

CUBATURE CALCULATIONS

GEOPHYSICAL SURVEYS FOR CUBATURE CALCULATIONS

During the design and execution of construction works it is often important, as far as possible, accurate estimation of the groundworks or relocation of materials both anthropogenic and natural. Such works are applicable to the construction of embankments, excavations, estimating the volume of the heaps and landfills. For this purpose, in addition to point drilling and geotechnical surveying, continuous, fast and non-invasive geophysical surveys are used. Due to the need to clarify the boundaries between the geotechnical layers stored at different time, as well as the determining the presence of native ground.



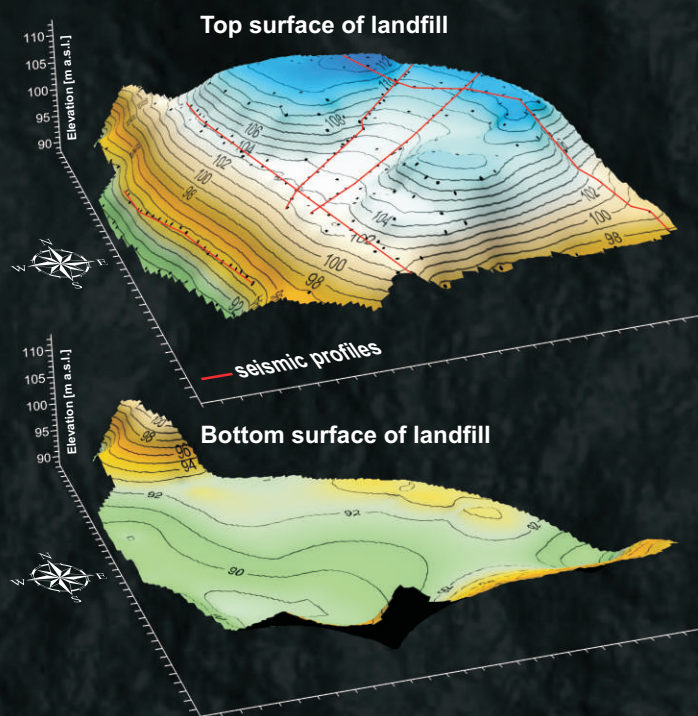
Seismic measurement on a municipal waste landfill to determine the depth range of the embankment and waste layers.



Most often, the following geophysical research methods are applied:

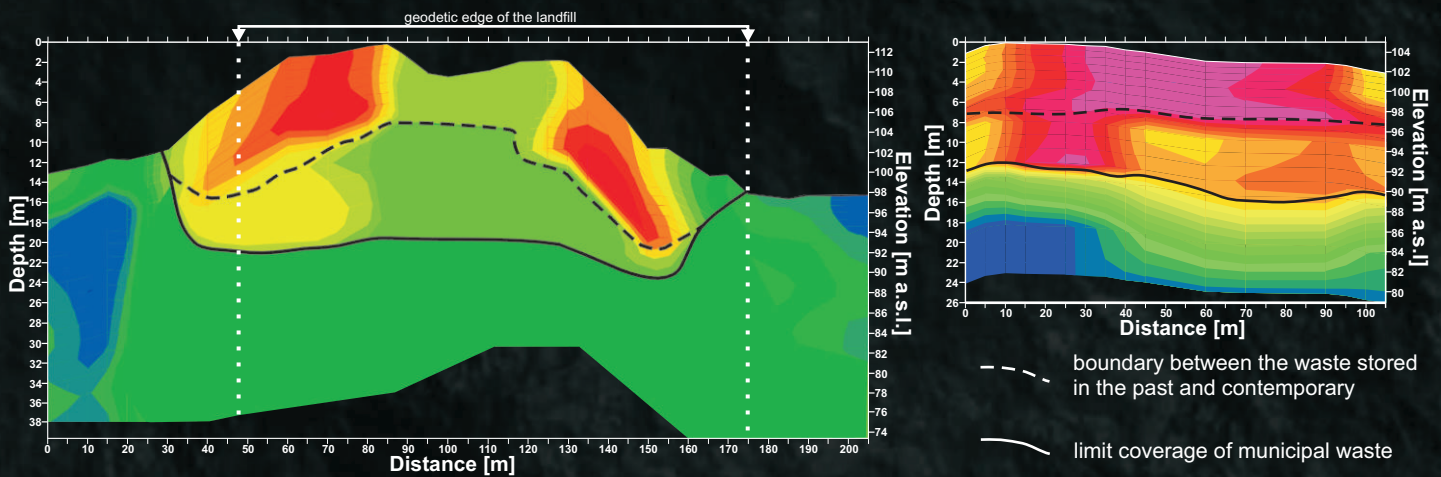
- 📡 seismic profiling MASW 2D,
- 📡 seismic refraction tomography,
- 📡 seismic refraction profiling,
- 📡 electrical resistivity tomography ERT 2D,
- 📡 GPR profiling.

