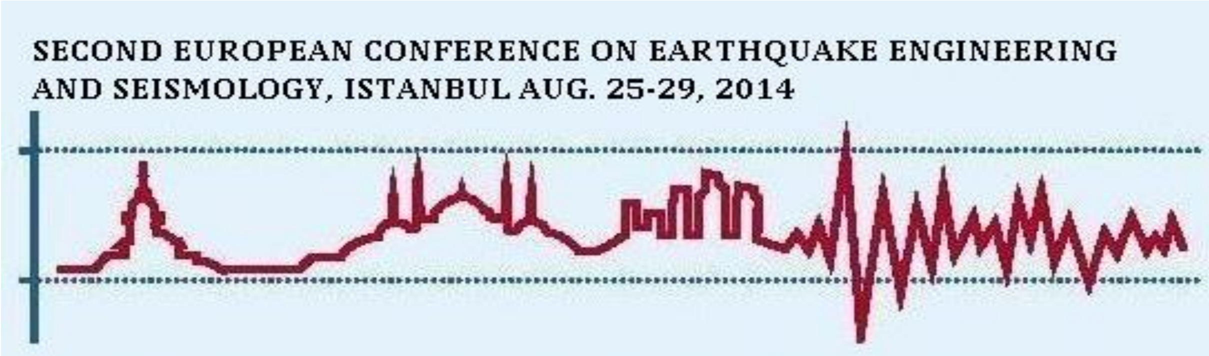

AMBIENT VIBRATION FOR UPDATING OF PERIOD-HEIGHT RELATIONSHIPS

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Fundamental periods of vibration are parameters needed both in design of new buildings and in assessment of existing ones. They can be determined through empirical relationships (e.g. simplified period-height expressions), numerical simulations (eigenvalue analysis) and experimental measurements (ambient vibration or earthquake recordings). Here we report an overview of simplified period-height expressions provided by the seismic code (e.g. CEN, 2003), by different numerical approaches applied to RC building types widely present in the European built environment considering some structural characteristics (cracking, masonry infills, elevation irregularities, etc., Masi and Vona 2010; Hatzigeorgiou and Kanapitsas 2013) and period-height relationships experimentally derived in a large number of RC building performing ambient noise measurements around the world (Navarro et al., 2007 for 39 Spanish buildings; Guler et al., 2008 for 6 Turkish buildings; Gallipoli et al., 2010 for 244 European buildings; Michel at al., 2010 for 60 French buildings; Chiauzzi et al., 2012 for 12 Canadian buildings; Pan et al., 2013 for 116 Singaporean buildings, Hanan Al-Nimry et al., 2014 for 29 Jordanians buildings). In Figures 1(a) and 1(b) some examples of period-height expressions are reported. They are related to numerical analyses on RC structural types representative of buildings without (Bare Frames, BF) or with masonry infills (Infilled Frames, IF), and experimental evaluations of T values through ambient vibration analyses based on measurements carried out using quick survey techniques (Horizontal-to-Vertical Spectral Ratio). By comparing period-height relationships obtained from these three above described approaches, large differences arise. Even when elastic values Te are considered, numerical analyses provide period values from 2 to 5 times larger than the experimental ones, respectively for infilled (IF) and bare frame (BF) types. Further, comparing both the numerical and the experimental relationships with the empirical formula currently provided in EC8 (CEN 2003) large differences are found too.

