The 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
3. Visual ModFlow; AquaChem- groundwater flow and quality modelling
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

The laboratory of Mining Conditions

The purpose of the laboratory of mining conditions is to conduct experiments in applied and engineering geology, mining enviroment and rock mechanics. Web page: http://mi.ttu.ee/maelabor.

The laboratory is equipped with modern equipment as following

1. Press for determining compressive strength
2. Los Angeles Test for aggregate quality
3. Full set of sieves
4. Geotechnical shear strength measurer for soil and loos material

Preparation equipment

1. Rock saw
2. Drilling machine
3. Sander
4. Oven

Field laboratory

1. Point load test

2. Schmidt hammer
3. Noise meter
4. Vibration meter
5. Dust meter
6. Stratoscope for mine roof analyses
7. Air speed meter

Hydrogeology ang mining water laboratory

http://mi.ttu.ee/hydrolabor/

1. Chemical field laboratory
2. Water probe pump Grundfos MP1
3. Water level measurement devices
4. Water flow measurement propeller

Mining geodesy laboratory

http://mi.ttu.ee/markseiderilabor/

1. Tachymeter Trimbel M3Total Station
2. Distanc meters
3. Portable computers and palm computers
4. GPS and other land-surveying systems

Applied geology laboratory

http://mi.ttu.ee/geoloogialabor/

1. Polarisation Microscope
2. Radioactive radiation meter PAKRI-E

Video laboratory

http://mi.ttu.ee/videolabor/

1. Particulate online analyse system WipFrag
2. Online activity sampling

A press for determining compressive strength

Cylinder or cubic samples are used for determining compressive strength and modulus of elasticity. Results are used for analysing inclination, stability and other strength properties of rock and pillars for developing rock breaking technology.

Figure 1 Press for uniaxial compressive strength tests

Figure 2 Brazilian method

Los Angeles Test for aggregate quality

For measuring aggregate (limestone, gravel, granite) strength with Los Angeles method.

Figure 3 Los Angeles testing machine

Shear strength measurer

Figure 4 Shear strength measurements

Shear tests are used for analysing soil and earth stability and other properties

Full set of sieves

Sieve analyses are performed with set of sieves and shaker or with WipFrag sieving software.

Figure 5 Full set of sieves

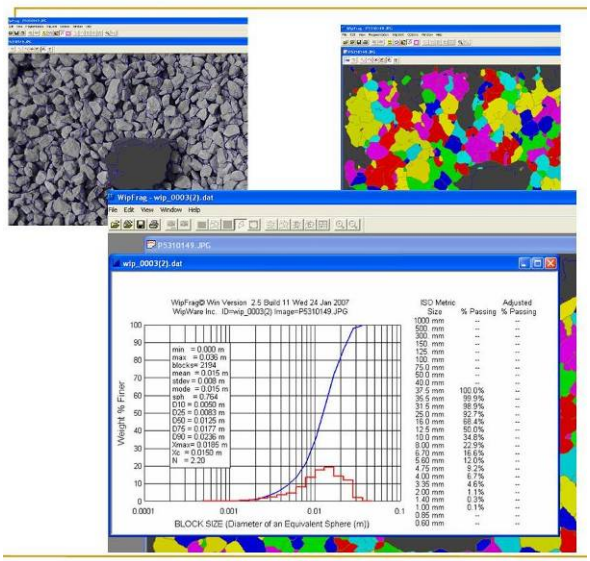

Figure 6 Particulate analyse system WipFrag

Polarisation Microscope

Figure 7 Polarisation microscope

Polarisation microscope is used for examining rocks and minerals.

