

Light transmittance (LT) measures the capacity of a material and how they transmit light all the way through themselves. Opaque materials obviously have a transmittance of zero as no light at all gets through.

Standard double glazing would typically have a G-Value of 0.64 which equates to 64% of the Suns heat being transferred into the building and a LT value of 0.82. Enhanced levels of Solar performance are often required on projects and to certain elevations within projects. It is quite common for higher performing solar glazing to be used on south facing elevations where G-Values in the regions of 0.28 – 0.4 maybe called for within the M&E consultants report. The use of lower G-Values to such elevations will allow a lower percentage of the Suns heat to be transferred into the building (0.28 = 28%) reducing the effect of overheating. Consideration should also be given to the effect this will have on the LT value as lowering the G-Value will also lower the amount of light transmittance through the glass. For example, solar controlled glazing providing a G-Value of 0.28 will have an LT Value of approximately 0.52.

Solar control can be achieved by using either energy coated glass which reflects the Sun's rays, or by body tinted glass which primarily absorbs the Sun's rays.

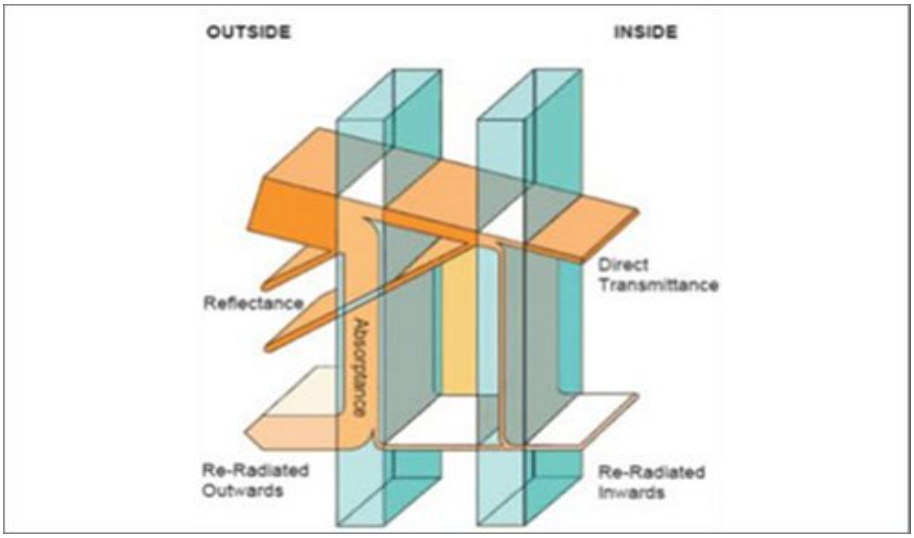


Image 2 demonstrates how direct sunlight can be either transmitted from the outside to the inside, reflected away, or absorbed and re-radiated through a double glazed unit.

3.0 Acoustics

Building acoustics is a complex science of controlling noise in buildings. This includes the reduction of noise transmission from one space to another and the control of the characteristics of sound within spaces themselves.

The main considerations for sound relating to windows are:

- Sound intensity - Measured in Decibels and are referred to as a dB rating.
- Sound absorption - The loss of sound energy when sound waves come into contact with an absorbent material such as ceilings, walls and windows.
- Noise Pollution - Noise disturbance which can have negative effects on health, wellbeing and general quality of life.

Within the UK, guidelines such as BS8233:2014 specify maximum permissible noise levels within a building. Other guidelines exist such as World Health Organisation which has a range of recommended maximum noise levels within a home.

It is common with most projects today that an acoustic assessment is undertaken and a report is supplied by a qualified consultant. The report should state what the specific acoustic requirements are for the building, not only for the windows but the total façade as well as internal criteria.

When relating to windows the acoustics for buildings are defined into separate performances

- Rw - Is the weighted sound reduction index.
- Rw +C- Correction factor to high frequency sounds (i.e. trains, jet planes, playing children),
- Rw +Ctr- Correction factor for low frequency sounds (i.e. traffic, far away jet plane),

It is important to understand each of the above and the acoustic rating measurement required within any specific acoustic report. For example, a typical composite double-glazed window can provide 32db Rw, however if you add in “C” (correction factor) it can be reduced by 1db providing 31db Rw+C, if you then add in the “tr” (traffic factor) you can further reduce the performance, sometimes by up to 5db reducing performance to 27Rw+Ctr. On a similar note, it is important to understand that a window performing to 32db Rw will not achieve the requirement of 32db Rw+Ctr.

Consideration should also be given to the ventilation strategy of the building and how acoustics can impact upon this. For elevations requiring a high level of acoustic performance acoustic trickle vents may need to be used, these typically achieve a sound reduction value of 40db Dn,e,w. Some projects may require targets in excess of this and as such alternative ventilation strategies may be required such as MVHR systems.

Acoustics are becoming more apparent as buildings are being built in inner city areas, under flight paths, and closer to transport routes, schools & industrial areas.

4.0 Window Specification

Now that we have reviewed the three most common criteria, what does it mean for the window itself?

