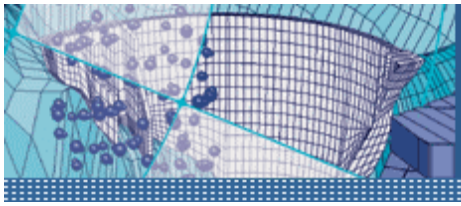


FLAC Version 6.0

***FLAC (Fast Lagrangian Analysis of Continua)* is a two-dimensional continuum code that can be applied to a broad range of problems in geotechnics, civil and mining engineering.**

***FLAC* 6.0** is characterized by a speedup **of double-precision version** by converting to Intel Fortran compiler. Also, it contains an **automatic re-meshing logic** for large-strain models including dynamic simulations. A new constitutive model for **modelling friction hardening behaviours** of granular soils was added. A generic **grid generation tool** is now embedded in the graphical user interface. Finally, a **compiled HTML help file** containing the contents of the *Command Reference*, *FISH in FLAC*, and *Example Applications* volumes from the *FLAC Manual* is now available.

FLAC/Slope is essentially used to assess the factor of safety of any kind of geometry.

FIELDS OF APPLICATIONS

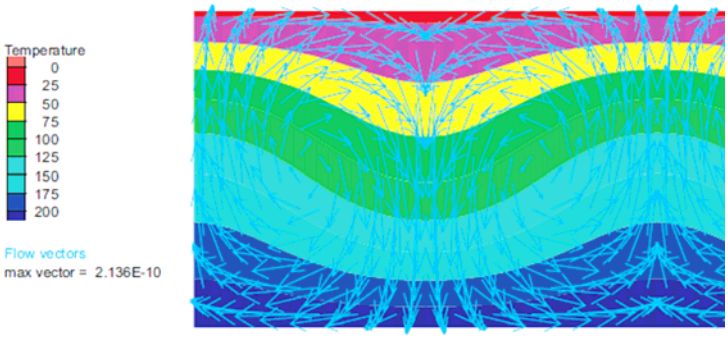
Thanks to its numerous functionalities, *FLAC* can be applied to:

- **Stability analyses of natural slopes and artificial embankments that may contain structural elements and be subjected to static or dynamic loading, in dry or wet environments**
- **Thermo-hydro-mechanical studies of dams that may contain reinforcement elements**
- **Mechanical analyses of underground excavations with complex phases**
- **Soil/Rock - Structure interaction modeling**
- **Modelling of non-linear behaviour and large deformations**
- **"Continuous-granular" coupling using *PFC* code along with *FLAC***

GENERAL FEATURES

GRID GENERATION

The "generate" command is used to "shape" the grid into the geometry of the object being modelled. The keywords "line, circle and arc" are available to define particular shapes. The keyword "table" can be used to move gridpoints to conform to the coordinate pairs specified in a table.
The model creation (geometry, geology, boundary conditions, excavations and/or loading phases) and its exploitation (parametric studies, interpretation of the results …) can all be done through the graphical user interface.



Convection cells in a heated, saturated, porous medium

CONSTITUTIVE MODELS

Many **Constitutive models** are available in *FLAC* **6.0**

✓ **Elastic** models
- Null (no material),
- Isotropic,
- Anisotropic.

✓ **Elasto-plastic** models
- Drucker-Prager,
- Hoek-Brown,
- Mohr-Coulomb,
- Double yield,
- Strain-softening,
- Ubiquitous-joint,
- Modified Cam-Clay.

✓ **Creep** models *(option)*
- Classical viscoelasticity,
- Two-component power law,
- WIPP,
- Burger,
- Crushed-Salt.

