New version of glass strength standard is major departure

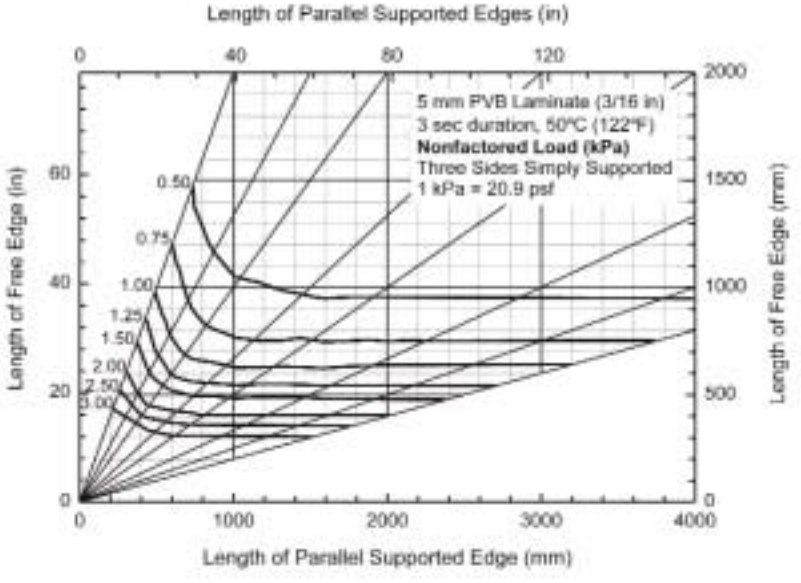
ASTM E1300, a work in progress, guides design and compliance

By Valerie Block

Flat glass standards address a wide range of quality and performance issues. They may describe the physical characteristics of glass or present methodologies for verifying acceptable performance under specific conditions.

ASTM E1300, Standard Practice for Determining Load Resistance of Glass in Buildings, often referred to as the "glass strength" standard, is under continuous development by a task group of industry experts who meet four times a year to discuss old and new issues, questions, and research related to glass strength.

A new version of ASTM E1300 has just been introduced, and it is a major departure from earlier editions of the standard. Before getting into the changes, however, let's look at the standard.



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Currently, ASTM E1300 addresses monolithic, laminated, and insulating glass constructions exposed to a uniform lateral load of short or long duration for a specified probability of breakage. The standard does not apply to glass with surface and edge treatments that alter the glass strength, such as wired, patterned, etched, sandblasted, drilled, notched, or grooved glass.

While ASTM E1300 is based on a determination of glass resistance to uniform lateral loads, the standard clearly notes that final glass thickness and type of glass will depend on a variety of factors, including thermal stresses, spontaneous breakage of tempered glass, effects of windborne debris, excessive deflections, considerations set forth in building codes, safety glazing requirements, and other site-specific concerns.

Design professionals use this standard to show compliance to building code regulations. Building code officials use the standard to verify compliance with applicable codes. And glass manufacturers, fabricators, and installers use it to assist their customers in selecting proper glass thickness.

Early Years

When the standard was first finalized in the mid 1990s, its 12 curved-line charts were received with mixed feelings. One straight-line chart that included all glass thicknesses seemed so much easier to understand and use. However, the proponents of ASTM E1300 convinced the industry, designers, and code officials of the technical merits of the new standard. The three model codes—BOCA, ICBO, and SBCCI—replaced the old straight line chart with the 12 new curved-line ones, and adopted the glass factors that were part of ASTM E1300. The International Building Code (IBC) and the recently adopted Florida Building Code followed this precedent.

ASTM E1300 assumes that the:

- Glass is free of edge damage and is properly glazed.
- Glass has not been subjected to abuse.
- Surface condition of the glass is typical of in-service glass.
- Glass edge support and system limits lateral deflections of the supported glass edges to less than $^{L}/_{175}$ of their lengths.
- Center of glass deflection will not result in loss of edge support.

