

Safety assessment of levee systems utilizing integrated geophysical surveying.

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Safety assessment of levee systems has become the high priority issue against the backdrop of recent severe flooding incidents around the world. Because the most earthen levees have been repeatedly mounded and repaired for many years, their internal structure is generally inhomogeneous both in a lateral and a longitudinal direction in spite of their similar appearance. The conventional spot drilling technique is incompetent for the evaluation of such heterogeneous internal structure of levees. It has been therefore required to develop an effective, inexpensive and easy-to-apply field survey method which enables to delineate the internal structure of levee body and assess the safety of levee systems. The physical properties that affect the safety of levees are mainly permeability and the stiffness or earthquake resistance strength. Because it is hard to obtain above two properties by means of one geophysical method, combination of several methods was examined at the actual levee.

The tested geophysical methods involve multi-channel surface wave dispersion measurement (MASW), capacitively-coupled resistivity (CCR) measurement, and multi-frequency electromagnetic (EM) survey. Because these methods require no fixing of the sensors on the ground, high performance on field measurement work can be accomplished, which leads to the continuous profiling along levees. The CCR measurement as well as EM survey successfully reconstructed resistivity profiles along the levee, and delineated anomalously high or low resistivity zones in the levee body. The MASW method reconstructed the shear wave velocity structure along a levee, and successfully imaged relatively high or low velocity zones in the levee body. Resistivity data obtained by the CCR and EM survey were used to estimate permeability of the levee body materials based on the empirical relationship between them for unsaturated soil materials. The S-wave velocities estimated from MASW were used as the good indices to evaluate the stiffness of levee body.

As a result, the combination of CCR or EM with MASW survey is helpful for safety assessment of levees for the prevention of levee failure caused by flooding and earthquakes.