

Punching behaviour of R/C flat slabs with openings under seismic loading

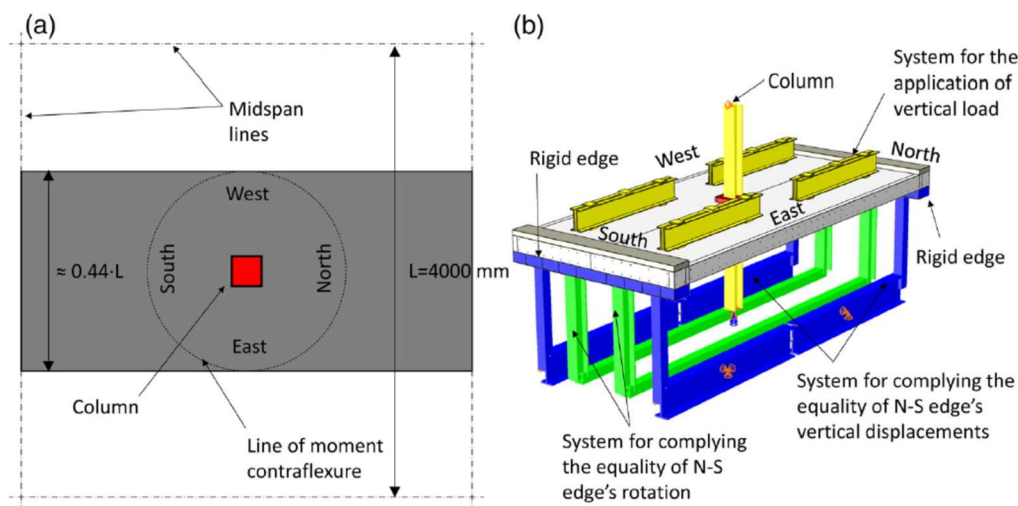
Summary

Flat slabs are widely used in many countries thanks to their economic and functional advantages. Although simple in appearance, a flat slab system presents a complex load bearing behaviour, especially in slab-column connections. The punching strength is an important subject in the design of flat slabs, frequently it is the conditioning factor in the thickness design. Nevertheless, the behaviour of flat slabs under the combination of gravity and seismic actions is still not sufficiently studied by the scientific community. The European Code EN1998-1, in 5.1.1(2)P, states: "Concrete buildings with flat slab frames used as primary seismic elements in accordance with 4.2.2 are not fully covered" by the EC8 section on concrete structures. This statement results from the lack of knowledge about the stiffness of slab-column connections and the brittleness of the punching failure. It is also the consequence of insufficient knowledge about the behaviour of slab-column connections under seismic actions. These lacks highlight the need for further research on the punching strength of slab-column connections under cyclic and dynamic horizontal loading.

This research is focused on the seismic response of flat slabs with openings adjacent to the column. The lateral response of slab-column joints in presence of an openings close to the column is poorly investigated. An important part of this work consists in the experimental activity including six specimens 4.15 x 1.85 m with a thickness of 15 cm. Numerical analysis is also included in this research, starting from the experimental results a numerical model is developed in order to predict the behaviour of continuous slab under combined vertical and horizontal loading.

Keywords

Flat slab, punching, seismic behaviour, cyclic loading, openings.



Lisbon setup: (a) idealized flat slab and specimen dimensions (b) Numerical Model.



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Period

2015-2019

Funding

Borse Pegaso Regione Toscana 2016 – Corsi Internazionali di Dottorato