On the relationship of peaks and troughs of the ellipticity (H/V) of Rayleigh waves and the transmission response of single layer over half-space models

Tuan T.T., Scherbaum F., Malischewsky P.G.

Hanoi University of Science, VNU, Viet Nam; University Potsdam, Germany; Friedrich-Schiller University Jena, Germany

Abstract: One of the key challenges in the context of local site effect studies is the determination of frequencies where the shakeability of the ground is enhanced. In this context, the H/V technique has become increasingly popular and peak frequencies of H/V spectral ratio are sometimes interpreted as resonance frequencies of the transmission response. In the present study, assuming that Rayleigh surface wave is dominant in H/V spectral ratio, we analyse theoretically under which conditions this may be justified and when not. We focus on 'layer over half-space' models which, although seemingly simple, capture many aspects of local site effects in real sedimentary structures. Our starting point is the ellipticity of Rayleigh waves. We use the exact formula of the H/V-ratio presented by Malischewsky & Scherbaum (2004) to investigate the main characteristics of peak and trough frequencies. We present a simple formula illustrating if and where H/V-ratio curves have sharp peaks in dependence of model parameters. In addition, we have constructed a map, which demonstrates the relation between the H/V-peak frequency and the peak frequency of the transmission response in the domain of the layer's Poisson ratio and the impedance contrast. Finally, we have derived maps showing the relationship between the H/V-peak and trough frequency and key parameters of the model such as impedance contrast. These maps are seen as diagnostic tools, which can help to guide the interpretation of H/V spectral ratio diagrams in the context of site effect studies. © 2010 The Authors Geophysical Journal International © 2010 RAS.
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Authors with affiliations:

• Tuan, T.T., Hanoi University of Science, VNU, Viet Nam

• Scherbaum, F., University Potsdam, Germany

• Malischewsky, P.G., Friedrich-Schiller University Jena, Germany

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