Rock saw

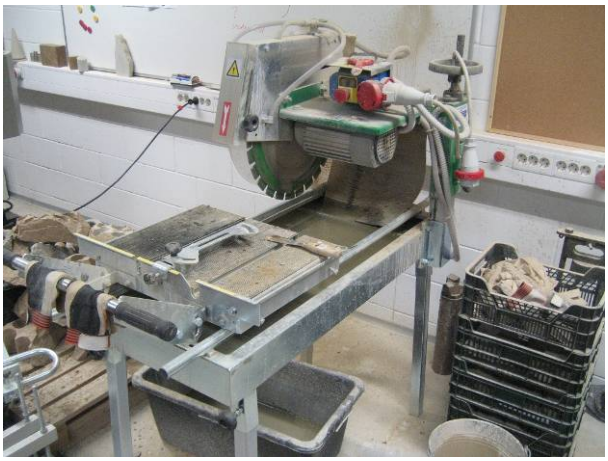

Figure 8 Rock saw

Rock saw is used for sawing marble, granite, concrete and other strong materials. Rock saw is used for preparing samples.

Drilling machine

Figure 9 Drilling machine

Drilling machine is used for boring core out of concrete, rock and building materials in laboratory.

Sander

Figure 10 Sander

Sander is used for preparing samples.

Oven

Figure 11 Oven

Oven is used for drying samples.

Point load test

Figure 12 Point load test

Point load test is used for measuring rock modulus of elasticity, compressive- and tensile strength, cut-ability on fieldwork. Testing samples do not need preparing.

Schmidt hammer

Figure 13 Schmidt hammer

Schmidt hammer determinates compressive strength and breakability.

Dust meter

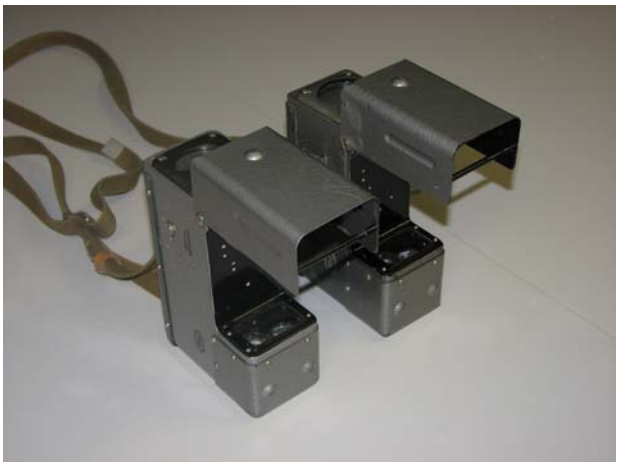

Figure 14 Dust meter

Measuring dust content in air.

Stratoscope

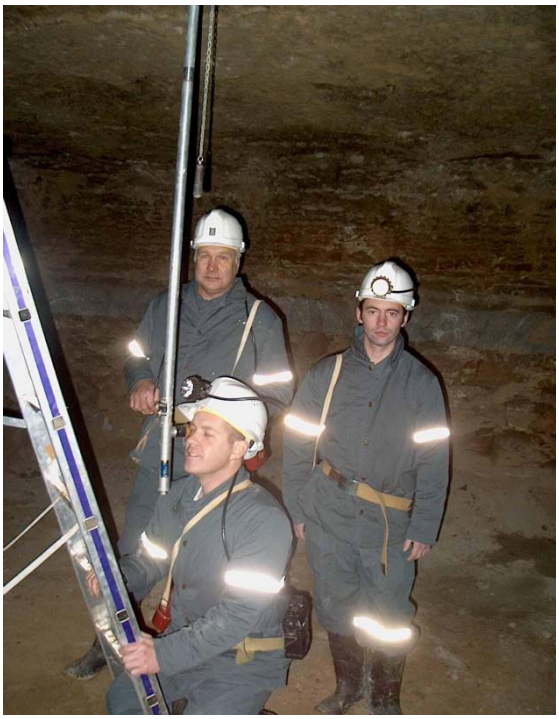

Figure 15 Stratoscope

Stratoscope is used for observing fractures, fissures and structure in layered deposits.

GPS systems

Figure 16 GPS

GPS units are used for locating measuring locations

Water probe pump MP1

Figure 17 Water pumping

Water pump is used for test pumping and determining filtration module.