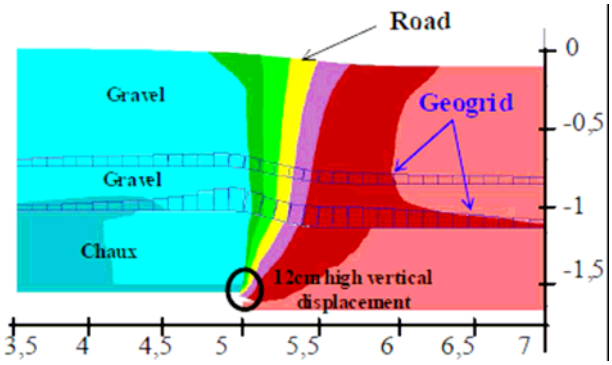
✓ **Thermal** models *(option)*
- Temperature-dependent thermal conductivity,
- Anisotropic thermal conductivity,
- Isotropic thermal conductivity.

Possibility to develop one's own constitutive models in C++ (*available as an option)*. They may be used in most of the Itasca codes. The user can also access constitutive models developed by other *FLAC* users ; they are available on our web site http://www.itasca-udm.com

INTERFACES

Interfaces are used to represent a plane on which sliding or separation may occur (e.g. bedding plane in a geologic medium, interface between foundation and soil/rock …)

STRUCTURAL ELEMENTS



***Model including geogrids**: distribution of axial forces within the geogrids and vertical displacements showing the spreading of deformations along the surface.*

- **Beam elements** are used to represent a structural member in which bending resistance and moments are important (shallow foundation, retaining wall).
- **Liner Elements** represent beam elements that include a failure criterion based on both bending stresses and axial thrust (concrete, shotcrete tunnel linings)
- **Cable elements** cannot sustain a bending moment (nails, rockbolts, cable bolts and tiebacks - pre-tensioned or not).
- **Pile elements** can transfer normal, shear forces and bending moments to the grid (foundation piles).
- **Rockbolt elements** are pile elements that include the strain-softening behaviour of the grout material, tensile rupture of the element, and the effect of changes in confining stress around the reinforcement.
- **Strip elements** are cable elements that can simulate tensile rupture, and whose interface shear behaviour is defined by a non-linear shear failure envelope that varies with confining pressure (reinforcing strips installed within a soil embankment

INITIAL AND BOUNDARY CONDITIONS

Certain gridpoints and zone variables can be initialized or fixed: stress state, pore pressures, saturation, velocity, temperature, and mechanical pressure.

LOADING

- **Mechanical**: simulation of an excavation, a stress field, a surface load …
- **Hydraulic**: 1) set up of pore pressures for an effective stress calculation; 2) uncoupled flow-mechanical analysis (mechanical steps are done once the hydraulic loading is set up and a hydraulic equilibrium reached); 3) fully coupled flow-mechanical modelling (both processes interact)
- **Thermal** (*option*): simulation of transient heat conduction in materials and the development of thermally-induced displacements and stresses. The thermal analysis may be coupled to the mechanical and the fluid calculations.
- **Creep** (*option*): modeling of visco-plastic behaviour of certain materials.
- **Dynamic** (*option*): simulation of an earthquake or an explosion. Hysteretic damping can be used to incorporate directly into the simulation a strain-dependency of shear modulus and damping functions

FISH MACRO-LANGAGE

All ITASCA codes possess the built-in programming language *FISH* that allows users to customize their analyses to suit their needs. Loading patterns, servo-control of test conditions and grid generation sequences may be defined using *FISH*.

INTERNATIONAL RECOGNITION

ITASCA Consultants, an expert in numerical modelling, offers a new vision of numerical solutions thanks to its know-how and its software solutions. At the crossroads of consulting and Research & Development, Itasca Consultants provides computer modelling solutions for both the public sector and consulting firms.

ASSISTANCE

Installation and general codes operations are provided for free by phone, fax or email. Web site support (**www.itascacg.com)** includes free codes updates and a « Frequently Asked Questions » (FAQ) page.

Training courses, general or tailored to users' needs, are regularly organized by ITASCA. Do not hesitate to contact us.

As provider of consulting services, ITASCA provides tailored help to solve technical problems and write specific procedures.

ITASCA Consultants, s.a.s.

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