Tips on the Inversion Analysis for the Pavement System

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1. Layer Properties:

- Layer thickness: The layers of the pavement need to be refined. For example, for a 10 cm-thick pavement system, the layering is recommended as follows:

  0.5, 0.5, 0.5, 0.5, 1.0, 1.0, 1.0, 1.0, 2.0, 2.0, 5.0, 5.0, …

  You can use this layering just as a guideline, and the right layering for your measurements should be based on the model-parameter resolution of the inversion analysis.

- Layer properties: The properties of the asphalt material can be as follows:

  - mass density: 2320 kg/cm^2
  - Poisson's ratio: 0.333
  - damping ratio: 0.02

2. Inversion Analysis

- Starting model parameters: At the option boxes for the starting model parameters, you need to give the values as given in Fig. 1. That is, depth-to-wavelength ratios should start from 0.45.

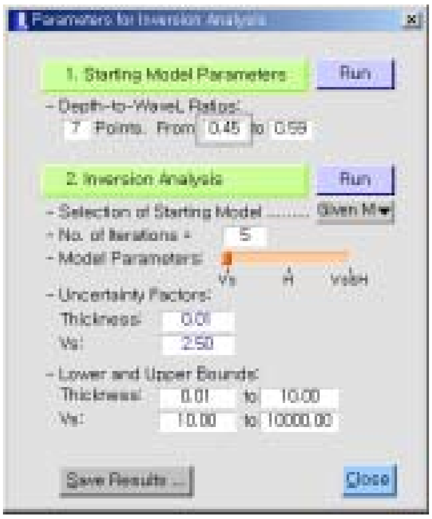

Fig. 1 Parameters.

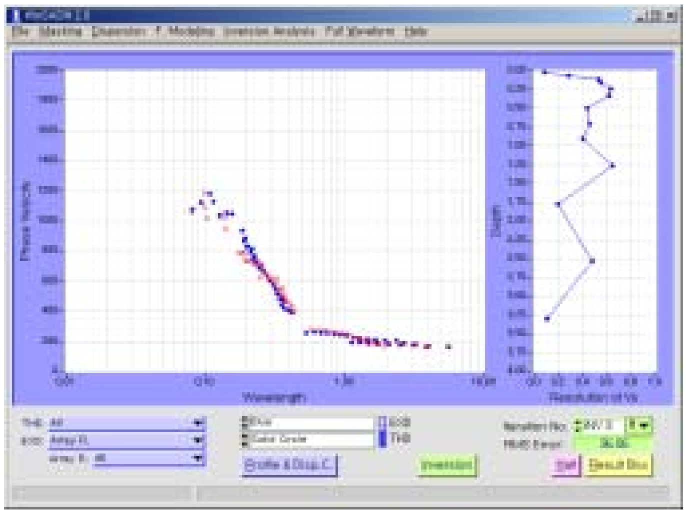

Fig. 2 Inversion Results

- Control factors: In the inversion analysis, it is the most important to look at the model-parameter resolutions as well as the comparison of the theoretical and the experimental dispersion curves. If the resolution drops below about 0.1, it is a better idea to use a different layering. (cf. Fig. 2). To improve the resolution of the model-parameters, it may be required to use both model parameters of thickness and velocity.

3. Interactive Masking and Dispersion Curves

- The masking of the measurements at the pavement system is specially difficult and requires a lot of experience. The basic tips in performing the masking is as follows.

