Numerical buckling analysis of geometrically imperfect glass panels under biaxial in-plane compressive/tensile loads

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Abstract

Modern architectural applications are frequently developed on the esthetic requirements of transparency and light that find good correspondence in the use of structural glass elements. Glass panels, for example, are widely used in the construction of domes, roofs, façades or frameworks in which, in conjunction with metallic bearing structures, they allow the realization of fascinating buildings. At the same time, they could be subjected to in-plane loads or multiple interacting actions that, in combination with high slenderness ratios, possible imperfections, limited tensile strengths and brittle behaviour could put forward their collapse. Because of these reasons, numerous authors recently focused on the experimental, analytical, numerical analysis of the load-carrying behaviour of glass panels under various loading conditions. In this paper, the buckling response of simply supported glass panels, affected by initial sine-shaped geometrical imperfections and subjected to various combinations of in-plane biaxial compressive/tensile loads, is investigated by means of large series of numerical simulations. The effects of various aspects (geometrical imperfections, slenderness ratio, boundary conditions, aspect ratio, biaxial loading ratio) are highlighted. Finally, a normalized interaction resistant domain is proposed for a possible verification approach.

Keywords: simply supported monolithic glass panels; uniaxial in-plane compression; biaxial in-plane compressive/tensile loads; interaction resistant domain; buckling verification approach.

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