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ROBUST GROUND VIBRATION PREDICTIONS BASED ON SASW TESTS

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ABSTRACT

Ground vibrations in the built environment are an important issue, as they cause nuisance to people, disturbance of sensitive equipment, and damage to buildings. They are caused by a variety of sources, such as road and rail traffic, construction activities, and industrial machinery. Several numerical methods have been developed for the prediction of ground vibrations [1, 2]. These methods can be used to assess the efficiency of vibration reduction measures in new or existing situations. The soil is typically modelled as a layered elastic halfspace. The dynamic properties of the soil layers have to be determined by means of in situ tests or laboratory tests.

The Spectral Analysis of Surface Waves (SASW) test is commonly used to determine the dynamic shear modulus and the material damping ratio of shallow soil layers [3, 4]. It is based on an in situ experiment where surface waves are generated by means of a falling weight, an impact hammer, or a hydraulic shaker. The resulting wave field is recorded by a number of sensors at the soil's surface and used to determine the dispersion and attenuation curves of the soil. An inverse problem is finally solved to identify the corresponding soil profile. However, the dispersion and attenuation curves are insensitive to variations of the soil properties on a small spatial scale or at a large depth. The information on the soil properties provided by these curves is therefore limited. As a result, the solution of the inverse problem is non-unique: the soil profile obtained from the inversion procedure is only one of the profiles that fit the experimental data [5].

The present paper focuses on the impact of this non-uniqueness on the prediction of ground vibrations. As an example, the prediction of the vibrations due to a hammer impact on a small surface foundation is considered. The foundation is located at a site in Lincent (Belgium), next to the high speed railway track L2 between Brussels and Köln. In a previous paper, a similar study has been performed, but the focus was restricted to the influence of the uncertainty on the dynamic shear modulus [6]. In the present paper, the uncertainty on the material damping ratio and the Poisson's ratio is also taken into account.

First, a Bayesian approach is followed to determine an ensemble of soil profiles that fit the experimental data obtained from an SASW test performed in Lincent. The experimental data consist of the dispersion

curve, the attenuation curve, and the P-wave arrival time. The ensemble of soil profiles is subsequently used in a Monte Carlo simulation for the prediction of ground vibrations. Based on the variability of the results, the frequency range where the SASW test allows for robust vibration predictions is determined. Finally, the influence of the sensor configuration in the SASW test is studied: it is examined how the sensor configuration should be modified in order to obtain robust vibration predictions in a specific frequency range.

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