The purpose of this Technical Note is to define limitations on glass configurations for which guarding and barrier calculations are being provided by Saint-Gobain Building Glass UK and Ireland (SGBG). These limitations are being put in place as a direct result of risks not being suitably assessed by those responsible for providing or approving glazing specification with regards safety.

CURRENT STANDARDS

BS 6180:2011 [1] provides guidance on glass barriers that protect people from hazards, which will include falling from height. This document is referenced by Building Regulations through the UK and Ireland. For full height barriers, the containment clause (8.6.3.1) states that "*The glass in full height barriers should be selected to resist the appropriate design loads…, and for its impact performance in accordance with the safety glazing recommendations given in BS 6262 (all parts).*"

BS 6262-4:2005 "*Glazing for buildings. Code of practice for safety related to human impact*" [2] provides guidance on glass types suitable for use in full height barriers. This is specifically with consideration to behaviour under impact with regards safe breakage, but without consideration to containment, or "no break" scenarios.

These requirements also relate to the requirements of Building Regulations Approved Document K Section 5: Protection against impact with glazing [3], which states that glazing in critical locations should also be a safety glass. The following glass types are typically deemed acceptable.

Table 1 - Glass types permitted in critical locations

Glass Type	Standard
Thermally Toughened Soda Lime Silicate Glass	EN 12150-2 [4]
Heat Soaked Thermally Toughened Soda Lime Silicate Glass	EN 14179-2 [5]
Laminated Safety Glass	EN 14449 [6]
Laminated Thermally Toughened Soda Lime Silicate Glass	
Laminated Heat Strengthened Soda Lime Silicate Glass	
Safety Rated Wired Glass	EN 572-9 [7]

It should be noted that more defined requirements, in the form of EN 12600:2002 [8] classifications, apply to balustrade infill panels and free-standing barriers, depending upon the free line distance from a permanent structure to the glazing. It should be considered what rationale exists that the same limitations are not specifically defined for full height glazing.

ISSUES ASSOCIATED WITH CURRENT STANDARDS

It would be considered that the use of thermally toughened glass will not provide any form of residual containment in the event of glass failure resulting from accidental damage, high energy impact or other causes.

With regards residential installations, where often no architect, structural engineer or designer is involved in the specification of the glass, it may be the case that acceptance is given to insulated glass units comprising only toughened glass types without due consideration to any residual risk. This risk would be expected to focus on residual containment in the event of glass failure.

Fundamentally, this may result in an installation where, although strength requirements are met, in the event of accidental damage, the glass will offer no protection from falling.

SGBG GUIDANCE AND LIMITATIONS ON PERMITTED CONFIGURATIONS

Full height glazing is typically designed with consideration to the requirements of building regulations [3, 9, 10, 11, 12], BS 6180:2011 and BS 6262-4:2005. More commonly, design now also considered the requirements of Eurocodes [13, 14], with EN 1991-1-1 [15, 16, 17] and PD 6688-1-1 [18] being used for provision of load requirements.

Toughened glass is commonly accepted as glazing in critical locations due to its safe breakage characteristics, which meet the requirements for containment as per BS 6180 and BS 6262-4. However, as the breakage of toughened will result in fragmentation, there is no residual strength to resist subsequent impacts or loadings. As such there is also limited integrity to hold the glass in place, resulting in a potential for it to fall from the frame or supports into which it is mounted.

When assessing risk, consideration can be given to the use of an annealed laminated pane within the glazing construction. Whilst this glass type is generally considered weaker mechanically, and so cannot withstand the same levels of static loading, with a sufficient EN 12600 classification, the glass would be expected to provide containment even when fractured.

As below, the laminated pane used externally, under normal conditions, won't be exposed to the internally applied loadings, but will provide containment in the event of accidental fracture of the internal pane, as well as preventing toughened glass falling from height.

