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Glass Failure Prediction Model for Out-of-Plane Bending of Waterjet-Drilled Holes

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Abstract

Use of fully tempered (FT), point-supported glass (PSG) as structural elements has become increasingly common. However, current US glass design charts and analytical methods found in ASTM E1300 are only applicable to rectangular lites with continuous line supports along one or more edges. As a result, practitioners use finite element analysis to determine maximum principle stress that dictates glass thickness. However, sole reliance on the single largest maximum principle tensile stress (SLMPTS) may not always be representative of actual performance as surface flaws often precipitate failure at lower stresses and different locations from the SLMPTS. This paper analyzes the experimental data for 10 FT specimens with waterjet holes subject to out-of-plane bending. Experimental time histories are converted to the to 3-second failure loads for determination of best fit m- and k- values for use with the glass failure prediction model to determine stresses for a probability of breakage of 1 in 1,000 and 8 in 1,000 lites.

Keywords: point supported glass; failure prediction model; fully tempered; allowable stress.

1 Introduction

Through-bolted, point-supported glass (PSG) is frequently used in modern facades for structural purposes. However, current US design standards (e.g. ASTM E1300[1]) are not applicable to point-supported structural glass and the lack of clear design criteria for PSG applications hinders wider usage. In an effort to provide meaningful design criteria to engineers and architects alike, this research applies a statistical glass failure prediction model (GFPM) to experimental stress data to provide design strength results for PSG specimens that provide a probability of breakage (POB) of 1 in 1,000 and 8 in 1,000, respectively. Experimental data includes load-time histories, ultimate stresses and stress distributions from experimental results of 10 fully tempered (FT) glass specimens. GFPM results are intended to 1) allow practitioners to benchmark designs for FT monolithic glass based

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