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SITE EFFECTS STUDY USING AMBIENT VIBRATIONS H/V AT ALGIERS BAY (ALGERIA)

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ABSTRACT

A study of ambient vibration H/V has been carried out to estimate the soil resonance frequency and amplification, as part of the shoreline development project throughout Algiers region aiming at expanding additional land around Algiers bay. An estimation of the thickness of the surficial amplification layers, mainly formed by embankments sometimes overcoming quaternary alluvium.

INTRODUCTION

Ambient vibration H/V has been used to determine the resonance frequency and thickness of the surficial ground layer at the Mohammedia site located in Algiers bay. . The average resonance frequencies of the ground, corresponding to this field has variable thicknesses filling, very useful information in the expertise of engineering geology and earthquake engineering.

DATA ACQUISITION AND ANALYSIS

Over 100 ambient vibrations recordings were performed at Mohammedia site (Figure 1), using a CityShark station (Chatelain et al., 2000, 2012) and a Lennartz 5-seconds sensor.

Signals were processed signals using the geopsy open source sofware (www.geopsy.org) to calculate H/V ratios.

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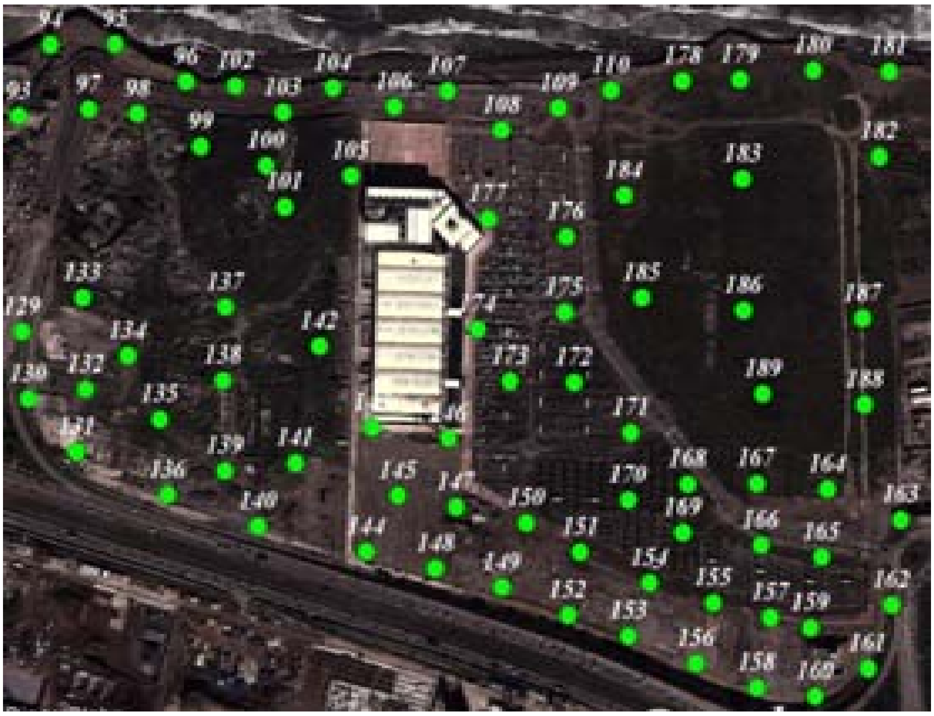

Figure 1. Location of ambient vibration recordings at Mohamedia site, Algiers bay

RESULTS

In general, a multitude of peaks appear on the H/V curves in both the low and very high frequency domains. According to their gaits, five categories of H/V curves have been identified:

- flat curves, which do not exhibit any peak;
- curves with a bulge;
- curves with two bulges;
- curves with a single peak;
- curves with two peaks.