Air speed measurer

Figure 18 Air speed measurer

Noise meter

Noise meter is used for measuring noise of mining machinery.

Figure 19 Noise meter

Radioactive radiation meter PAKRI-E

Radioactive radiation meter Pakri-E is used for measuring γ-, α- and β- radiation rate.

Figure 20 Radioactive radiation meter Pakri-E

Water level measurement device

Water level is measured with mechanical and electronic meters.

Figure 21 Water level measuring device

Water flow measurement propeller

Water flow is determined with propeller.

Figure 22 Water flow measurement propeller

Vibration meter

Vibration meter is used for measuring vibration of mining machinery and blasting.

Figure 23 Vibration meter

Distance measurements

Distances are measured with lasers, meters, and wheels.

Figure 24 Distance measurements

Fieldwork computer

Portable computers with GPS units are used for data capturing, 3D modelling and mapping field data

Figure 25 Portable computer

Tachymeter Trimble M3Total Station

Survey is performed with help of tachymeter, lasers and GPS

Figure 26 Tachymeter Trimble M3 Total Station

Field laboratory Hach Drel 2800

Minewater quality is measured with field laboratory

Figure 27 Measuring chemical composition of water

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.

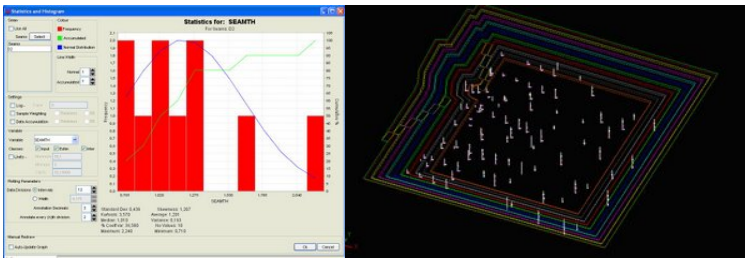

Figure 28 Statistics and histogram about seam D; Clockwise and anticlockwise ramp in mining with bench

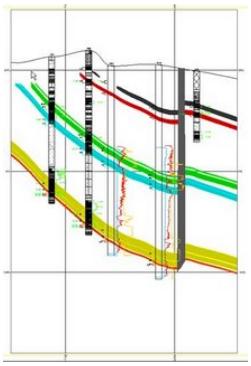

Figure 29 Cross-section of layers with drillholes, geophysics and grid net

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.