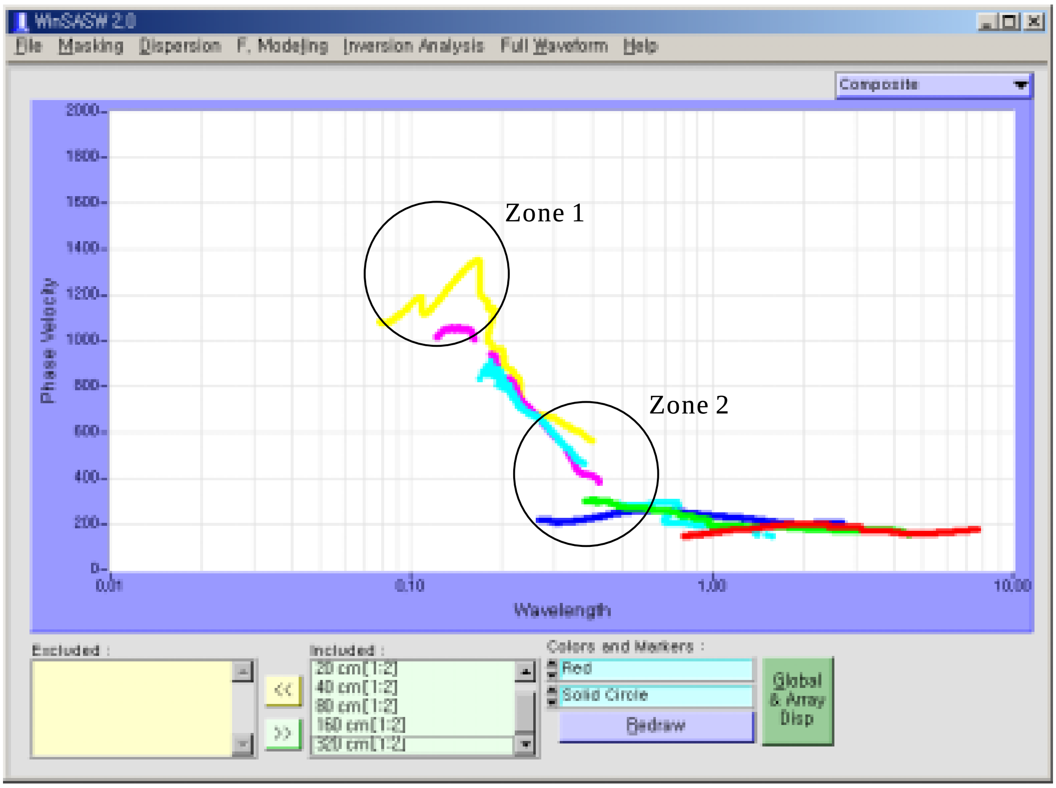

Fig. 3 Typical Dispersion Curves Contaminated by Higher Modes of Stress Waves

In case of a pavement system, there are two zones contaminated by higher modes of the stress waves, as shown in Fig. 3. Zone 1 comes from the measurements using small receiver spacings typically similar to the pavement thickness. It is believed that zone 1 is attributed to the reflected body waves at the interface between the pavement layer and the underlying soil layer. Zone 2 is also attributed to the contrast of two layers, and the phase-velocities corresponding to the underlying soil layers become dominant. Therefore, in the interactive masking procedure, you should take these effects into consideration in the determination of the phase-velocity dispersion curve. Fig. 4 is one example to lead to the successful inversion analysis.

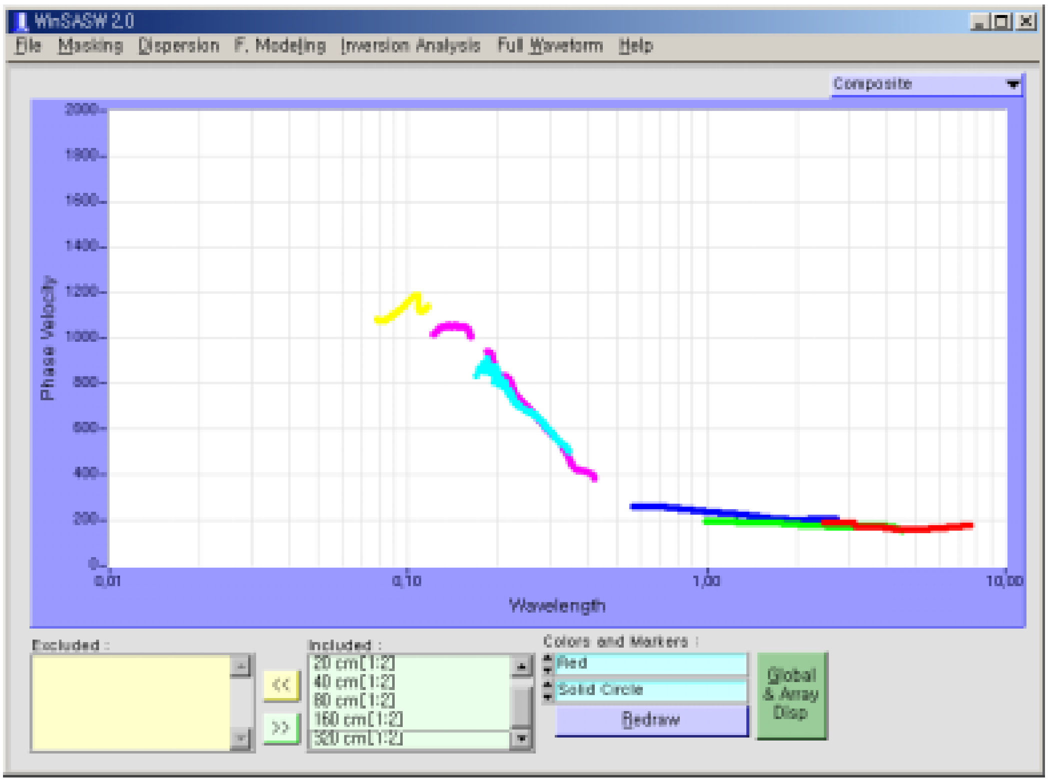

Fig. 4 One Example of Dispersion Curve for the Successful Inversion Analysis

4. Measurements at the Pavement System

- Smallest Receiver Spacing: The measurements at the pavement system should incorporate all the essential receiver spacings. One of the important receiver spacings is the shortest one. The shortest receiver spacing should be about half of the expected pavement thickness to estimate the shear-wave velocity of the pavement itself. In case of Fig. 4, the shortest receiver spacing is 0.1 m, which is about the thickness of the pavement system. Since the measurement based on the receiver spacing similar to the pavement system is corrupted by the body-wave reflections, not much information is retrieved from the measurements. Therefore, the 0.05-m receiver spacing should have been included in the measurements.
- Largest Receiver Spacing: Unlike the geotechnical site, the depth-to-wavelength ratio at the pavement system is much smaller. Therefore, the largest receiver spacing should be greater than the one usually adopted for the measurements at the geotechnical sites.