In fact, in some places, where the seismic bedrock is very close to the surface or flushes times, was obtained H on V flat curves (without peak) as in Figure 2. This rock outcropping or near the surface is due to tectonic movements, knowing the active aspect of the entire Algerian margin

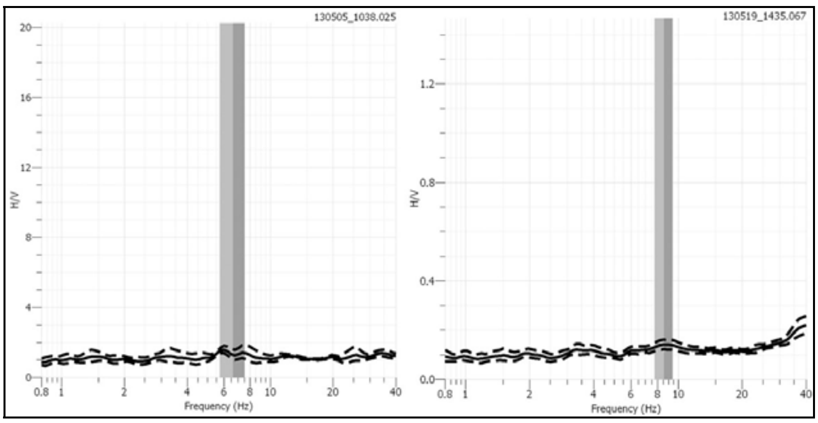

Figure 2. Example of flat H/V curves. These curves indicate that there is no amplification. Note, in particular the right curve on which we see the amplitude is less than 1

H/V curves exhibit a plateau or bulging (Guillier et al., 2005) of small amplitude ranging between 1.1 and 1.3, which give a low rate or medium contrast (Figure 3). This can be probably explained by the alluvial formations based on the altered marl that sometimes found in drilling.

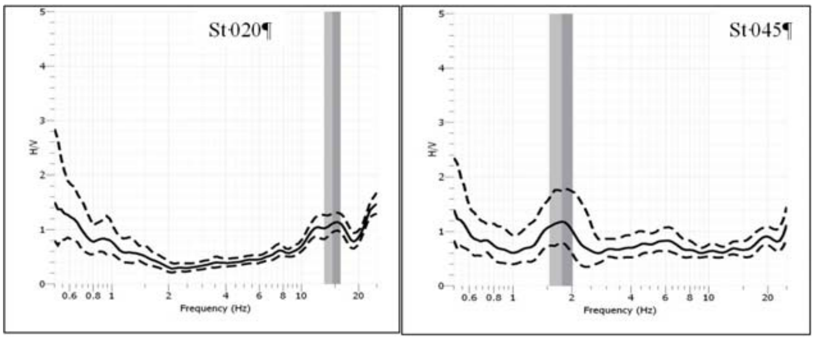

Figure 3. Examples of H/V curves with bulge, at various frequencies, which is explained by the change in thickness of the alluvial layer and backfill, as also observed in the boreholes

In other places, the frequencies obtained from the H on V curves showed peaks in the 20 - 30 Hz range (Figures 4 and 5), with an amplitude between 2 and 3 and sometimes over 10, suggesting a strong velocity contrast between two surficial layers. The upper layer is probably composed of quaternary alluvium and backfill based on healthy marl as found in a nearby drill core.

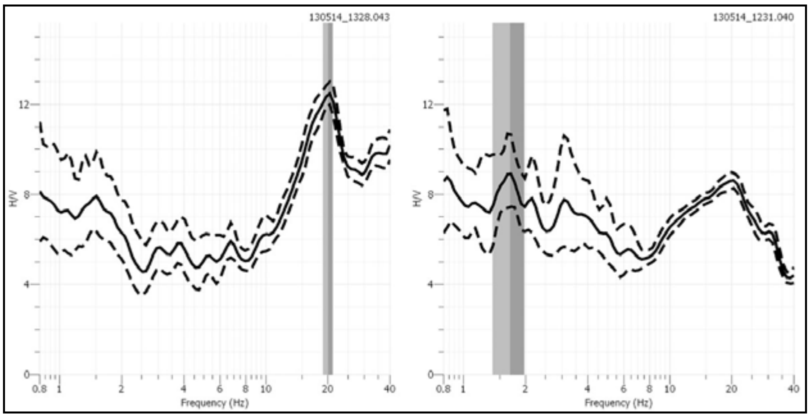

Figure 4. Curves H / V showing the peak frequency around 20 Hz to the left and right graph, however, with a higher amplitude peak around 1.5 Hz in the right graph.

