STABILITY & RESISTANCE OF HYBRID GLASS STRUCTURES UNDER SEISMIC & TEMPERATURE LOADS

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Abstract

Glass structural members usually have thinner cross sections compared with other construction materials. This raises stability and failure issues. This paper examines numerically a glass one-storey pavilion in high seismicity zone. The stability, seismic and temperature resistance of the structure depend heavily on the brittle nature and the type of glass. The structural body of the pavilion consists of moment frames assembled by columns and beams, assuming a glass diaphragm roof at the top level of the building. For each structural member a combination of different glass types is assumed in order to achieve an optimization of performance and failure pattern. A base isolation system is also considered. Proper finite element models were used to represent the composite cross sections. The combination of the different glass types, permits forming stable and resistant hybrid composite structures reaching the EC's target safety levels, avoiding immediate collapse.

Keywords: hybrid glass structures, public building, seismic design, temperature load, base isolation

1 Introduction

Glass is always a dominant structural material for the facades due to its transparency and its high strength both in compression and tension [1,2]. Nowadays its use in buildings has changed. Apparently, the evolution of the material's properties in combination with the high esthetical value are the main reasons of a new architectural trend, known as "Transparent Buildings" [3,4].

Hybrid and composite structural glass have been fashioned in order to avoid the brittle failure of glass [1,5]. Current research has shown that a combination of different materials e.g., steel or wood and other types of interlayers within the glass cross-section, is possible to shift the failure of the material from brittle to pseudo-ductile without affecting the transparency [1,5].

The elastic and brittle nature of glass makes the proper design under seismic, and temperature loads challenging. So far, only a few design codes or guidelines exist regarding such buildings with extensive details [1,6]. The aforementioned loads could be crucial in their response, since seismic actions cause increased stress states that can lead to collapse, whereas temperature loads have a strong effect on the delamination of the glass cross-section [2,7].

This paper examines the influence of the temperature difference on the stability and the response of a glass pavilion. The response of the structure in temperature difference is considered in combination with its response under the seismic action. The seismic response of the pavilion was numerically investigated in previous research of Achillopoulou & Stamataki 2021 [8].