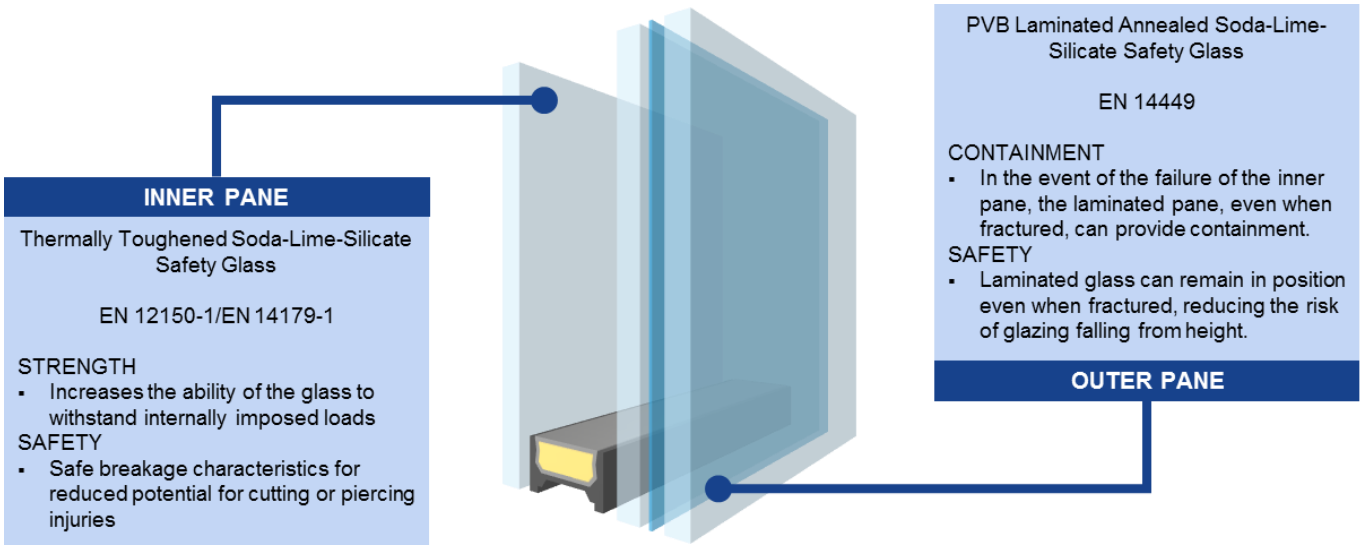

Figure 1 - Glass type specification for low risk design

EXCEPTIONS

Exceptions will apply where evidence is provided that; an architect, civil or structural engineer or Local Area Building Control officer, have agreed with a proposed specification that does not incorporate a laminated pane, and are willing to attest to the suitability of this glazing specification. SGBG will take no responsibility for suitability or validity of such specifications.

REFERENCES

[1] British Standards Institute, *BS 6180:2011 - Barriers in and about buildings. Code of practice,* BSI, 2011.

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[3] HM Government, *The Building Regulations 2010 - Approved Document K - Protection from falling, collision and impact,* 2013.

[4] European Committee for Standardization, *EN 12150-2:2004 - Glass in building. Thermally toughened soda lime silicate safety glass. Evaluation of conformity/Product standard,* CEN, 2004.

[5] European Committee for Standardization, *EN 14179-2:2005 - Glass in building. Heat-soaked thermally-toughened soda lime silicate safety glass. Evaluation of conformity/product standard,* CEN, 2005.

[6] European Committee for Standardization, *EN 14449:2005 - Glass in building. Laminated glass and laminated safety glass. Evaluation of conformity/product standard,* CEN, 2005.

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[9] Riaghaltas na h-Alba, *Technical Handbook 2015 - Domestic,* Riaghaltas na h-Alba, 2015.

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[15] European Committee for Standardization, *NA to BS EN 1991-1-1:2002 - UK National Annex to Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings,* CEN, 2002.

[16] European Committee for Standardization, *NA to IS EN 1991-1-1:2002 - Irish Annex to Eurcode 1 - Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings,* CEN, 2002.

[17] European Committee for Standardization, *EN 1991-1-1:2002 - Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings,* CEN, 2002.

[18] British Standards Institute, *PD 6688-1-1:2011 - Recommendations for the design of structures to BS EN 1991-1-1,* 2011: BSI.