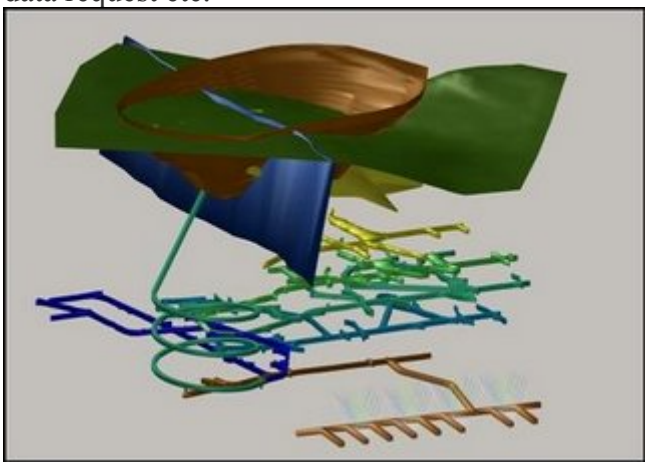

Figure 30 Granite underground mine project

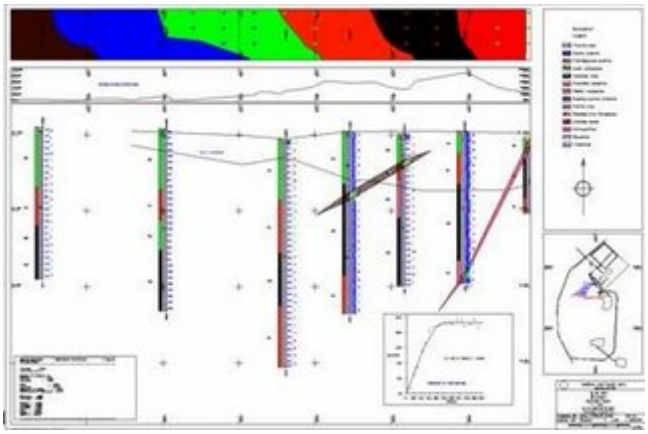

Figure 31 Analysis of mining conditions

Surpac Vision homepage and instructions **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.

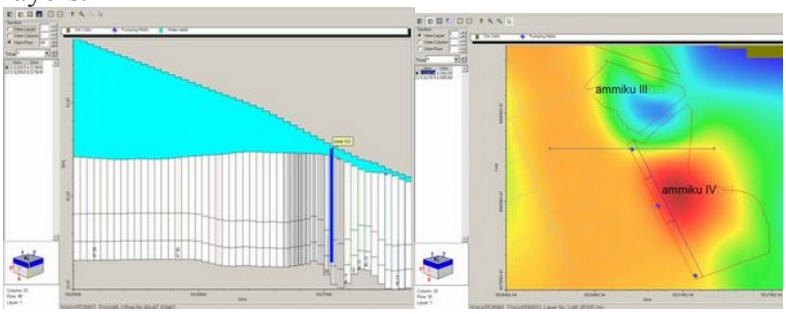

Figure 32 Cross-section and its location

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).

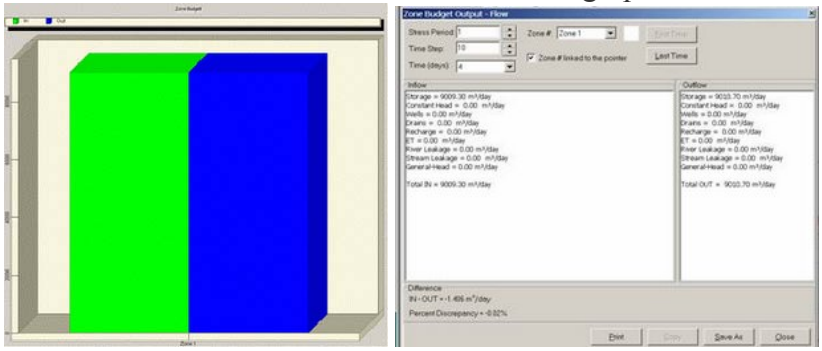

Figure 33 Incoming and outgoing water volumes

Water flow directions

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

Figure 34 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.

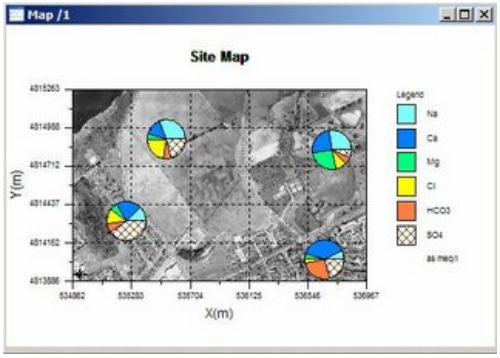

Figure 35 Map of water chemical contents

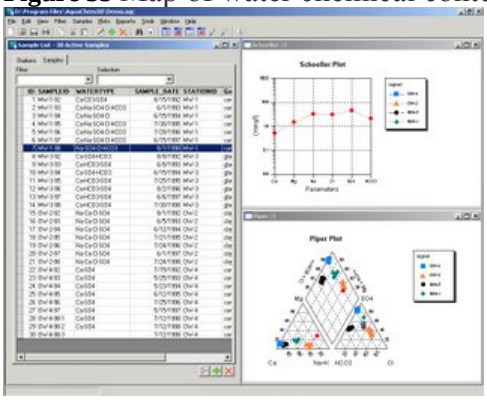

Figure 36 Water analysis illustration

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

AquaChem users instructions siit

Software MapInfo Professional

MapIfo 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.

