

Glass as a Structural Material: Post-tensioned Glass T-Beam

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Abstract - Glass, traditionally, is used in buildings as windows because its strength capacity in windows is not significant. However, there is more demand for usage of glass such as beams, columns and decks. Glass' brittle nature has hindered its use as a strength carrying member. Aesthetics, recyclability, and transparency are the main reasons of the interest for glass in structural field. Moreover, glass may show significantly more benefits for certain types of projects such as historic building preservation and aesthetic buildings and bridges, where envelopments with minimal visual interruption are needed. However, more research should be done to be able to meet the demands and benefit from the advantages of glass. This study aims to contribute to the literature of structural glass and enhance the use of glass as a structural material, so a T-shaped glass beam is studied to develop a proper and safe design. Since glass is a brittle material and has high compressive strength and lower tensile strength, a T-beam is post-tensioned in order to increase its initial fracture capacity and obtain ductile post-fracture performance. Several material tests are conducted to confirm the theoretical mechanical properties of glass as a material under compression and bending (indirect tension). After obtaining mechanical properties of the glass to be used in research, Finite Element Models (FEMs) of the T-beams were generated and analytical hand calculations were done for the same types of glass beams. Tests of T-shaped annealed (float) glass beams with and without post-tensioning were conducted. The results of the experiments were compared with the analytical hand calculations and FEMs. In this study, a glass T-beam was post-tensioned and its initial fracture capacity was increased. This resulted in a more ductile post-fracture performance, which would avoid sudden collapse and provide a safer fracture performance.

Keywords: Post-tensioned Glass Beam, Glass as a Structural Material, Glass Beam, Glass T-Beam