

# **Analytical and Experimental Investigation of Post-tensioned Tempered Glass T-Beams**

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**Abstract** - Construction materials used for buildings and bridges show significant changes during the course of last centuries. While stone, bricks, adobe, and timber had traditionally been the main construction material, the 20<sup>th</sup> century has been dominated by reinforced concrete and steel especially for tall structures. Strength, ductility, and unit weight are the major concerns in structural design, while appearance is more important from architectural point of view. Recycling is becoming more important from sustainability and environmental aspects. Glass being brittle in nature has always raised concerns to be used as a structural material. However, recent studies show that glass may become a structural material with its high compressive strength in the order of 400 MPa to 800 MPa accompanied by large bending induced tensile strength in the order of 120 MPa when tempering is used. This opens new possibilities for architectures and civil engineers: recently staircases, pedestrian bridges, and larger window glasses are being used. This study focuses on using tempered glass with post-tensioning, which is a carefully engineered technique to use an exquisite material glass in structural engineering for beams and columns. Tempering causes outer layers of glass to be evenly compressed while being in equilibrium with internal forces at the core as tension. Especially bending stresses are well tolerated in tempered glass panels. This study focuses on post-tensioned glass for theoretical design and laboratory loading experiments on T-beams. Hand calculations for post-tensioned tempered glass beams (PTTGB) had good correlation with FEM and test results. The ultimate capacity of tempered glass beams are much larger than regular glass beams but brittle behaviour at failure requires larger safety margins; furthermore, plastic coating or lamination is needed to prevent small glass pieces to shatter around.

**Keywords:** tempered, glass, beam, test