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Three-dimensional numerical modelling of site effects in the Palatine Hill, Roman Forum, and Coliseum archaeological area

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In this work we analyzed the three-dimensional seismic site response of the Central Archaeological Area of Rome, which includes the Palatine Hill, Roman Forum, and Coliseum area. The study area is characterized by complex site conditions (stratigraphy, dynamic properties, surficial and buried morphology, etc). Detailed three-dimensional large-scale model was built in order to evaluate site response using dynamic numerical modelling approach. The explicit finite□difference code FLAC3D (ITASCA Consulting group Inc., 2017) was used for numerical simulations.

The area of Rome is affected by earthquakes from different seismogenic districts: (1) the central Apennine mountain chain, located about 90–130km east of Rome (M = 6.7–7.0); (2) the Colli Albani volcanic area located 20km to the south of the city (M=5.5); and (3) the Rome area itself characterized by rare, shallow, low-magnitude events (M < 5). Both artificial and natural accelerograms were then simulated to be compatible with the reference spectra associated to the three earthquake scenarios.

This study highlights the role of local geological and geotechnical conditions producing amplification of seismic ground motion. The analyses show maximum amplification factors, defined in terms of Housner Intensity ratio for three periods range (0.1-0.5; 0.5-1.0 and 1.0-2.0), as high as 2.2–2.4 over the period range of 0.1–1.0 s. Such values can be significantly relevant for the monumental and archaeological heritage of this area, as many are highly vulnerable due to their great age. Physical phenomena controlling site response are discussed on the basis of buried and surficial morphology and lithostratigraphic conditions. Finally, microzonation maps are produced in order to ascertain the seismic hazard of the examined area and, consequently, to assess possible parameters for seismic retrofitting of the monuments.