Non-destructive, Photoelastic Quality Control for Large-format, Thermally Toughened Glass

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Abstract

Currently, the quality control of thermally toughened glass is carried out through destructive tests on standardized small-format glass panes to ensure fracture pattern and bending strength. However, these tests are costly and time-consuming. To reduce the need for such tests and enable non-destructive quality control of the residual stresses, photoelastic measurement methods for surface stress and edge stress offer a promising alternative. Previous studies have established correlations between photoelastic measurements and destructive tests, defining limits to ensure the mechanical properties of thermally toughened safety glass, but only for standard size format specimens. Therefore, experimental tests were carried out on 3,000 mm × 1,000 mm glass samples to determine surface stress, edge stress and fracture pattern. Particular attention was paid to comparing the photoelastic results of large-format specimens which were produced under the same cooling settings as the standardized small format specimens. The aim of this work is to verify limits from standards and literature on large-format specimens to evaluate whether non-destructive measurement methods can provide reliable results for quality control. By analyzing contingency tables, this study demonstrates that the limits of the standards poorly identify non-conforming thermally toughened glass, whereas the limit values from literature perform well in this regard but also reject some unnecessarily conforming glass. These findings provide insights into the suitability of photoelastic methods for sustainable and efficient quality control of large-format thermally tempered glass.

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Keywords

Thermally Toughened Glass, Photoelasticity, Surface Stress, Edge Stress, Quality Control

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