CESARE'22
3rd Coordinating Engineering for Sustainability and Resilience
May 6th – May 9th, 2022, Irbid, Jordan
ISSN:2788-6204

STRUCTURAL STABILITY STUDY AND DESIGN OF STEEL-GLASS COMPOSITE STRUCTURES UNDER EARTHQUAKE ACTIONS

Nikolaidis Th.[1], Papaevangelou S[1], Baniotopoulos C. C.[1,2]
[1]Institute of Metal Structures, Dept. of Civil Engineering, Faculty of Engineering,
Aristotle University of Thessaloniki
Thessaloniki, GR-54124, Greece
thnik@civil.auth.gr; pspyridou@civil.auth.gr; ccb@civil.auth.gr

[2]School of Engineering, University of Birmingham
B15 2TT Birmingham, United Kingdom
c.baniotopoulos@bham.ac.uk

ABSTRACT

The present paper studies the structural behavior and the necessary design aspects of steel and structural glazing composite buildings in areas with high seismic risk. In recent years, the great progress in the design of specialized types of glass structures reinforced with metal frames due to their high architectural impact created the need of additional design requirements against seismic action. A structural glass system when exposed to intense seismic conditions could experience significant damage that would reduce its bearing capacity and downgrade the life safety level. Thus, the enhancement of the stability and the structural performance of such structures subjected to seismic actionscould lead to an optimal configuration of the composite of steel and glass structural system.

In the present study individual design specifications according to the Eurocodes Framework and Normative special guides are assesed, and a methodology to evaluate the earthquake resistance of composite buildings with structural systems of steel and structural glazing is proposed. This methodology is applied toa case study and in particular, to the design of an Orthodox Church constructed with a load bearing system of steel and glass. The overall system of the building has been numerically simulated using SCIA Engineer Software by a complex 3-D FEM model. This model includes all the structural steel frame elements as well as multiple laminated glass shell elements.

The principal focus of the study is the structural stability of the system considering the interaction of glass facades with the steel elements during intense seismic conditions, taking into account specifications for the resistance of a single structural glass member according to the CNR-DT 210/2013-Guide. Applying the proposed method a satisfactory percentage overlay could be achieved by choosing the right material distribution of structural glass that leads to a safe increase of the load-bearing capacity of the steel members, leading to less material usage of steel and increasing the transparency of the building.

References

[1] K. Haaruis, T. Wever, *Glass-reinforced steel structures,* Glass Struct. Eng. (2016), Springer, pp.195-203, 2016, *Vol. I, 4th Edition*, McGraw Hill, 1989.
[2] Baniotopoulos C.C., Nikolaidis Th., Moutsanidis, G., (2016), *Optimal Structural Design of GlassCurtain Wall Systems*, Proc. Institution of Civil Engineers (ICE) - Structures & Buildings, Vol.169 (6), 450-457.