The 2002 Version

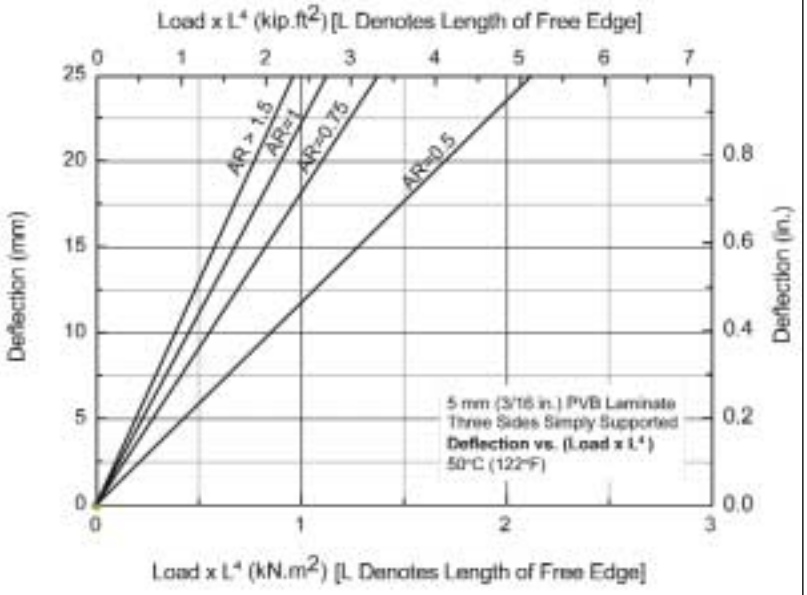
The 2002 version of ASTM E1300 is a major departure from earlier editions. The ASTM E1300 Task Group has expanded the standard in response to the needs of users. However, while the standard still only applies to glass of rectangular shape, the assumptions have changed to reflect the standard's expanded nature. The standard now addresses two-, three-, and four-sided support conditions where the edges are assumed to be simply supported and free to slip in plane. Glass edge support on two sides is assumed to behave as a simply supported beam, and glass supported on one side is assumed to behave as a cantilever.

The charts have been expanded to show aspect ratios up to 10. From the original 12 charts, the standard now has more than 80. Where the standard first concentrated on rectangular shapes of monolithic glass supported on four sides, it now includes charts for three-, two-, and one-sided support conditions. In addition, a companion deflection chart that enables the user to determine the approximate maximum lateral deflection accompanies each non-factored load chart.

The factors for glass laminates also have been deleted, and a new series of non-factored load and deflection charts for glass laminates has been added. As more research has been conducted on the strength of laminated glass, the task group has been able to incorporate this information into the standard.

Insulating glass is separated into several types—those units with monolithic glass lites of equal (symmetric) type and thickness, simply supported continuously along four sides; those with one monolithic lite and one laminated lite under short or long duration loads; and those with laminated glass over laminated glass under short or long duration loads.

Following the American Society of Civil Engineers (ASCE), the 2002 version of the standard has made the shift from 60-second to 3-second duration loads. However, an appendix in the ASTM E1300 standard presents additional load duration factors from three seconds up to beyond one year for the user. In another appendix, further instructions are given on combining loads of different duration.



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The standard does not consider all design situations. For situations not addressed by the standard, users are advised to retain a design professional who will use engineering analysis and judgment to determine the load resistance of the glass.

