Designing glazing to withstand climatic loads is covered by various Codes of Practice and Standards. Three distinct methodologies exist, specifically;

- Design charts
- Permissible Stress
- Limit State Design (See **CLIMATIC LOADS 3D**)

With regards the accepted methodology, this will typically need to be one approved by Building Control, or other relevant certifying bodies. This document will introduce and discuss the various methods applicable to vertical glazing, which will typically be subjected to wind pressure, acting inwards to the building, and wind suction, acting outwards from the building.

DESIGN CHARTS

Within the UK, BS 6262-3:2005 [1] outlines both a method for determining the wind loads for low rise building as well as design charts for various glass substrate type combinations.

The design charts within BS 6262-3 are based on effective area and wind load. The effective area of the glazing (A_e) is determined based on the shape factor (F), and area (A) of the glazing. The shape factor is, in turn, determined from the aspect ratio (r) of the longest edge (a) to the shortest edge (b);

$$r = \frac{a}{b}$$

$$F = \frac{4 \cdot r}{(r+1)^2}$$

$$A_e = A \cdot F$$

Once the wind loading and the effective area are known, the two values are used in conjunction with the design charts, to determine a suitable thickness. The following chart, for toughened-toughened configurations, shows that for a wind load of 2250 N/m^2, and an effective area of 3.25 m^2, a **4mm + 4mm** configuration is insufficient, and a **4mm + 6mm** is therefore required as a minimum.

The follwing chart is intended for illustration only and should not be used to determine glass configurations to withstand wind loads. Instead, if applying this methodology, refer to the charts within BS 6262-3.

