Editorial

*On 26 September 1997, at 00:33 GMT, a M_L 5.5 shock struck the Umbria-Marche region, followed 6 hours later, at 09:40 GMT, by another earthquake of M_L 5.8. By mid October, a total of 6 shocks with magnitude between 5 and 6 hit the region. In spite of the fact that the earthquake was moderate, the damage, estimated at 5 billion US dollars, was severe. The high vulnerability of many of the old buildings, although some had been retrofitted and others strengthened after the 1979 Umbria earthquake, was one of the causes of the severity of the damage [ANIDIS - SSN. 1997]. Damage was also caused by site amplification, as shown by accelerometer records in different types of soil [*Carrubba and Maugeri*, 2001] and by down-hole experiments performed in Fabriano [*Crespellani* et al., *1999]. The damage occurred not only to buildings [*Dolce and Larotonda*, this special issue], but also to geotechnical structures such as dams [*Paoliani*, this special issue], retaining walls [*Crespellani* et al., *2001] and slopes [*Guadagno and Magaldi*, this special issue]. Moreover, tourism, one of the main sources of income for the area, was completely suspended for several months.*

*To plan the reconstruction of the villages and towns hit by the earthquake, the Department of Civil protection issued a project of microzonation for the whole area. In particular the Gruppo Nazionale per la Difesa dai Terremoti [GNDT] was charged with performing a detailed microzonation investigation of three localities: Fabriano, Nocera Umbra and Sellano, all of which were heavily damaged by the earthquakes. Several research teams were involved in the project, representing a unique opportunity to check microzonation methodologies both in the light of scientific aspects [TC4, 1999] and criteria for practical application [International Decade for Natural Disaster Reduction, 1998]. The microzonation study of the town of Fabriano [*Marcellini* et al., *this special issue] may be considered a guideline for performing microzonation especially after an earthquake when the scientific validity of results must be coupled with the needs of local administrators, the principal one of which is to start reconstruction as soon as possible. Measurements for the reduction of seismic risk are also presented. These measurements should be based on an accurate evaluation of local site effects and destructive potential of earthquake ground motion [*Decanini* et al., *this special issue], as well as soil response and design spectra [*Grasso* et al., *this special issue]. Guidelines are given not only for the structural retrofitting of the ancient masonry buildings [*Borri* et al., *this special issue], but also for the retrofitting of foundations [*Grasso* et al., *this special issue].*

The special issue, devoted to the 1997-1998 Umbria-Marche earthquake, is subdivided in the following 5 parts. Parts 1 and 2 are reported in Vol. XXXV, n. 2, June 2001, and parts 3, 4 and 5 are reported in Vol. XXXV n. 4, December 2001.

Part 1 - Geotechnical and structural aspects of damage

Dolce and Larotonda report their detailed investigation of the damage in Fabriano, Sellano and Nocera Umbra with the aim of distinguishing, building by building, between structural and non-structural damage and emphasising the role played by the vulnerability of the buildings in the area. Paoliani shows that although the 1997 sequence was characterised by moderate shocks, it affected critical plants in the region such as earth dams. An overview of the whole microzonation project and the main aspects of Fabriano microzonation are summarised in Marcellini et al., *with particular attention to the methodology adopted and principal results obtained in light of practical application.*

Part 2 - The microzonation of Fabriano

Part 2 contains the research studies performed to prepare the microzonation maps, including evaluation of historical earthquake scenarios, expected ground motion, and geological and geotechnical investigation and characterisation. Then, seismic response analysis and site effect zonation of the Fabriano municipality are presented. Historical investigation plays an important role in establishing input motion, as described by Castelli and Monachesi who report on the historical earthquake scenario for the town of Fabriano. Assessment of input motion is performed using a probabilistic and stochastic approach by Franceschina et al. *and a deterministic approach by Priolo. Romanelli* et al. *also use the deterministic approach, considering both scaled and extended sources. Geological, geophysical and geotechnical inves-*

*tigations receive particular attention. Detailed geological maps are drawn and soil characteristics are studied to determine the main lithologies of the zones [*PARRONI et al.*]. Seismic investigations, based mainly on down-hole and FTAN techniques, are reported by* NUNZIATA et al. *Dynamic soil properties and soil degradation behaviour are evaluated by* CAVALLARO et al. *via monotonic and cyclic loading torsional shear tests. Site amplification from the earthquake data in Fabriano is evaluated by* MICHELINI *and* GOVONI. *The site effect zonation of the Fabriano municipality, determined by means of both the spectral ratio and Nakamura method, is reported in* TENTO et al.*; five zones are identified with different soil amplifications up to 6, in the range between 2 and 4 Hz for the Serraloggia-Spina zone. For evaluation of the design spectra for the Borgo and Serraloggia-Spina zones (which should be used instead of the Italian Building Code for the reconstruction and retrofitting of buildings in the Fabriano municipality), seismic response analysis, based on accurate and dynamic soil characterisation, is presented by* CRESPELLANI et al.

