Rocking behaviour of prefabricated concrete frames subjected to earthquake action

H. Degée, V. Denoël
University of Liège, Department ArGEnCo,
Chemin des Chevreuils, 1, 4000, Liège
e-mails: {H.Degee,V.Denoel}@ulg.ac.be

Classical portal frames made of prefabricated concrete elements are usually designed assuming that column-bases are encased in the foundation and that beam-to-column joints behave like perfect hinges. Their seismic behaviour is thus similar to the one of a vertical cantilever beam subjected to imposed horizontal accelerations at the foundation level. The maximum acceleration level sustainable by the structure is essentially conditioned by the bending resistance of the column base.

However the actual resistance of the system can be much higher than estimated on the base of the above condition only. Indeed as soon as the connection is broken, the system starts rocking, which doesn't necessary lead to overturning since the system is stabilized by the weight of the horizontal beam.

The objective of the present study is to compare the maximum acceleration that the frame is able to sustain, whether rocking behaviour is accounted for or not. To this purpose, differential equations governing the rocking behaviour of a "dolmen-like" system are developed and solved with a classical newmark integration scheme. The impact of the size and weight of the columns and lintel is investigated and a comparison is made with a similar system where the rocking is not taken into consideration.

It appears that the maximum allowable imposed acceleration can be increased by more than 100% in some cases, but that this overstrength capacity is strongly depending on the value of the vertical loads acting on the structure.