



1. Research activity (max 1.000 words)

During the first year of the PhD, the bibliographic research on the topics related to the research project was deepened and continuously updated, both to deepen the methodologies of data analysis and to properly choose the case studies. The test-sites in which perform the seismic monitoring campaigns aimed at the acquisition of data functional to the objectives of the research project were individuated. The first site is located in the disused quarry of Acuto (Frosinone), where, for previous research activities, it was decided to monitor the deformational behavior of a rock block prone to failure. This site is also suitable to carry out the purposes of this research, since here it is possible to monitor the vibrational behavior and the mobility of the rock block in relation to the stresses induced by natural factors, for example by the action of the wind. The monitoring system includes two weather stations with rain gauge, hygrometer, thermometer, anemometer for wind direction and speed, six strain gauges and four extensimeters for monitoring the main fractures that characterize the rock mass. In July 2016, during experimental activities aimed at investigating the behavior of the rock mass sector monitored in response to external perturbations, seismic data were acquired. Preliminary data analysis lead to determine the different frequency and mobility response of the rock block with respect to the quarry wall, testifying its kinematics independent from that of the quarry wall. These preliminary results were the subject of a contribution presented at an international conference held in June 2017 (Progressive Rock Failure Conference, Ascona, 5-9 June).

In March, a new campaign of seismic measures was carried out, aimed at strengthening the knowledge of the experiment conducted in July 2016 and at investigating possible changes in the vibrational response of the rock masses monitored in response to vibrations induced by a generator. In fact, in addition to the permanent monitoring system, six one-component FBA11 accelerometers provided by ENEA (Casaccia Research Center) were installed, in order to continuously record the vibrations induced on the rock mass and on the rock block. Data analysis was carried out with the aim of highlighting the different responses of the rock mass and of the rock block. A second site is located along the Terni-Giuncano (Terni) railway line, where is possible to monitor the vibrational response produced by continuous train transits on a rock mass close to the railway. In this site a geomechanical survey was carried out, aimed at identifying the main discontinuity systems and the size of the typical blocks of the rock mass. In addition, a seismic monitoring spanning 57 days was conducted in this site, aimed at monitoring the effects induced on the rock wall by train transits. The seismic monitoring was carried out using two three-component Lennartz LE-3Dlite MkIII velocimeters, installed near the track and at the base of the rock wall, and four one-component FBA11 accelerometers installed on the rock wall at different heights along the same vertical. This configuration was adopted in order to evaluate the energy generated by the railway transits (near the track), its attenuation in reaching the base of the rock wall and its propagation within the rock mass. Preliminary data analyses have been carried out, in particular to compare the effects induced on the rock mass by different types of train.

Spectrograms and spectral analyses carried out so far show that no significant differences emerge in terms of vibrational response for the different trains transited within the considered monitoring period.

An analysis method consisting in the decomposition of the seismic record in different frequency bands was applied to all the seismic datasets acquired at the Acuto and Terni test site. The seismic records were filtered in three different frequency bands (high, medium, low) in order to highlight the different vibrational contributions in each frequency band. Previously obtained results show a more marked contribution to the high and medium frequencies for the Terni site, while at the Acuto site the effects observed at high frequencies are more relevant. The preliminary results obtained were the subject of a contribution presented at the 36° GNGTS conference (National Group of Geophysics for Solid Earth, Trieste, 14-16 November 2017). All the preliminary results obtained so far will be the base for more focused analysis that will be developed in the second year. Moreover, further long-period seismic monitoring will be carried out in the two test-sites with more resolute seismic devices, in order to analyze a wider frequency range.

2. Research products

a) Publications (ISI journals)

- S. Martino, F. Bozzano, P. Caporossi, D. D'Angiò, M. Della Seta, C. Esposito, A. Fantini, M. Fiorucci, L.M. Giannini, R. Iannucci, G.M. Marmoni, P. Mazzanti, C. Missori, S. Moretto, S. Rivellino, R.W. Romeo, P. Sarandrea, L. Schilirò, F. Troiani, C. Varone, 2017. *Ground effects triggered by the 24th August 2016, Mw 6.0 Amatrice (Italy) Earthquake: Survey and Inventorying to update the CEDIT catalogue*. *Geografia Fisica e Dinamica Quaternaria* 40: 1-20 DOI 10.4461/GFDQ 2017.40.7

b) Publications (NON ISI journals) -

c) Manuscripts (submitted, in press) -

d) Abstracts

- D'Angiò D., Curi L., Fiorucci M., Iannucci R., Lenti L., Martino S., Paciello A., 2017. *Fractured rock mass response to induced vibrations: preliminary results from two test sites*. Riassunti estesi del 36° convegno GNGTS (Gruppo Nazionale di Geofisica della Terra Solida), pp.696-700. ISBN:978-88-940442-8-7
- D'Angiò D., Fiorucci M., Lenti L., Martino S., Paciello A., 2017. *Preliminary results of vibration modes induced by forced dynamic shaking in a quarry rock wall*. Proceedings of Conference & Workshop Progressive Rock Failure, Monte Verità, Switzerland, 5-9 June 2017, pp. 62-65