Laboratory of mining design and planning

The purpose of the laboratory of mining design and planning is to apply mining software systems, test and develop them in scientific and teaching process. The laboratory consists of software, databases, methods, hardware with necessary equipment (scanners, printers, plotters, savers, presenters, computer servers), see the website http://mi.ttu.ee/mgislabor

The most used mining modelling software in the world have been set up in the laboratory:

1. Gemcom Minex – modelling stratified deposits
2. Gemcom Surpac – modelling mining processing and work procedures
4. MapInfo Professional, Discovery, MapBasic - GIS
5. Vertical Mapper- spatial modelling
6. Encom Discover- spatial modelling for mining environment
7. AutoCAD Civil 3D- planning
8. FLAC – modelling of rock mechanics, dynamics and properties
9. PLAXIS – geotechnical spatial modelling
10. Mining specific software – parameters of pillars, productivity, mining equipment co-operation and fleet calculations, (Caterpillar and Mining Department of TUT)
11. Ashtech GPS data management and analysing
12. GeoLab

Laboratory of mining design and planning

Minex software is used for modelling and design of stratified deposits. Geological modelling and design for lignite, phosphorite, zinc, bouxite, iron ore and platinum deposits. Is mainly used for Estonian oil shale deposit planning.

With Minex software it is possible to perform:

Geological modelling taking into account breaks and water regime. To optimize mining with longwall, reconstruct ramps, overburden coefficient, economical ratio, to calculate volumes. Shortwall mining with blasting scheme, ramps, roads, heap, redirect pollution.

Figure 1 Statistics and histogram about seam D; Clockwise and anticlockwise ramp in mining with bench
Figure 2 Cross-section of layers with drillholes, geophysics and grid net

Minex homepage http://www.surpac.com/
Software **Surpac Vision**
With Surpac Vision software it is possible to design and optimize: surfaces mines, underground mines, tunnels, design drillholes and blasting, model blocks, to make geodetic data request etc.

![Figure 3 Granite underground mine project](image)

**Figure 3** Granite underground mine project

![Figure 4 Analysis of mining conditions](image)

**Figure 4** Analysis of mining conditions

**Surpac Vision homepage and instructions** [http://www.surpac.com/](http://www.surpac.com/)
Software Visual ModFlow Professional

Software is for constructing three-dimensional groundwater flow and contaminant transport modeling. With the ability to simulate groundwater and surface water interactions, and the added capability of calculating changes to groundwater chemistry, groundwater professionals now have a complete set of tools necessary for addressing water quality, groundwater supply, and source water protection initiatives. Modeling results help to make decisions about mining technology and mining operations.

Visual MODFLOW has the tools necessary to:

- Graphically assign model grids, properties and boundaries
- Visualize model input parameters (2D or 3D views)
- Run the flow, pathline, and transport simulations
- Automatically (WinPEST) or manually calibrate the model
- Display and interpret the modeling results in full 3D
- Produce professional reports

Model input parameters and results allow to visualize in two-dimensional cross-sections and schema and three-dimensional to visualize results. Using dynamic model it is possible to create new conditions adding new data and valuate water level, groundwater flow directions, volumes of pumping water in underground mines and surface mines using time.

Cross-sections based on generated model

Creating cross-sections it is possible to visualize in passant water level location in geological layers.

![Figure 5 Cross-section and its location](image)

Balance of the incoming and outgoing water

Model gives the results of incoming and outgoing water volumes at certain moment of time in certain water level. Results can be viewed in graphs and as data tables (Figure 2).

![Figure 6 Incoming and outgoing water volumes](image)
Water flow directions

Simulisation results reveal directions of the water which is shown in Figure 3.

Figure 7 Water flow direction at the moment of 50 days.

Homepage http://www.modflow.com/
Software AquaChem

AquaChem is software for water analysis. AquaChem enables to analyse water chemical contents and physical parameters, wide analysis, calculate, model, create graphics.

**Figure 8** Map of water chemical contents

**Figure 9** Water analysis illustration

AquaChem homepage

http://www.waterloohydrogeologic.com/software/aquachem/aquachem_ov.htm

AquaChem users instructions siit
Software MapInfo Professional

MapInfo Professional is software based on GIS. It allows to manage GIS data, model and manipulate.

MapInfo Professional allows to:
Look map data and geographic coordinates analysis
Carry out data to map
create maps and plot
create and refresh map database

Functionality:
Data visualisation: 3 different views: tables, map, graphs. Monitoring data in scale, create new map objects, to associate the map objects with the data in tables, thematic maps, 3D thematic maps, cartographic legend, to combine objects.
Spatial analysis: do SQL-queries and saving, spatial queries and buffers.

Figure 10 Plan created with coordinates

Figure 11 Buffering mining influences

MapInfo Vertical Mapper
software which increases MapInfo analysing capabilities including more difficult functions based on statistic and raster-grid models. It allows to analyse and visualize height models, to create thematic maps revealing trends, to interpolate.
Figure 12 Pollution model. This model is illustrative and does not own real values.
AutoCAD

AutoCAD is software based on vector graphic. It is used in creating technological schemes, cross-sections and plans. With AutoCAD it is possible to create 2D and 3D spatial mechanical drawings. Suitable for creating drift, cross-sections schemes, supports in geological crush zones, anchor support schemes, ventilation schemes etc.

Figure 13 Bench properties

Figure 14 Mining with backfilling

Figure 15 Opencast mining

Figure 16 Breaking with hydraulic hammer
Figure 17 High selective surface oil shale mining technology modelled with AutoCad
AutoCAD homepage http://www.autodesk.com/
**Plaxis**

Plaxis is geotechnical modelling software. It allows to analyse deformations, stability, ground water flow, create quickly elements, nonlinear and time devolving models taking into account pore pressure in unisotrophic soils.

**Figure 18** Situation before and after deformation

**Figure 19** Pore pressure

WipFrag
Granulometry Analysis Software. It supplements screen analysis, helps to evaluate loose which cannot be screened.

Figure 20 Work in 3 phase

Figure 21 Explanation of the graph

FLAC

Flac is used for calculating stability, deformations, pressure, crush and to visualize in plastic, elastic and rheologic environment. In addition it can be used for crack calculations using thermal and water flow data.
The output is 2D and 3D models.

Figure 22 Joint system for the models

Figure 23 Cavern model in Maardu granite deposit
Caterpillar and Mining Department of TUT Mining specific software – *parameters of pillars, productivity, mining equipment co-operation and fleet calculations*,

Figure 24 Transport cost analyses and fleet selection in Caterpillar FPA
Software laboratory is continuously testing and analyzing available software, applying it to local problems and updating licences. Some of the softwares being tested are:

1. Itasca Software
2. SoilVision Office 2009
3. ArcGIS 9.2
4. Plaxis 3D Foundation
5. Carlson Software 2009 For AutoCAD with built in ICAD
6. TranSim VS