

### Purpose

The Australian Glass Group issues technical bulletins to provide clarity on a range of technical aspects of high performance glass, including glass properties, performance, application and other interest areas

### Deflection in Glass

*This technical bulletin is set out to define deflection in glass and its effects, characteristics and limits in respect to glass & window panel design within relevant standards.*

#### Deflection Definition:

In engineering, deflection is the degree to which a structural element is displaced under a load. It may refer to an angle or a distance.

Source Wikipedia.org

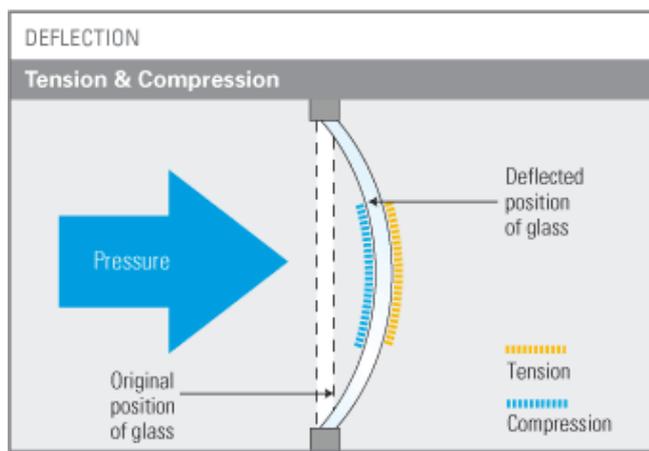
#### How is deflection a factor in glass / panel design?

Glass is able to deflect under load to reasonable levels easily, however also being a brittle material, if deflection exceeds the material's ability to resist, the material fractures.

In addition, a glass panel's strength can also be adversely affected by edge and surface faults, seeds or other small scars from handling, which can also adversely affect the ability of the product to resist failure under load and deflection.

It is also important to note that heat treatment (i.e. toughening) of glass does not change the deflection characteristics of glass.

Being a brittle material, it is vital that panel deflections are not exceeded and placed into openings where they are at risk of breakage if deflection limits are exceeded.



#### AS1288-2006 Glass in Buildings – Selection and installation

The BCA (Building Code of Australia) adopted the Glass Standard AS1288-2006 Glass in Buildings - Selection and installation. Glass selected within the parameters of the standard are considered as “deemed to comply” and require no further certification or engineering other than they fall within this standard.

## Deflection clauses within AS1288-2006 Glass in Buildings – Selection and installation

Section 3 of AS1288-2006 defines material characteristics and principles for glass for use by engineers when designing glass and glazing applications. It includes strength factors for glass types, thickness tolerances and...included within these defined principles is a limitation upon safe deflection of glass.

### Refer extract from AS1288-2006 Glass in Buildings – Selection and installation, Section 3.3.3

*Glass shall be designed for the serviceability limit states by controlling or limiting deflection.*

*The maximum deflection for all glass under serviceability limit state actions shall be limited to –*

*a) Span/60 for two, three or four edge supported panels : or*

*b) Height/30 (or cantilever length/30) for cantilevered panels such as cantilevered structural glass balustrade.*

*Glass designed in accordance with Section 4 and other relevant sections, as appropriate, is deemed to comply with the requirements of this clause.*

What does this mean?

Span is the dimension between supports. For panels supported on all four edges, it corresponds to the smaller of the sight size dimensions. So as an example for a 4 sided supported panel, 2000mm x 1000mm, a maximum deflection limit allowable is 16mm. If loads applied enable this to be exceeded, we cannot use it and we need to choose a thicker glass. This is the basis behind the many wind-load charts within section 4 of AS1288-2006 Glass in Buildings – Selection and installation, and the supplementary tables for this section.

With respect to balustrades, if we have a cantilevered application, we can only choose glass types which do not exceed height/30. For example, using a panel, continuously fixed along its base and with a cantilever height of 1000mm, the top edge of the glass is not allowed to deflect more than 33mm.

So in summary, for general glazing applications, allowable deflection for glass design is limited to the above factors. This is relevant for those load conditions the glazing needs to resist, such as wind load or others as set out within the loading standard AS / NZS 1170.2:2001 Part 1 & 2.