U-Value: Typical double glazed composite window will provide an area weighted U-Value in the region of 1.45 - 1.55W/m2K, this making standard part L requirements of 1.4 - 1.6W/m2K an easy target to achieve. Where more onerous U-Value targets are detailed to be required as part of the energy performance assessment triple glazed units may be required. A triple glazed unit will provide U-Values in the region of 0.8 - 0.9W/m2K. It is quite common to see U-Value targets in the region of 1.1W/m2K 1.2W/m2K for which a combination of double and triple glazed units can be utilized to achieve the performance whilst maintaining aesthetics and providing a cost-effective solution.

Solar Control: Standard double glazing will provide a G-Value of approx. 0.6 - 0.7 and an LT-Value of 0.8 - 0.85. With triple glazing achieving a 0.53 G-Value and an LT-Value of 0.74. Solar control options are then available to further lower the G-Value down as far as 0.28.
Solar control coatings are the most popular choice in the market as they offer good performance whilst maintaining a ‘neutral’ appearance. They offer enhanced levels of solar control (0.35 - 0.4) balanced with high levels of light transmittance (0.64).

Body tinted glass would be used where heat gain is strong and glazing with a solar control coating is unable to reduce the solar energy enough to stop a room from overheating. In this case as the glazing is tinted it coincides with the visible light spectrum and will have a greater effect on the light transmittance. Body tinted glass can provide a G-Value of 0.28 with a reduced LT value of 0.52

Acoustics: Acoustic performance can vary within a supplier’s product range. Double glazed units generally achieve values from 32db Rw up 39db Rw, with triple glazed options available up to 43dbRw. Manufacturers should be able to provide whole window tested data to offer proof of performance for various glass build-ups within their own range of windows.

It is important to note that acoustic glazing can be heavy and sometimes weigh up to 55kg per m2, this can have implications on the achievable manufacturing sizes of the windows and doors.

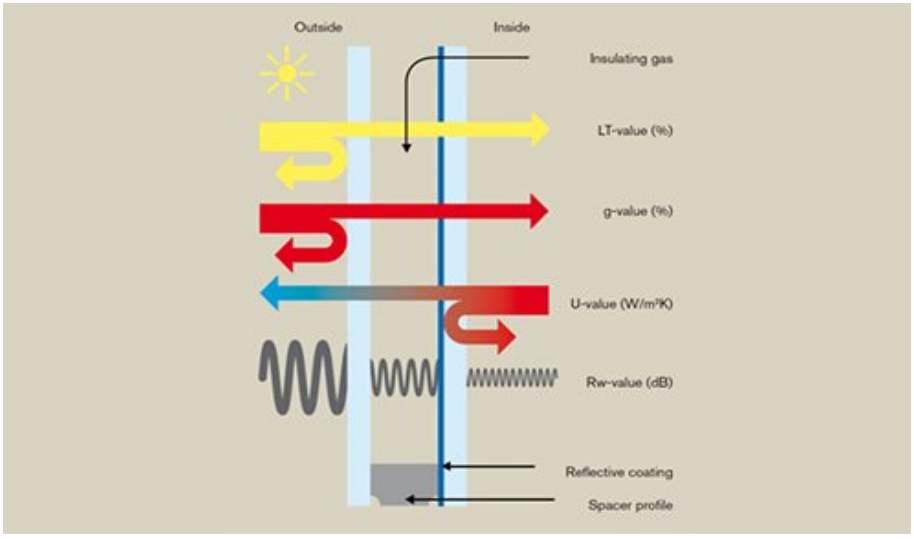


Image 4 shows the transfer of heat, light and noise through a double glazed unit.

5.0 In Summary

Each of the 3 properties listed will influence the design, performance and cost of your building:

Thermal Performance: Understanding the U-Value and the performance of various window systems, and the project requirements is vital in specifying and designing window packages. U-Values can be defined as either glass only centre pane values, or more commonly as area weighted U-Values including for the whole window (glass and frame). U-Values in the region of 1.4-1.6 W/m2K can be fairly easy targets to achieve with either double glazing alone or a combination of double and triple glazing. As U-Value requirements drop it is important to speak with suppliers to understand how these targets can be met with the introduction of triple glazing.

Solar Control: When considering solar control, it is important to understand the G-Value requirements both as an overall project and on an elevation by elevation basis. Understanding this will allow suppliers to include for glazing specifications to meet the requirements of the project, whilst ensuring areas where solar control is not required are not over specified.

Acoustics: As with the G-Value, it is important to understand the acoustic requirements of the windows across the project, and on an elevation by elevation basis. Considerations should be given to the fact that higher level acoustic requirements within both double and triple glazed systems will have a detrimental effect on the overall U-Value of the window.

Acoustic glazing can also be heavy and weigh up to 55kg per m2 which can have implications on the design of your windows. As glass weights get heavier the manufacturing sizes generally decrease and as such the introduction of transoms or mullions may be required.

Cost: Whilst Thermal, Solar and Acoustic requirements can have an impact on the design, they can also affect the cost of a project. As U & G values drop, and Acoustics increase, costs typically start to rise.

Solution: Early engagement is the key, window manufacturers have had many years of experience assisting with all aspects of the above and can help offering key solutions to your requirements. Manufacturers should be able to provide you with whole window test data for their systems, and present this in a format allowing you to go back to your M&E and Acoustic consultants to present the information and agree the best way forward with your project.

The end result. Confidence that the window system specified is providing the required performance and desired aesthetic.