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Project S4: ITALIAN STRONG MOTION DATA BASE

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<http://esse4.mi.ingv.it>

Deliverable # 7

APPLICATION OF SURFACE-WAVES METHODS FOR SEISMIC
SITE CHARACTERIZATION OF ITACA STATIONS

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1. Scope and Description of the Deliverable

The Deliverable reports on site characterization for a given set of accelerometric stations of RAN (Italian accelerometric network) with particular attention to shear wave velocity profiles. The activities were part of Task 3 of Project S4.

The shear wave velocity model estimated allows both a classification of the accelerometric station following the existing normative and the evaluation of new proxies for site effects (see Deliverable S4-D13). Surface wave analysis has been chosen as the primary investigation method since it offers the possibility of reaching the required accuracy at reasonable costs.

Several RUs contributed to this task. The use of different surface wave methods allow the different geological situations (thin/thick deposits, profiles with large impedance contrasts etc..) to be investigated.

From the estimated shear wave velocity model some relevant parameters for site classification, such as V_{s30} , the seismic bedrock depth (conventionally defined as the interface below whom $V_s > 800$ m/s, from EC8), the V_s to the seismic bedrock and the natural frequency in case of shallow bedrock site, can be estimated.

Appendix A – Description of the execution and interpretation on surface wave tests

Appendix A resumes the acquisition, processing and inversion of surface wave data for the characterization of several of the accelerometric stations of the RAN within Project S4.

After a short introduction, criteria for the selection of RAN stations are summarized, and a map with the location of the sites which have been investigated is shown. Then the techniques used by the different RUs for acquisition, processing and inversion are described. Particular attention is paid to the description of the inversion techniques since they are the central aspect of surface wave testing. Then some case histories are reported for representative sites. Finally, a table summarises the main parameters for seismic classification of stations.

The appendix of this Deliverables is available at the web site : <http://esse4.mi.ingv.it>.

3. Relevance for DPC and/or for the scientific community

The shear wave velocity profile of the station is of primary importance for the usability of the accelerograms recorded by the RAN. Indeed site effects have a relevant influence on the records and the interpretation of earthquake data requires them to be taken into account carefully. For this reason, the importance of having a good characterization for the sites of accelerometric networks is worldwide recognized. For example, all the stations of the Japanese network Kik-net are fully characterized: the shear wave velocity profiles and other relevant parameters are available for every user. Characterization of the station is a prerequisite for scientific and technical use of the accelerometric database ITACA. Considering that the number of stations with available shear wave velocity profile was very limited at the start of Project S4, efforts for increasing the number of well characterized stations were mandatory. The activities of Task 3 allowed more than 60 stations to be classified after having estimated S-wave velocity profiles reaching the maximum possible depth considering stratigraphy, used instruments and methods.

The obtained results are of great importance for any future use of recorded RAN data. Not only they are necessary when searching the data base for a ground motion with particular characteristic, but they form the basis for improving ground motion prediction equations for Italy (and consequently the hazard analysis).

For the technical and professional community, the availability of shear wave velocity profiles for the RAN station is necessary when selecting recorded time histories for advanced seismic design procedures. Time histories analyses are receiving increasing attention for the design of structures and for the verification of slope stability. Meaningful results can be obtained only with an ad-hoc selection of the input motion, which requires a full characterization of the site of the recording station.

Finally for the scientific community also the methodological aspects related to surface wave analysis are relevant. These techniques are receiving increasing attention both by the scientific and technical communities due to their flexibility and cost effectiveness. Yet, the complexity of the analysis requires a full understanding of limitations and further improvements in the standard of practice and in the state of the art. Some of the RAN sites were challenging for the application of surface wave inversion techniques. These sites required the development or the improvement of new methodologies by some RUs to provide reliable results. These advancements are documented in the appendix and in the RUs reports. It is expected that they will offer the basis for the publication of scientific papers.

4. Changes with respect to the original plans and reasons for it

No major changes occur in the plans for this Deliverable. The only differences with respect to the original plans concern the choice of the RAN investigated sites. Due to logistic problems, a few profiles were removed from the planned list, and some were added. In particular, new sites were considered in the Abruzzo region after the L'Aquila earthquake.