For determining glass choices for wind load, this deflection limit is a key factor. When referring to the wind-load charts to determine glass thickness, the glass solutions set out will already allow for this deflection limit.

### Deflection limits on frames

We would also note that deflection of frames within which glass is to be installed are separately considered and are understandably much more stringent. This is again referenced within the design criteria of AS1288-2006, section 3.5.

Deflection limits for frames are set out with AS2047-1999 Windows in Buildings – Selection and installation, which covers windows in buildings or there is a frame factor of span/150 where applicable

### Aesthetics and allowable deflection

In consideration of all of the above, we occasionally receive queries from clients concerned over large deflections observed in larger, typically squarer panels (especially in respect to Insulated glass units). Clauses within AS1288-2006 also allow us to increase allowable areas for a given thickness of glass when installing Insulated Glass Units (IGU's).

Referencing AS1288-2006, Section 3.4.2 when specifying IGU's, we are allowed a factor of 0.625 against ULS and SLS loads, which effectively increases allowable areas of a given thickness of glass. This is also referenced in Section 4.2 within the wind load section. Basically both panels are allowed to share the allowable load, increasing allowable spans

Similarly within AS1288-2006 Glass in Buildings – Selection and installation, Section 5 – Criteria for Human Impact safety.

We refer to Section 5.22, where, assuming both components of an IGU are the same, we are able to multiply the deemed to comply solutions within the tables in this section by a factor of 1.5.

For Example, if using a 4mm Toughened Product, in reference to table 5.1 (Maximum areas of safety glass) we have a single glazed maximum area of 2.2m<sup>2</sup>. This clause 5.22 allows us potentially to increase this to a maximum area of 3.3m<sup>2</sup>, assuming wind load allowances are also considered. Potentially this makes for quite a large unit, which will clearly deflect.

***When choosing thinner glass make-ups, particularly within IGU's it is important that designers and owners are aware of this, and if deflection is considered excessive, a thicker glass should be selected.***

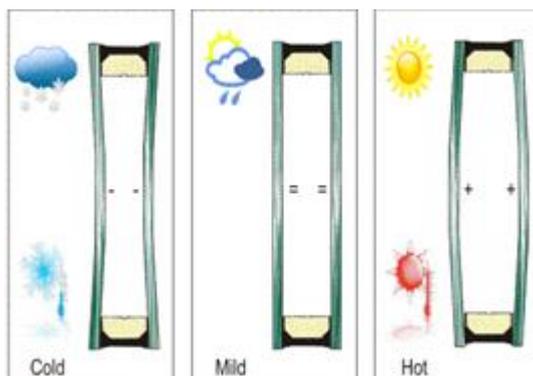
### Other relevant Standards

#### **AS/NZS 4667:2000 – Quality requirements for cut-to-size and processed glass**

There is no guidance within this standard for us to fall back on if clients are questioning levels of deflection within glazed panels. Assuming deflection of any panels in question is within the allowances of AS1288-2006 as previously outlined, there is no other defined resolution.

#### **AS/NZS 4666:2012 – Insulating Glass Units**

Within Appendix D of this standard, the opening paragraph (D1) deals with deflection and reflection. In brief, due to the sealed airspace within an IGU, changes in relative air pressure can give cause for glass to deflect either in or out. In addition, we are also looking through 4 glass surfaces, (as opposed to 2 in a single glazed panel). The airspace and extra glass surfaces effectively give a double reflection and potentially a high level of visible distortion. This clause recognizes this and notes:



**These distortions are an inevitable consequence of the laws of physics and cannot be eliminated.**

Other areas of deflection relevant to within the IGU standard include:

**Appendix E : E6.4** - Unsupported edges and the awareness of edge deflection on unsupported edges and the effects of deflection of the edge seals.

**Appendix H : Internal Colonial bars.** Awareness of the effect of deflection and potential for glass to touch internal bars inside the airspace.

**Should you need any further information or wish to discuss the contents of this bulletin, please contact your local Account Manager or our Technical Services Manager Mark Collins on 0413 904 343**

#### Disclaimer:

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