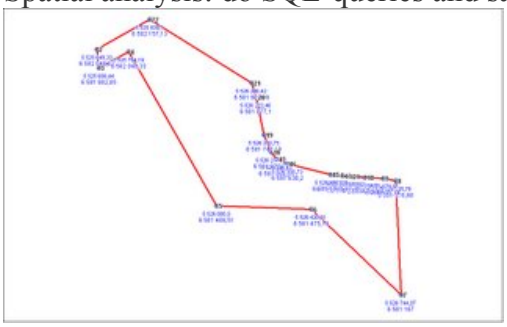

Figure 37 Plan created with coordinates

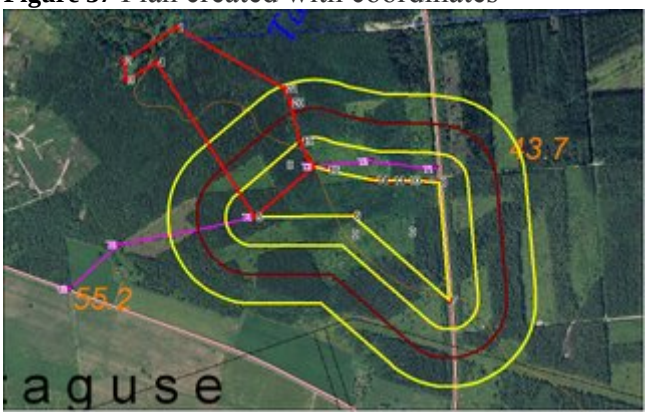

Figure 38 Buffering mining influences

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.

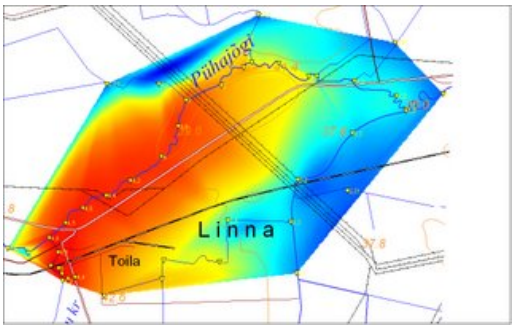

Figure 39 **Pollution model. This model is illustrative and does not own real values.**

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.

