Thin glass in membrane-like structures – applications, modelling and testing

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Abstract

With the recent advances in development of thin glass for consumer electronics, and improved glass prestressing technologies, it is now possible to create structures where the glass withstands significant biaxial deformation acting as a membrane. Such applications potentially include cable net structures with form-following flexible glass skins, pressurized glass elements (pneus), and biaxially curved laminates.

The paper presents the currently available thin glass products and their potential applications, as well as prestressing and lamination technologies. Applications of thin glass in membrane-like structures are presented that have been developed and built at our institute, including a thin glass covered cable net structure built for the glasstec fair's "glass technology live" exhibition in October 2018 and recent improvements of this design. It will also look at the possibilities of inflatable glass elements (pneus) and the advantages of biaxially cold bent thin glass.

A method of modelling glass membrane structures using a combination of parametric design, mechanical models and finite element calculations is presented.

It also includes experimental testing of membrane-acting glass. As described in our 2017 IASS paper [1] both the uniaxial four point bending test and the biaxial double-ring bending test according to EN 1288 do not work for thin glass due to large deformations and membrane stresses. Therefore, new test setups for evaluating both edge and surface strength of thin glass are presented including strength test results using the new equipment.
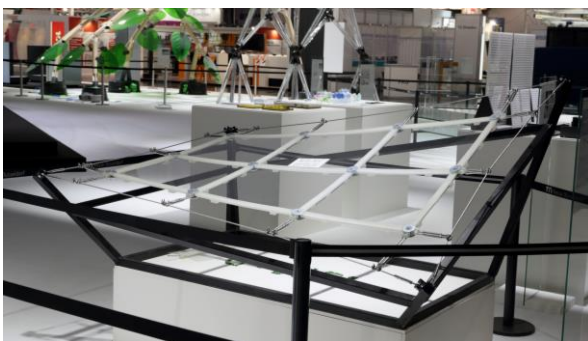
Figure 1: first prototype of biaxially curved thin glass cable net

Figure 2: thin glass during uniaxial bending test

References

[1] J. Schneider, J. Neugebauer, M. Schuster and T. Peters, "Cold-bent thin glass laminates for architectural applications: Computational design and material modeling". In: Proceedings IASS (Hamburg, Germany) 2017