Characteristics of the Later Arrivals at Amagasaki Site of CEORKA Network (3)

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Introduction

Large amplitude pulse-like phases were observed in the horizontal components of many records at the Amagasaki (CEORKA) site, after the S-arrival with the interval around 4 sec. In Akazawa, 2003, it was specified azimuth and the location of earthquakes that pronouncedly generate such pulses. Also, using simulations of SH-waves in the two-dimensional 2-layer model (sediments + bedrock), it was found that the trapping of waves between surface and bedrock boundaries could generate this kind of series of pulses. In this study, the same series of pulses are reproduced using a multi-layer velocity model.

Numerical simulation using 4-layer velocity model

Kagawa et al., 1998, developed velocity model of Osaka basin consisting of 3 sedimentary layers over bedrock. In this model it was assumed that depth of layer interfaces are proportional to the bedrock depth. Velocity and density inside each layer are constant. Important feature of this 4-layer model is that in case of vertical incidence of S-wave, travel times inside each layer are practically the same. To construct velocity model for this study, 2-D bedrock model from Akazawa, 2003, and the 4-layer model Kagawa et al., 1998, were combined.

Then, simulations of SH-waves were made similar to Akazawa, 2003, using the developed model. Results show that in this case, amplitude of the first trapped wave (between the bedrock and surface) becomes very small, but immediately after it appears a new phase with large amplitude that is not visible in the observed record. According to the above feature of the 4-layer model, probable reason of this phase is the constructive interference of the waves reflected by each layer interface.

If this hypothesis is true, the same result is expected for simulation in 1-D model, which is easier to analyze. Therefore, taking into account that the depth of bedrock at Amagasaki site is 1.5km, equivalent 1-D model was developed and simulations for case of vertical incidence of S-wave pulse were made. Results are similar to the 2-D simulations: wave reflected from the bedrock is small, but immediately after it large secondary phase appears.

Solution of the problem

One possible way to bring into correspondence the simulated and observed records is to apply small variations into the coefficients that control depths of the layer interfaces (in order to shift the time of incidence into an interface). By try and error model was changed using new coefficients, selected within the plus/minus one standard deviation range of raw data, and made 1-D simulations. It was found that most effective is a small increasing of the coefficient of depth of first interface (from the surface) from 0.193 to 0.21-0.23. Using this new value in the 2-D 4-layer model it become possible to reproduce the wave reflected from the bedrock interface and reduce amplitude of the secondary phase.

Conclusions

Representative 4-layer model (3-D case) is the average velocity model of the Osaka sedimentary basin after Zhao et al., 2002. Using this model it is possible to reproduce observed ground motions in wide area rather well. But in case of simulations for a specific site, instead of using averaged model, a more 'local' model sometimes is able to explain observed records better, and Amagasaki site becomes one of the realistic examples of such approach.

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