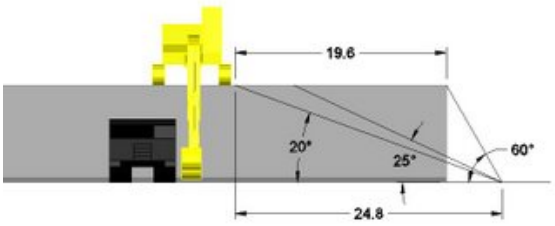

Figure 40 Bench properties

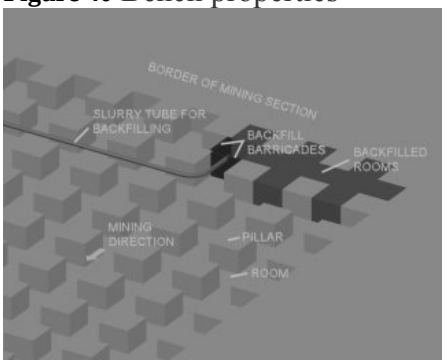

Figure 41 Mining with backfilling

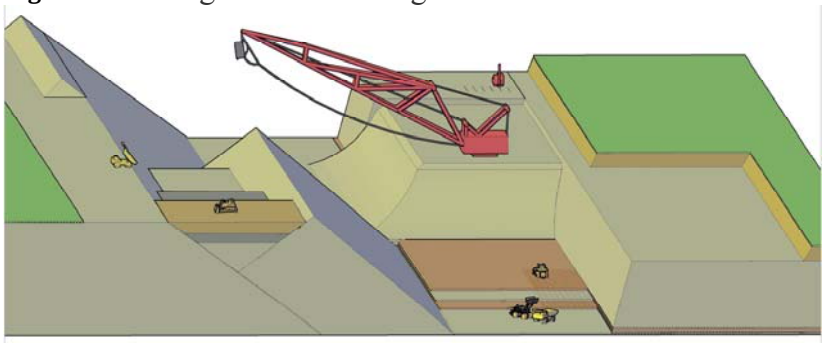

Figure 42 Opencast mining

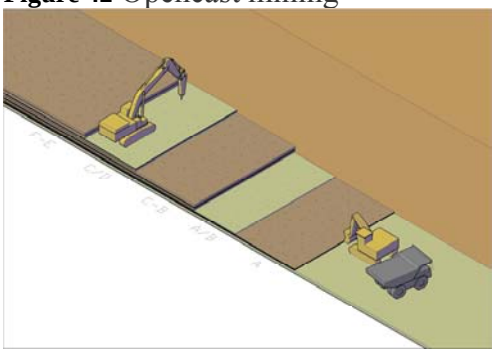

Figure 43 Breaking with hydraulic hammer

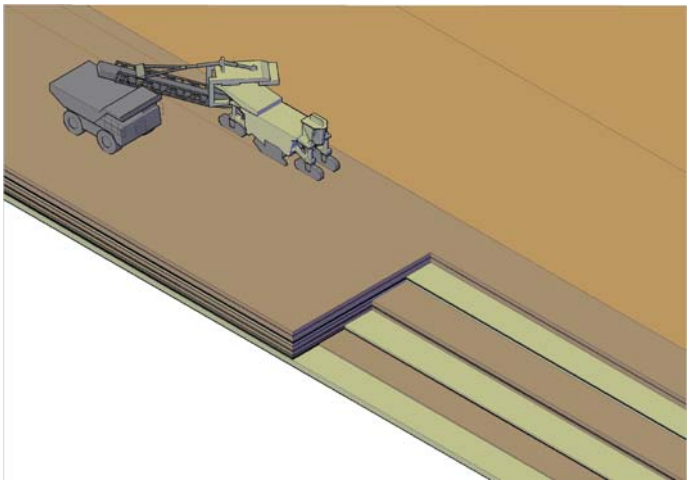

Figure 44 High selective surface oil shale mining technology modelled with AutoCad AutoCAD homepage http://www.autodesk.com/

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.