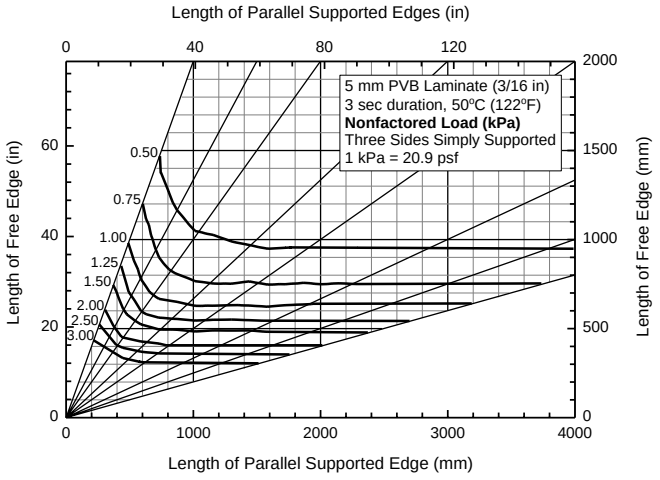
Key Concepts

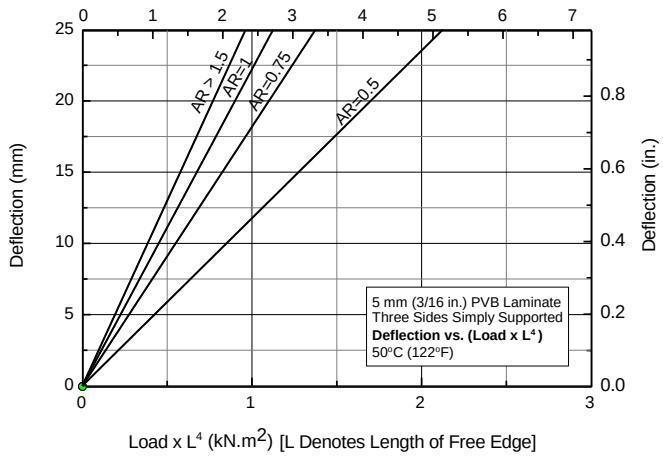
There are several key terms that are used in ASTM E1300. They are:

- *Glass type factor*. This is defined as a multiplying factor for adjusting the load resistance of different glass types.
- *Specified design load*. This is the magnitude in pounds per square foot, type of load (wind or snow), and duration of the load given by the specifying authority.
- *Load resistance*. This is the uniform lateral load that a glass construction can sustain based on a given probability of breakage and load duration.
- *Non-factored load*. This is the three-second duration uniform load associated with a probability of breakage of less than or equal to eight lites per 1,000 for monolithic glass.
- *Load share factor.* This is a multiplying factor derived from the load sharing between the two lites, of equal or different thicknesses and types.

Using the Standard

While many users rely on software created to perform the necessary calculations, others elect to cal-





Software is available to make the E1300 calculations for determining proper glass choice.

culate load resistance of glass by hand. ASTM E1300 directs the user to perform the following calculations:

Step One. The specifying authority or design professional provides the design load, the rectangular glass dimensions, the type of glass required, and details showing that the glass edge support system meets the stiffness requirements ($L/175$).

Step Two. Determine the non-factored load from the appropriate monolithic or laminated chart.

Step Three. Determine the glass type factor from Tables 1 or 2.

Step Four. Multiply the non-factored load by glass type factor to get load resistance.

By multiplying the non-factored load from the glass charts by the relevant glass type factor and load share factor, the user will get the load resistance associated with a breakage probability less than or equal to eight lites per 1,000. The load share factor is used with the glass type factor and the non-factored load charts to give the load resistance of the insulating glass unit, based on the resistance to breakage of one specific lite only.

Step Five. Determine the approximate maximum lateral center-of-glass deflection. (For one-side supported glass, determine the approximate lateral deflection of the free edge opposite the supported edge.)

Step Six. If the load resistance is less than the specified load, then other glass types and thicknesses may be evaluated.

Future of ASTM E1300

Because glass strength is important to the design of a building, both in terms of structural performance and building code compliance, ASTM E1300 has been widely used and referenced. While some users have expressed a desire for a more simplified approach to determining glass strength, most agree that the additional charts are helpful because they provide needed guidance and information in areas not previously covered by the standard.

One subject now being considered by the task group is the equivalency of other types of laminated glass interlayers to laminates made with polyvinyl butyral (PVB). The task group intends to provide guidance on this subject in future editions of the standard as a means of enabling designers, building code officials, and the industry itself to better understand the critical performance issues that surround the use of glass in buildings. g

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To order or download a copy of ASTM E1300-02, visit the ASTM Web site at www.astm.org.

For information on compatible software, visit the Standards Design Group Web site at www.standardsdesign.com.

If you have a specific question about the standard, direct it to the author at valpgmc@comcast.net.