Technical Update No 3

Condensation on glazing frames

Condensation is considered here from the point of view of appearance. Condensation may also lead to rot and deterioration of surfaces and fitments.

The CWCT Standard for curtain walling (Clause 2.15.1.1) and the Standard for slope glazing systems (Clause 2.16.1.1) require that:

'Condensation shall not form on the interior surface of any framing members of windows or doors prior to the formation of condensation on the interior surface of any double-glazed unit, with a centre-glazing U-value not greater than 3.0 W/m^2 K contained in the vision areas of the curtain wall (slope glazing system)".

This is to say that when the internal temperatures are greater than the external temperatures the inner surface temperatures of the framing members should be greater than the lowest temperature anywhere on the inner surface of the double-glazed unit.

The centre-glazing U-value of 3.0 W/m^2 was set as this is marginally greater than the U-value of 2.8 W/m^2 achieved by a 6-12-6 glazing unit with an air-filled cavity, the normal glazing used in the UK at that time. The clause is written in this way so that this particular glazing unit acts as a benchmark and the required frame performance is independent of the psychrometric conditions (temperature and relative humidity) that are beyond the control of the specifier / designer.

The inner surface temperatures of an insulated glazing unit vary over the surface. Assuming conditions of colder outside and warmer inside, conduction of heat through the glazing frame and/or the edge seal of the glazing unit will lead to lower surface temperatures at the edges of the glazing unit when compared with the centre pane values.

For internal temperature of 20^oC, external temperature of 0^oC and glazing U-value of 2.8 W/m^2 the centre pane surface temperatures are 12.9^oC inside and 2.5^oC outside. The difference in temperature between the glass surface and the air temperature arises because of the surface temperature resistance. The inner surface temperatures will be between 1^oC and 3^oC lower at the edge of the vision area depending on the frame detail. Figure 1 shows surface and internal temperatures for a typical window frame and glazing.

19 June, 2000

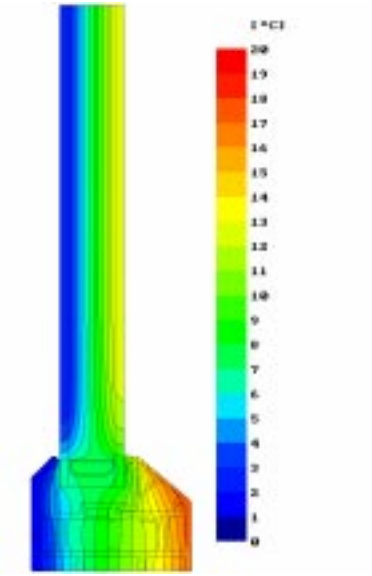

Figure 1 Cross-section through a window showing temperatures

The inner surface temperature of the glazing unit and frame will be greater at the top edge than the bottom edge due to convection currents (down draft) past the glazing. Figure 2 shows a thermal image of a glazing unit and frame. For tall glazing units the room temperature may vary with height but specification of the internal environment is seldom this detailed.

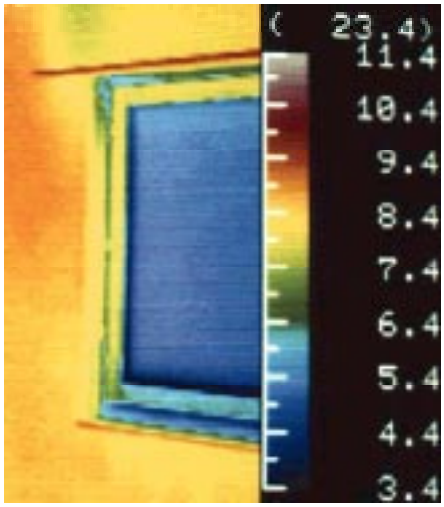

Figure 2 Window showing variation of surface temperature with height

The intention of Clause 2.15.1.1 (curtain walling) and 2.16.1.1 (slope glazing systems) is that no condensation should form on the interior surface of the glazing frame before it forms on the inner surface of the glazing. With a 6-12-6 air filled glazing unit this generally requires the surface temperature of the frame to be greater than 10^{o}C to 12^{o}C.

Methods for calculating surface temperatures and assessing condensation risk are set out in:

- 'Specifying and assessing for heat transfer (the U-value)'
- 'Specifying and assessing for condensation risk'
- 'Procedures for assessing glazing frame U-values'
- 'Assessing heat transfer and condensation risk for a curtain wall'

all of which are available from CWCT.

Software packages are readily available to undertake thermal analysis of window and curtain wall frames. CWCT and others can provide thermal analyses and condensation risk assessment of glazing systems and other constructions.

With the use of advanced glazings such as low-e coatings, gas filled cavities, triple glazing and warm edge spacers heat loss through the glazing is reduced and internal surface temperatures of the glazing are higher. A gas filled unit with low-e coating has a U-value of 2.0 W/m^2 K and today centre pane U-values as low as 1.0 W/m^2 K are possible.

Glazing with a lower U-value than 2.8 W/m^2 K will have an inner centre-pane surface temperature greater than 12.9^oC. For instance the inclusion of a low-e coating can raise the centre-pane surface temperature to 15.2^oC. Thus by changing only the coating on the glazing it is possible to cause condensation to form on the framing surface first rather than it first forming on the glass surface. This should not be deemed to invalidate the frame design. However, it is good practice to use better insulated framing profiles for higher performance glazing units. As stated above surface temperatures can be calculated for all configurations of glass and frame profile.

As temperatures drop surface condensation first occurs as a misting at the lower edge of the glass or on the frame. It may be acceptable for this to happen on a few days of each year provided that the condensation does not become so heavy that it runs from the surface. Misting will be less noticeable on the frame than on the glass. With the use of advanced glazings it may be appropriate for condensation to form on the frame before it forms on the glass in the vision areas.

Greater surface condensation may lead to water running across the glass and or frame surface this is never acceptable under the design psychrometric conditions. Note that the actual internal temperature and relative humidity may differ from the design conditions as they depend on the way in which the building is used. The building design should take account of intended use but not necessarily abuse or change of use.

The CWCT standards set default design environments, Clause 2.15 (curtain walling) and Clause 2.16 (slope glazing). These values may be used unless the building design team establishes different conditions based on the building services design for the building.

Frames and glazing should also be, 'Designed to reduce energy consumption of the building, Clause 2.15 (curtain walling) and Clause 2.16 (slope glazing systems). This requires that an acceptable total U-value is achieved.