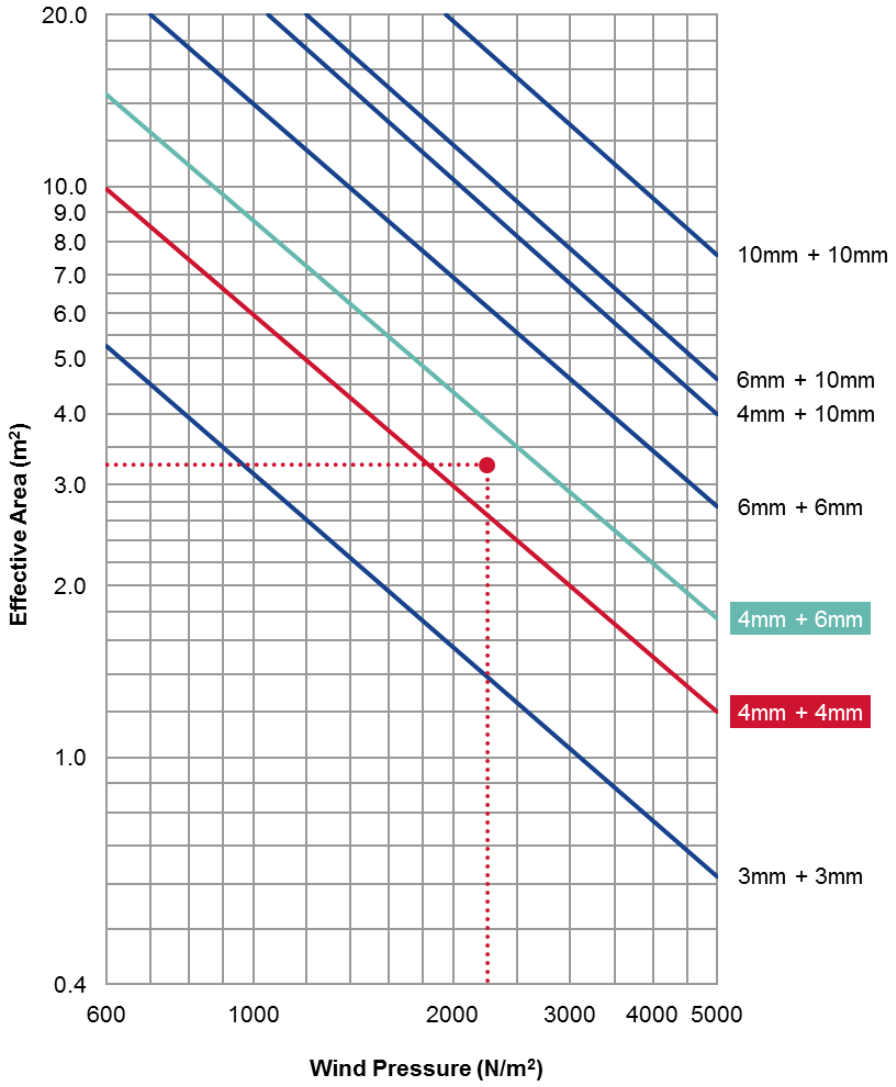

Figure 1 - BS 6262-3 Design Chart Example

PERMISSIBLE STRESS DESIGN

Permissible stress design is a relatively simplistic method for determining the expected suitability of glass and glazing subjected to imposed loads. This method will permit any glazing configuration to be assessed, which exceeds the limited configurations provided within the BS 6262-3 design charts.

Under permissible stress design, loads provided by BS 6262-3, BS 6399-2 [2] and/or BS EN 1991-1-4 [3, 4], would be used as working loads and applied, unfactored, when determining stress and deflection generated.

ALLOWABLE STRESS

Detail on the mechanical properties, failure modes and theoretical strength of glass is provided in a separate document. To simplify the determination of the ability of glass to withstand applied loads, the allowable stresses for glass are predominantly dependent upon the type of glass and the duration of a load, and factored as such.

BS 6262-3 provides no guidance on glass strength, as such alternative sources, such as German TRLV [5] guidelines can be considered.

TRLV GUIDANCE

German guidelines TRLV (Technical Rules for the Use of Line Bedded Glazing) [5] provides the following allowable stress limits;

Table 1 - TRLV Permissible Stresses

Glass Type	Permissible Stress (N/mm^2)
	Vertical Glazing
Thermally Toughened Float Glass	50
Thermally Toughened Patterned Glass	37
Enamelled Thermally Toughened Float Glass*	30
Heat Strengthened Glass	29
Enamelled Heat Strengthened Glass*	18
Annealed Float Glass	18
Annealed Patterned Glass	10
Laminated Annealed Float Glass	22.5

* Permissible stress of enamelled surface.

STRUCTURAL USE OF GLASS

Additional recommendations for allowable stresses are provided in Structural Use of Glass [6], which defines values based on load type and glass type;

Table 2 - IStructE Permissible Stresses

Load Type	Load Example	Glass Type Allowable Stress (N/mm^2)	
		Annealed	Thermally Toughened
Short Term Body Stress	Wind	28*	59
Short Term Edge Stress	Wind	17.8*	59

* Valid for annealed glass greater than 10 mm nominal thickness. For 6 mm nominal thickness glass, values may be multiplied by 1.4.

LIMIT STATE DESIGN

Limit state design is discussed in **CLIMATIC LOADS 3D**, as the methodology is complex and applicable to both vertical and overhead glazing.

REFERENCES

[1] British Standards Institute, *BS 6262-3:2005 - Glazing for buildings. Code of practice for fire, security and wind loading,* BSI, 2005.

[2] British Standards Institute, *BS 6399-2:1997 - Loading for buildings. Code of practice for wind loads,* BSI, 1997.

[3] European Committee for Standardization, *EN 1991-1-4:2005+A1:2010 - Eurocode 1. Actions on structures. General actions. Wind actions,* CEN, 2005/2010.

[4] European Committee for Standardization, *NA to BS EN 1991-1-4:2005+A1:2010 - UK National Annex to Eurocode 1. Actions on structures. General actions. Wind actions,* CEN, 2005/2010.

[5] Deutsches Institut für Bautechnik, *Technische Regeln für die Verwendung von linienförmig gelagerten Verglasungen (TRLV),* DIBt, 2006.

[6] M. Haldimann, A. Luible and M. Overend, *Structural Use of Glass,* IABSE, 2008.