



DPC-INGV S3 Project- The Gubbio experiment: multidisciplinary investigations for the characterisation of local seismic response.

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Within the Italian Project S3 (DPC-INGV) “Shaking seismic scenarios in areas of strategic and/or priority interest” the urban area of Gubbio has been chosen as a test site for the calculation of ground shaking scenarios for forecasting purposes. The area has been selected because the urban and / or geomorphologic characteristics of the town of Gubbio and its surrounding are good representatives of many areas in Central Italy: an historical centre of high cultural and artistic value founded on a rocky hillside with new residential and industrial areas developed on the alluvial plain.

A great deal of effort has been put in the seismic characterisation of the Gubbio basin, since the general purpose of the work has been the quantification of site effects in intra-mountain basins. Recent studies have shown in fact that significant site effects take place in the Eugubina plain, as evidenced by the generation of surface waves. This area was formed during an extensional phase of the Quaternary tectonics and was in filled by lacustrine and fluvio-lacustrine deposits with thickness of 300-500 metres.

Several investigations with active and passive seismic survey techniques have been planned and carried out in the plain, also favoured by the intense seismic activity typical of the area. These investigations have been mainly related to the monitoring activities of 4 temporary transects of seismometric stations, operating between June 2005 and May 2006. Two transects have been positioned perpendicularly to the valley axes, one parallel and one near to the Gubbio city. More than 300 local and regional earthquakes have been recorded, with maximum magnitude equal to 4. A 2D array has

been operating as well from June to September 2006, to better understand the generation of surface waves. Parallel to these activities noise measurements data have been collected in the field for 90 sites, using the single station technique for the estimation of the fundamental resonance frequencies. Further 4 noise measurements with a seismic array have been collected to build an S wave velocity profile in soft sediments, considered representative for the whole plain. The geometry of the basin below 500 m of depth has been investigated through the acquisition of a seismic line 4.5 km long, in correspondence of one of the transects. This has been used to perform a tomography of arrival times which allowed to recognise the position and shape of the reflecting horizons. As a final step the first 30 metres of deposits have been characterised over a 30 km² area, using both stratigraphy studies provided by the Gubbio council and data collected from surveys in situ and lab tests.

The preliminary results are relative to the analysis of seismic recordings. These show that the seismic response for the Gubbio town centre, near the steepest hillside, does not show significant amplification effects, the empirical transfer functions being practically flat. On the contrary the recordings from the transects in the plain confirm the low frequencies resonance (< 1Hz) and the long duration of the signal in a wide area of the central part of the basin, while in the proximity of the borders the amplification frequencies tend to increase and their amplitude to diminish. These results appear to be strongly controlled by the thickness of the alluvial deposits. Non conventional methods (sonograms and polarization) are being applied on these data, to evaluate the characteristics of the arrivals following the body waves, which determine a significant increase in the duration and energy content of the low frequency portion of the signal.

The results of the spectral analysis and of the velocimetric data are in good agreement with those from micro-tremor analysis. The combination of the results obtained from the two approaches will allow to better constrain the geometry of the basin and the characteristics of the alluvial deposits, especially in term of bedrock topography and average velocity of the sedimentary cover.

All data collected have been input in a Geographic Information System and will be utilised to define a 3D geotechnical model of the basin, together with the information derived from the various investigations. The 3D model will then be used to compute the seismic response at different locations in the plain.