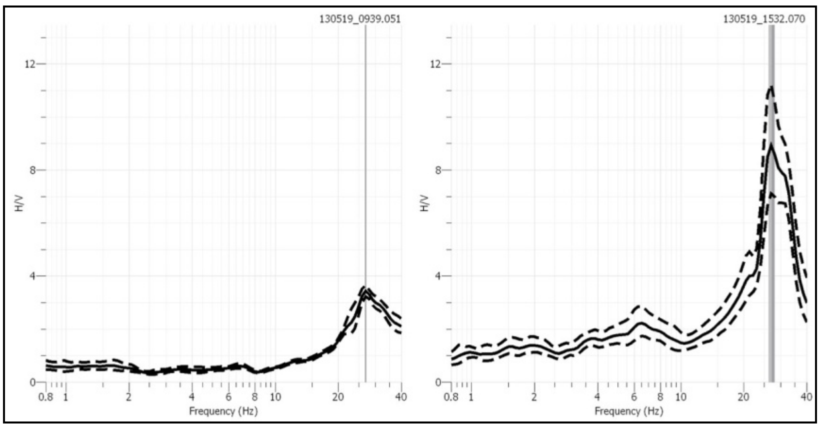

Figure 5. H/V curves showing frequency peaks around 27 Hz. This kind of H/V curves are less frequent, and reflect the presence of a thin layer of Quaternary sediments.

Some curves show two peaks (Figure 6) with an amplitude between 1.2 and 4, and sometimes over 10. Indeed, these two peaks indicate the presence of two interfaces, already observed in the curves with two bulges. The amplitude of the two peaks is due to a strong velocity contrast (e.g. Oubaiche et al., 2012) between the sedimentary layers and the substratum.

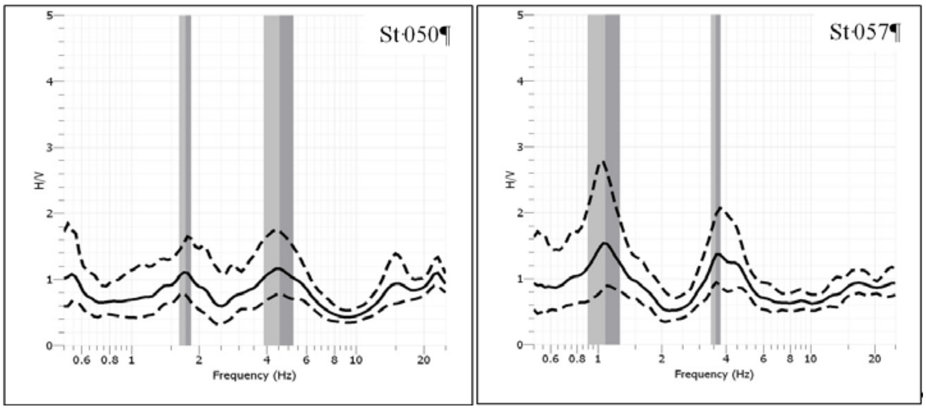

Figure 6. H/V curve exhibit two peaks. The two peaks, sometimes with high amplitude, could correspond to three layers embodying the alluvial and backfill layer resting on marl based on metamorphic bedrock that are observed in several places at the Bay of Algiers

Conclusion

We carried out an ambient vibration H/V recordings in order to determine the soil frequencies, number and thickness of layers in the subsoil, also using a core drilling at a site in Algiers bay.

These results, using boreholes and sometimes downhole tests have allowed us to estimate the thickness of fillings, using the formula $f_0 = Vs/4h$, from 2 up to 4 meters.

This work shows the importance of using ambient vibration H/V in order to compensate for the small number of drillings due to additional cost to achieve a sufficient number to get a good coverage. Indeed, it takes a few core drilling and a good ambient vibration recording mesh to assess the soil layer thickness and number of layers. In addition, a map showing the resonance frequency distribution will be produced.

Using ambient noise H/V allows characterizing the most surficial soil layer, which is often composed of fills (Gueguen et al., 2000 ; Machane et al., 2008), especially in coastal areas, or to materialize the rocky foundations, corresponding, in the Algiers bay, to the metamorphic basement, as described by Hellel et al. (2010; 2012).

Finally, the first results from electrical imaging confirm those obtained with the H/V method. This allows generalizing this kind of approach to achieve large-scale mapping for urban planning and seismic microzoning.

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