Part 3 - The microzonation of Nocera Umbra

Nocera Umbra was one of the most damaged villages in the region as described in DOLCE *and* LAROTONDA *(Part 1). It should be emphasised that Nocera Umbra was the site with the highest PGA (0.55 g) recording. Geological, geophysical and geotechnical investigations have been performed for the seismic response analysis and site effect evalitation. Detailed geological maps are drawn and soil characteristics are determined for the site microzonation of Nocera Umbra [*BOZZANO et al.*]. Seismic studies, based mainly on down-hole and FTAN techniques, are reported by* NUNZIATA et al. *Dynamic soil properties and seismic response analyses are presented by* CRESPELLANI et al. *for the evaluation of the design spectra of two sites in the Nocera Umbra municipality.*

Part 4 - The Microzonation of Sellano

Situated on top of a steep hill, the ancient centre of Sellano was completely ruined by the earthquakes. This represents an area requiring further detailed analysis by the structural engineering community of Italy, since the majority of the buildings had been retrofitted following the earthquake of 1979. Despite the non-elevated magnitude of the 1997 shocks, nearly all the buildings (including the retrofitted ones) suffered heavy damage. Unfortunately, due to the lack of recording instruments, there is no experimental evidence of the role played by site effects or source-site directivity effects. A detailed geological map, showing the complex subsoil of the old town, is reported by GUADAGNO *and* MAGALDI*; the authors also report on the permanent ground displacements and landslide phenomena caused by the earthquakes. Seismic investigations based mainly on down-hole and FTAN techniques are reported by* NUNZIATA et al. *Dynamic soil characterisation for seismic microzonation is reported by* CAVALLARO *and* MAUGERI.
Non-linear soil behaviour and empirical correlations between dynamic soil properties and SPT results are described for practical use by local engineers in the reconstruction and retrofitting of buildings in the Sellano municipality. Following the guidelines of the Manual for Zonation on Seismic Geotechnical Hazard edited by the Japanese Society of Soil Mechanics and Geotechnical Engineering [TC4, 1999], ZUCCARELLO et al. *draw the grade-2 microzonation maps of the old centre of Sellano and its surrounding villages. The maps show the microzonation of amplification for ground motion and slope instability.* CAPILLERI et al.*, on the basis of the seismic input evaluation and site dynamic characterisation, perform a non-linear site response analysis for grade-3 microzonation of ground motion of the old centre of Sellano. Three zones in the old centre of Sellano are identified with one specific response spectrum for each zone.*

Part 5 - Measurements for the reduction of seismic risk

*Fundamental to the understanding of geotechnical risk is knowledge from the multidisciplinary fields of seismology, geology, geophysics and geotechnical engineering. This enables the creation of detailed microzonation maps of seismic geotechnical hazards, including ground motion, slope instability and soil liquefaction [*CRESPELLANI et al.*, 2001;* CRESPELLANI *and* MADIAI*, 2001]. However, they are only a preliminary step in the adoption of appropriate measures for the reduction of seismic risk. To achieve this goal, the evaluation of the site dependent spectra and criteria of microzonation must better incorporated in the Italian Seismic Code [D.M. 16 January, 1996], such as in the France Seismic Code [AFPS, 1990]. Specific guidelines for retrofitting ancient masonry buildings and their foundations [*CRESPELLANI *2000;* CRESPELLANI *and* UZIELLI*, 2001] need to be drawn and adopted by the engineering community. Measurements for the reduction of seismic risk should be based on an accurate evaluation of the local site*

effects and the destructive potential of earthquake ground motion, as presented by DECANINI et al. *To start with the reconstruction, the design spectra, which depend on the site conditions underneath a given building, must be evaluated.* GRISSO et al. *evaluate the design spectra for strengthening the foundations of two buildings in Sellano. The design spectra are compared with the site-dependent spectra that are reported in the Eurocode 8 [EC8, 2000]. Guidelines for strengthening masonry foundations are also given. Finally, guidelines for the structural retrofitting of ancient masonry buildings are reported by* BORRI et al.

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Guest Editors

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