An example of online system for probabilistic seismic hazard assessment at the surface of non linear soil deposits

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Abstract

Probabilistic seismic hazard assessments (PSHA) keeping into account amplification effects in non linear soil deposits require a relatively complex, multidisciplinary approach. The purpose of this presentation is to describe the preliminary version of an on-line system (www.eriskzone.net) suitable to define, with a limited effort, the probabilistic seismic hazard at the ground surface accounting for site amplification effects. The software relies on advanced probabilistic procedures and analytical tools for soil amplification assessment, and provides an example on how state of the art procedures could be applied more extensively, even to smaller projects and for multiple analyses throughout large areas where limited information on local soil characteristics is available.

At present the system, which is freely available on the Internet and is intended for demonstration purposes only, covers the whole Italian territory and, including some features which will be made available on the web in the near future (see below for details), it presents the following main characteristics:

1) The seismic hazard at the bedrock is contained in a database and cannot be changed by the User.
2) Site amplification is computed based on advanced amplification functions using local parameters as defined by the User.

The system as described above has been available on the Internet since November 2005, with the exception of the advanced amplification functions (item 2) which are currently being tested and will be made available shortly replacing the basic amplification criteria adopted in the original version.

The seismic hazard at the bedrock is the result of a conventional PSHA carried out throughout the Italian territory over a grid of nodes. It includes pre-defined hazard curves obtained for several oscillation frequencies and magnitude+distance values estimated by a disaggregation procedure.

As far as site amplification is concerned, the non-linear effect of the soil layers on the intensity of the ground motion at the surface is captured by a site-specific, frequency-dependent amplification function, $AF(f)$, where f is a generic oscillator frequency. The method exploits the results of thousands of nonlinear dynamic analyses of different types of "pilot" soil columns subject to real rock ground motions. Median $AF(f)$ and related uncertainty can be coupled via convolution with the site-specific bedrock hazard to obtain the surface ground motion hazard for the site (e.g., Bazzurro and Cornell, 2004a and b).

Although the system focuses on seismic hazard, it includes also a simplified procedure to predict structural damage based on building characteristics as defined by the User. The purpose is to show that besides hazard other aspects of seismic risk can also be included in the same framework. At present the system does not perform a rigorous convolution procedure to establish structural damage, but simply provides an estimate of the probability of having a pre-defined damage level based on fragility curves obtained from the literature. In the future the structural damage capability could be enhanced by implementing a proper convolution procedure and adopting user-defined fragility curves.

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