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SEISMOLOGICAL ANALYSES AIMED AT 3RD LEVEL SEISMIC MICROZONATION OF THE 138 MUNICIPALITIES DAMAGED BY THE 2016-2017 SEISMIC SEQUENCE IN CENTRAL ITALY

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The evaluation of the seismic spectral response under earthquake excitation (i.e. the site response) represents a main step towards an accurate quantification of the seismic hazard and is a fundamental step for the highest level of seismic microzonation considered in Italy, i.e. the so-called 3rd level (MS3). The Italian Guidelines for Seismic Microzonation recommend, for the MS3, performing the assessment of local seismic response by experimental or numerical techniques based the former either on passive measures of environmental seismic noise or on strong and/or weak-motion events, while the latter on 1-D and 2-D numerical simulations, respectively. Following the destructive seismic sequence that struck Central Italy during 2016-2017, the Extraordinary Commissioner for the reconstruction, appointed by the Italian Government, promoted the MS3 of all 138 damaged municipalities, entrusting the Center for Seismic Microzonation and its applications (CMS) for the scientific coordination of the activities. The CMS organized the work into 6 transversal Thematic Units (UT), made up of experts of the individual fields, whose purpose was to investigate specific technical-scientific aspects, organize and harmonize all the existing or collected data and providehigh quality products in order to achieve the final goal. One of the 6 UTs was the Seismological Analysis Thematic Unit (UTAS). Four institutions have been involved in the UTAS: OGS - IstitutoNazionale di Oceanografia e di GeofisicaSperimentale, Seismological Section CRS, also with the role of coordinator; INGV - IstitutoNazionale di Geofisica e Vulcanologia, Sections of Rome and Milan; UNIGE - University of Genoa, DISTAV Department; and ENEA - AgenziaNazionale per le NuoveTecnologie, l'Energia e lo SviluppoEconomicoSostenibile.The mainUTAS purpose wasto providequantitative informationof the site response amplification useful for the MS3 of the localities belonging to the 138 damaged municipalities.For the analysis of seismological data, the first step was to make a census of the seismological stations (seismometric and accelerometric, permanent and temporary) existing in all the MS3 localities. Then, two buffer

areas of 1 km and 5 km, respectively, were built around eachmunicipal area (i.e. site), with the aim of selecting 1) the stations useful for the evaluation of site effects (included in the area extended with the 1 km buffer), and 2)the candidates to be set as a reference site (included in the area extended with the 5 km buffer). As a result of this procedure, 111 sites were identified as useful and then analyzed, out of a total of 247 existing stations. 109 stations were used for the evaluation of site effects (and in three cases also as reference sites) of 102 MS3localities (corresponding to about 20% of the total), while the remaining two stations were used exclusively as reference sites. At each station, four products were estimated: a) Spectral ratios between the horizontal and vertical components estimated from both earthquakes (EHV) and environmental seismic noise (HVSR) recordings; b) Spectral amplification curves, estimated by Fourier amplitude spectra or response spectra, for the horizontal and vertical components of the ground motion; these values were obtained by applying both the classical reference-site spectral ratio technique (RSSR), and the generalized inversion technique (GIT). c) Site-specific acceleration response spectraestimated by the spectral amplification curvesand the seismic input defined at each MS3locality; d) Amplification factors computed from the pseudo-acceleration response spectra for three period ranges, and amplification factors between the observed PGV and PGA and those predicted by a well-establishedGround Motion Prediction Equation. Each participant group carried out the analyses on different sets of stations using its own method. The results were harmonized and summarized into homogeneous site-specific forms, containing general (i.e. geographic, instrumental, geological, seismological) information, and the graphic representation of the four products. As a conclusion of theUTAS study, carried out in a very limited period (2 net months), a considerable set of quantitative information was delivered to CMS and authorities, providing important indications to be used for the 3rd level microzonation of thedamaged municipalities and their reconstruction. We eventually think that this experience can be taken as a reference model of technical/scientific activity for future post-earthquake interventions.