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Geological 3D-models in urban infrastructure construction: studies in Levi ski resort, Finnish Lapland

Juho Kupila and Jouni Pihlaja
Geological Survey of Finland, Rovaniemi, Finland (juho.kupila@gtk.fi, jouni.pihlaja@gtk.fi)

Effective infrastructure construction in urban environments requires more and more detailed background information. One important part of this information is characteristics of the geology of the working area. To get this valid data, we have many suitable tools, like soil mapping, drilling and GPR (Ground Penetrating Radar). By using these tools, we can create datasets, from which we can create geological 3D-models for different purposes. GIS (Geographical Information Systems)-based data processing is the most important part of this stage.

The study area of this project is located in the municipality of Kittilä, Finnish Lapland, in the center of the Levi ski resort. The study area and surroundings are under fast townplanning and there are, for example, plans for a hotel, apartments and underground garages and service routes, thus it is very important to determine the volume of quarrying. As well, the quality and quantity of existing soil is valid data for the reuse of materials and upcoming construction.

In this research, 3D-models are created according to soil mapping, exact modeling of the land surface, drilling program and GPR-survey. Acquired results include models of bedrock level, soil surface level and interfaces between different soil layers and some information about ground water. Different parts of the model are analyzed using GIS-software and results include, among others, detailed information about the volumes and quality of subsurface materials. For more detailed results, for example, forthcoming underground construction area can be separated from the whole townplanning area and models will cover only that part. After field work sessions and data management, it was found out that soil material in the study area is mostly sandy gravel and moraine. This is very important information for the future construction work. There is lack of suitable materials and so it is important to know the consistency of soil layers in advance. Also the depth of the soil effects intensively on the complexion of the planning and construction, so the exact model of bedrock level is another important result, as well as information about ground water level.

Results of these studies prove that 3D-modelling is a fast and cost-effective tool not merely e.g. in mine planning and constructing but even in these kinds of large-scale everyday infrastructure construction works.