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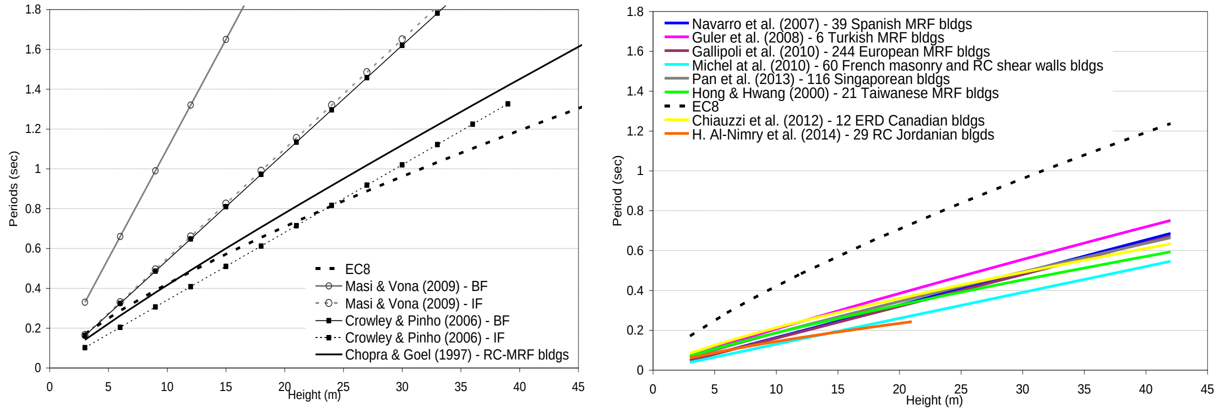

(a) (b)

Figure 1 (a) Comparison between period-height relationships from numerical models of RC MRF buildings without (BF) or with infill walls (IF) and EC8 one (CEN, 2003). (b) Comparison between period-height relationships from experimental estimations on RC MRF buildings and EC8 one (CEN, 2003).

The comparison between numerical and experimental results shows very large differences also when numerical simulations were carried out on models taking into account the role of soil-structure interaction (Hatzigeorgiou and Kanapitsas, 2013).

A possible reason for the difference between code provision and experimental measurement could be attributed to the fact that the large part of code expressions are derived from measurements performed by Goel and Chopra (1997) on a set of US buildings, while experimental measurements were performed mainly on European buildings. This difference is highlighted in figure 2, reporting data taken from fundamental period estimations on 244 European RC buildings and ones on 318 RC US buildings (Perrault and Gueguen, 2014). The EC8 relationship is much closer to fundamental periods experimentally estimated on US buildings.

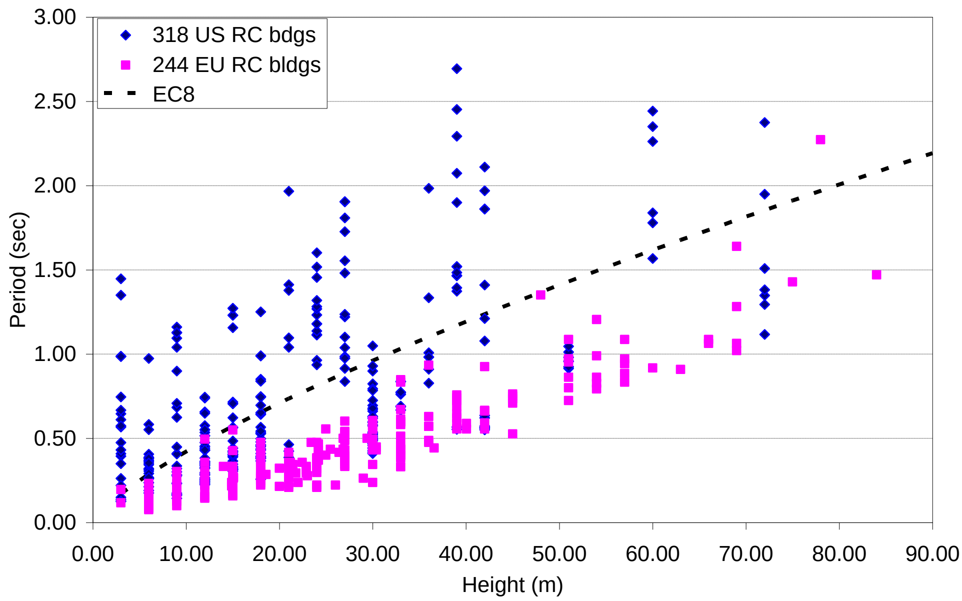

Figure 2 Comparison of fundamental period estimated on 244 European RC buildings and on 318 RC US buildings.

The comparisons carried out show that further studies, both numerical and experimental, are needed to better understand the role of the most important structural parameters on the period values of RC buildings in view of explaining the large differences between numerical and experimental values, also taking into account the peculiarities of the built environment in different countries.

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