All of these methods image the structure of medium well but the most conclusive results are obtained by using seismic surveys due to the direct correlation between seismic waves velocities and structure or geomechanical state.

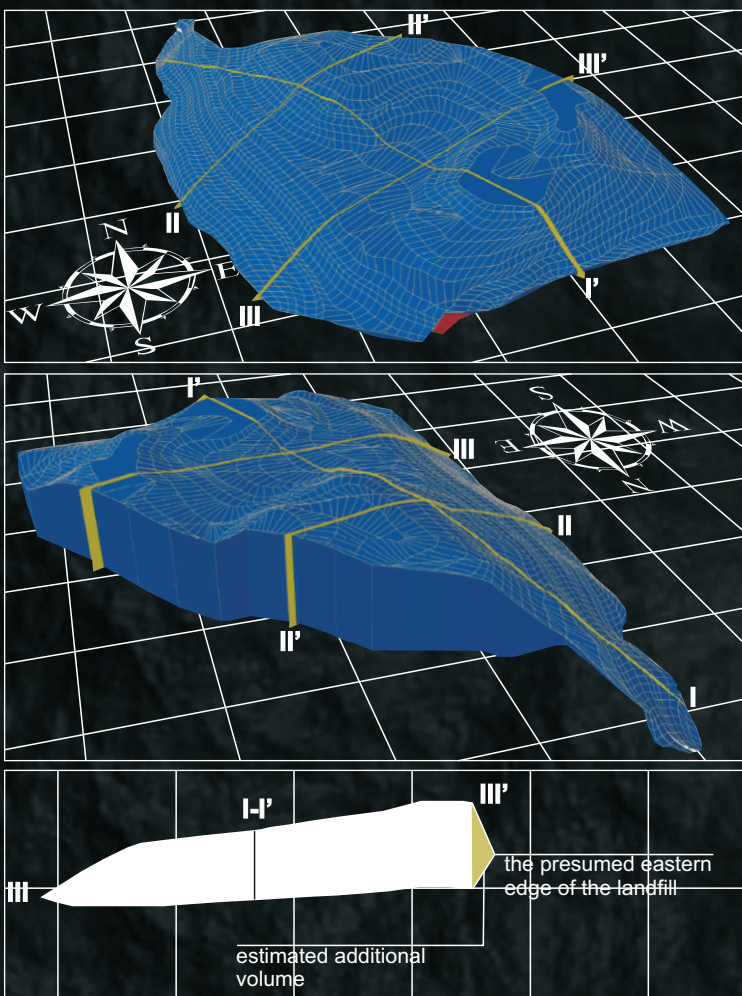


3D elevation maps of the municipal waste landfill top and bottom surfaces. Top surface map was established on the basis of geodetic surveying while the bottom surface map was created by careful determination of the floor of the landfill using seismic surveys along the profiles marked on the top surface map.

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Longitudinal (left) and transverse (right) seismic cross-sections made to identify the depth range of landfill. In both sections, there are clear geophysical boundaries where the solid line indicated depth range of entire landfill. The dashed line marks a clear seismic boundary, separating the two waste disposal stages.



3D model of the landfill (top and middle) constructed on the basis of surveying and geophysical surveys. It was used to calculate the volume of waste. The bottom figure shows the selected cross-section visualization, together with an estimation of the additional volume, detected by seismic testing.

Seismic surveys allow the direct determination of the so-called seismic boundaries. It gives possibility to determine the depth range and thickness of: embankments, aggregates, layers with varying density or coverage of municipal waste landfill. Information obtained from such studies are used to determine surface and cubic capacity (volume) of defined layers. The cubature is determined on the basis of the geodetic land surface and the spatial location of the boundaries under the surface determined by seismic surveys. Volume, for verification purposes, is estimated using two methods: the sum of the unit cuboids and the total of the solids between the triangular polygons forming the top and bottom surfaces of the analyzed layer.

The results of such studies are presented as cross-sections with the determined boundaries, contour maps and spatial blocks, as well as sections in any selected places of the model. The best results are obtained using the seismic method, because the other geophysical methods (electrical resistivity, GPR) have more limitations and provide ambiguous results.