CESARE'22

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

NUMERICAL AND EXPERIMENTAL STUDY OF STEEL BEAM TO COLUMN CONNECTIONS UNDER DYNAMIC LOADING IN LOW-RISE PREFABRICATED MODULAR BUILDINGS

Nikolaidis Th.[1], Ziakis I.[1], Papaevangelou S[1], Katakalos K.[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; ioadimzia@civil.auth.gr; pspyridou@civil.auth.gr; kkatakal@civil.auth.gr; ccb@civil.auth.gr

[2]School of Engineering, University of Birmingham
B15 255 Birmingham, United Kingdom
c.baniotopoulos@bham.ac.uk

ABSTRACT

In the present paper the behavior and the structural performance of steel beam to column connections is investigated for an innovative type of low rise prefabricated modular building system. The load bearing system is composed by lightweight steel frame members connected with double-shell composite walls that play the role of smart façade elements. Aiming to obtain a clear perspective of the dynamic performance of the system, a series of experimental and numerical tests of critical structural details such as the steel joints of the systems has been carried out. Two alternative types of steel beam to column specimens consisted of welded and bolted parts with differences in rigidity were tested in quasi-static cyclic loading in order to investigate their bearing capacity, as well as their hysteretic behavior.

Using ANSYS software a three-dimensional nonlinear FEM model was developed and validated comparing the respective numerical results with the experimental results from the tested specimens. The same quasi-static cyclic loading history scheme was applied both for the numerical models and the test specimens to register the critical issues of the joint components under investigation. The obtained experimental and numerical results are presented and discussed in terms of moment-rotation response, failure mode, load-bearing capacity, ductility, and energy dissipation capacity. Moreover, the developed numerical models were used for the evaluation of the structural response of the system and for the optimization of the cost, the shape and the bearing capacity of the joint. With regards to energy dissipation capacity of the system under investigation, it is obvious that both the tested specimens as well as the respective numerical models absorb a significant amount of energy from the overall steel frame system of the composite modular structure.

References

[1] Baniotopoulos C. C., Wald F, (eds), *The Paramount Role of Joints into the Reliable Response of Structures. From the Classic Pinned and Rigid Joints to the Notion of Semi-rigidity*. Kluwer, Dordrecht, 2000.

[2] Nikolaidis Th, Vitalis T, Baniotopoulos C C, *Analysis of Thermal and Buckling Behaviour of Double-Shell Composite Wall Exposed to Fire*, Proc12th Inter Congres on Mech. 12HSTAM, Thessaloniki, Greece, 2019.