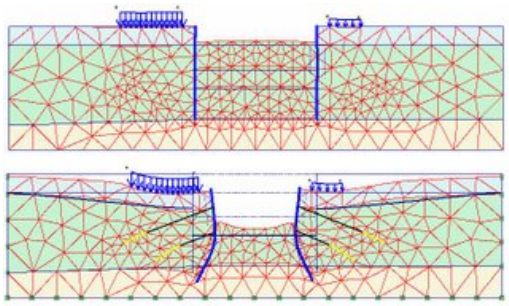

Figure 45 Situation before and after deformation

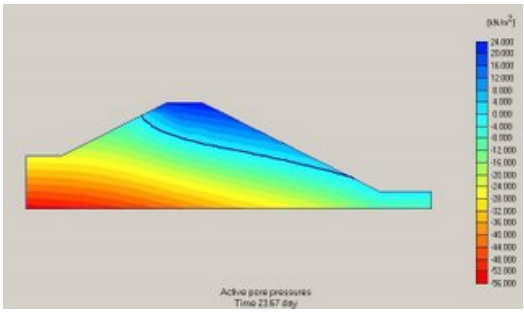

Figure 46 Pore pressure

Plaxis homepage http://www.plaxis.com/

WipFrag

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

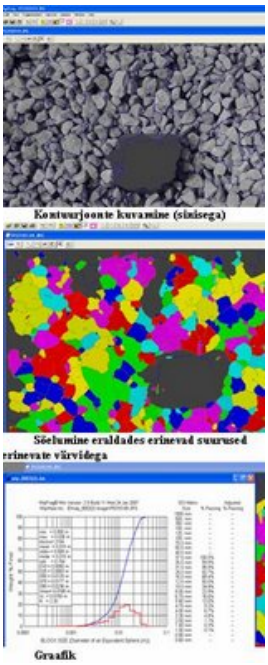

Figure 47 Work in 3 phase

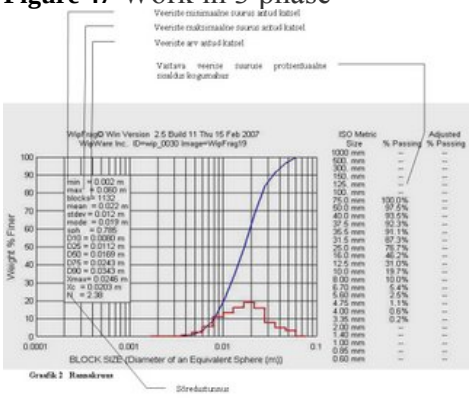

Figure 48 Explanation of the graph

WipFrag homepage http://www.wipware.com/wipfrag.php

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.

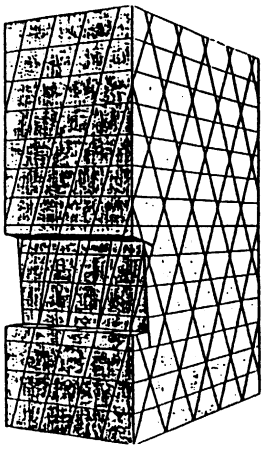

Figure 49 Joint system for the models

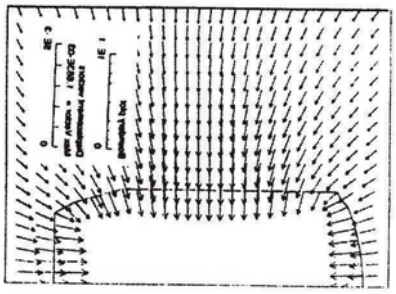

Figure 50 Cavern model in Maardu granite deposit

Caterpillar and Mining Department of TUT Mining specific software – ***parameters of pillars, productivity, mining equipment co-operation and fleet calculations,***

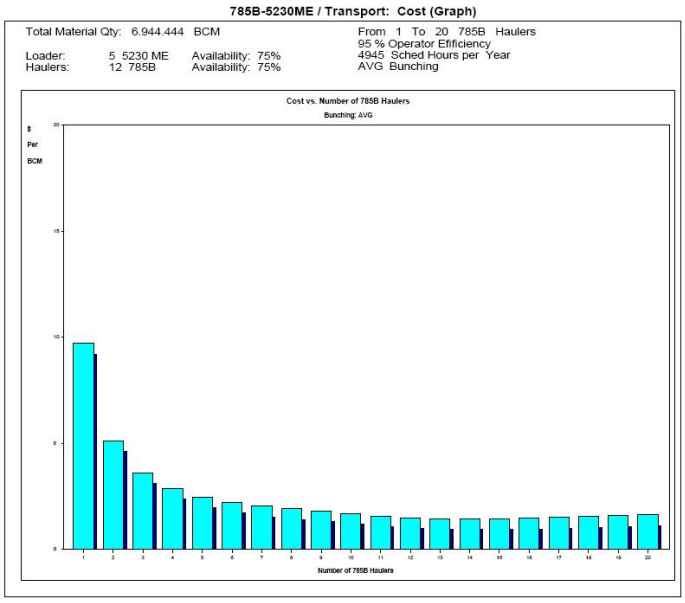

Figure 51 Transport cost analises and fleet selection in Caterpillar FPA

Software laboratory is continuously testing and analisyng available software, applying it to local problems and updating licences

Some of 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