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Effect of non-structural elements on the dynamic behaviour of moment-resisting framed structures

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Effects of earthquakes on building structures have studied from many researchers on the recent scientific and technique literature. The phenomenon is clear: inertia forces are governed from structural and non-structural stiffness and masses. The distribution of seismic lateral loads and their magnitude are strongly correlated to the fundamental period of the structure. Therefore, an accurate evaluation of the fundamental period is a crucial aspect for both static and dynamic seismic analyses. In fact, the fundamental period determines the global seismic demand through the spectral acceleration directly evaluated from the linear and/or nonlinear acceleration response spectra (provided from codes or derived from detailed analyses of site effects). Recent earthquakes highlighted the significant effects derived from the interaction between structural and non-structural elements on the main dynamic parameters of a structure and on the lateral distribution of the inertial forces. Usually, non-structural elements acts together with the structural elements, adding both masses and stiffness. Using numerical and experimental campaigns, many researchers have studied the effects of infill walls on the dynamic behaviour of buildings and several simplified models have been proposed to take into account the presence of non-structural elements within linear and nonlinear numerical models. As example, Kliner and Bertero tested a 1/3 scaled structure (moment-resisting infilled frame model) and determine its behaviour during earthquakes. They found that the infills increased the stiffness of the frame in about 5 times. Consequently, in these cases the fundamental period reduces and the inertia forces generally increases. Meharabi et al. tested a 6-storey, three bay, reinforced concrete moment resisting frame, designed according to the provision of UBC-91, and they shown that the lateral force resistance of an infilled frame was higher than that of bare frame. It was concluded that a proper design of the infills would have beneficial effects on the seismic behaviour of frames. Elouali et al. studied the effect of inflill walls on vibration periods of frames. The infill wall was modelled as an equivalent diagonal strut. It was concluded that the fundamental period of the infilled frame could be reduced in about 50 to 70% from that of the bare frame.
Considering existing mathematical models proposed in the recent scientific literature and the main geometrical and mechanical characteristics of Italian buildings, a parametric study has been conducted using several numerical analyses. Finally, a comparison between the predicted response of numerical models and the response of real structures have been done.

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