

Comparative test of three surface-wave methods at the Williams Street Park in San Jose

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http://www.oyo.co.jp/product/1-geo_survey/6-surface_wave/surface_wave1.html

The Williams Street Park in the San Jose City (California, U.S.A), is located in the south part of the city along the Coyote Creek. Significant liquefaction was observed along the Coyote River in the 1906 San Francisco earthquake. Comparative test of three surface-wave methods has been carried out at the Park.

We have perform three surface wave methods, a control source method (SASW : Spectral Analysis of Surface Waves), an impulsive source method (MASW : Multi-channel Analysis of Surface Waves), and a micro-tremor method (MAM : Micro-tremor Array Measurement) have been performed.

The SASW has been performed since 1990s mainly in the U.S.A. The method uses industrial shaker that generates 1 to 100Hz single-frequency sine waves. The weight of mass is 100kg. Two seismometers (vertical motion, velocity meter, eigen-frequency of 1Hz) are used as receivers in the test. During the measurements, source frequency was changed from high frequency to low frequency with the interval of 0.5 to 1Hz. Receiver spacing was increased from several meters to 60m as source frequency decreases. A source was placed so that a source-receiver offset is equal to the receiver spacing. A dispersion curve was calculated from the cross-correlation of two traces.

The MASW has been proposed in the end of 1990s by Kansas Geological Survey. The method is now popular in Japan and U.S.A. A 5kg sledgehammer is used as source and 24 low frequency (4.5Hz) geophones are used as receivers in the test. A receiver spacing is 2m. Sources are placed at the middle of geophones. The number of sources is 25. The CMP analysis of surface waves is applied to the data. One cross-correlation gather is obtained by stacking all CMP cross-correlation gathers. The MASW (Multi-channel Analysis of Surface Waves) was applied to the cross-correlation gather and the time domain waveforms was transformed into frequency - phase velocity domain.

The MAM is applied earth science problems mainly in Japan. Authors are applying the method to engineering and site amplification problems. Three triangular arrays are used in the test. Maximum array size is 50m. The number of receivers is 10 and low frequency (4.5Hz) geophones are used as receivers. These receivers are connected to the seismograph by a multi-channel cable. Data length is about 10minutes. SPAC (Spatial Auto Correlation) was used for calculating a dispersion curve.

Figure 3 shows dispersion curves obtained from three surface-wave methods. Frequency range of 5to 10Hz, it is important for S-velocity estimation down to 20m, three dispersion curves agreed well. Phase velocities differ in the frequency range lower than 5Hz. The cause of difference may be high eigen-frequency geophones and small size array.

The comparative test of three surface-wave methods has been performed and the phase-velocity curves agreed well in the frequency range of interest. The result shows the reliability of the surface-wave methods.

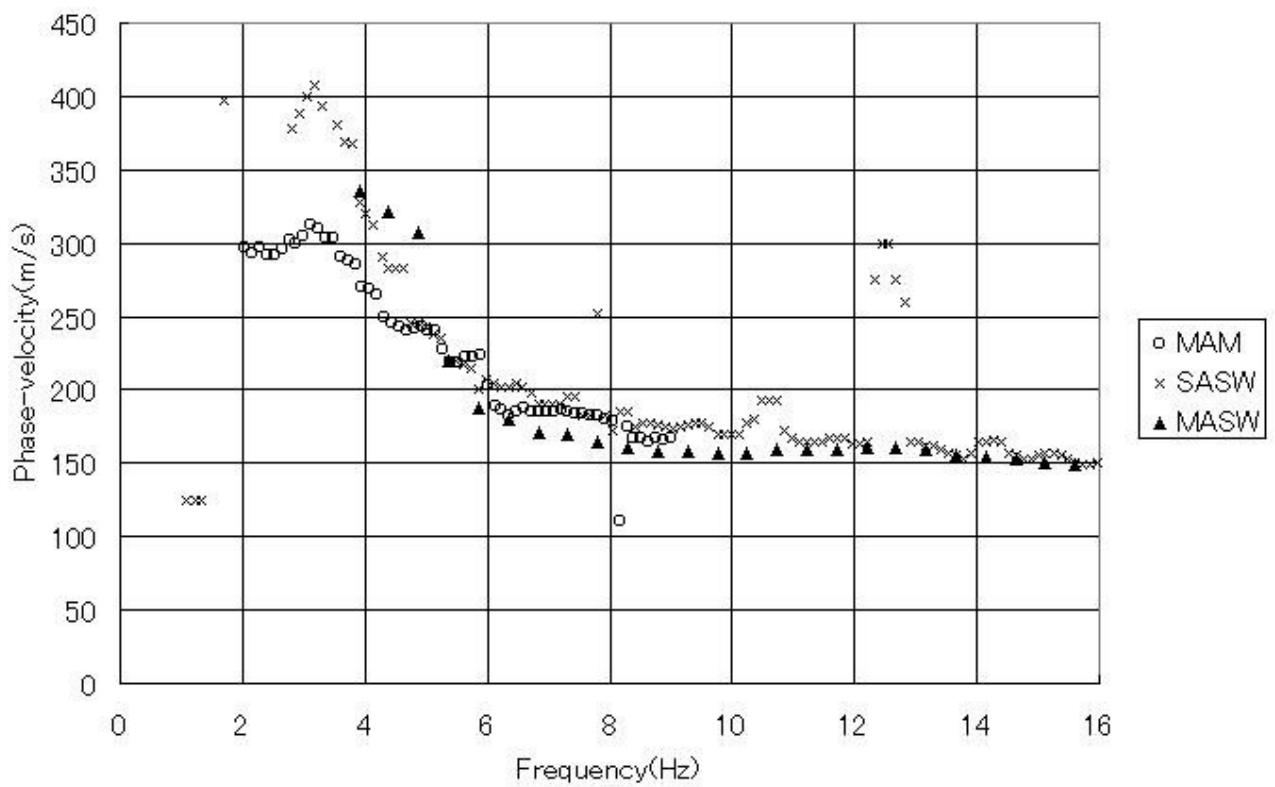


Figure 1 Dispersion curves obtained from three surface-wave methods