FLAC® VERSION 8.1

Explicit Continuum Modeling of Non-linear Material Behavior in 2D

ABOUT *FLAC*

FLAC is a numerical modeling code for advanced geotechnical analysis of soil, rock, and structural support in two dimensions. *FLAC* utilizes an explicit Lagrangian finite-volume formulation that can model complex behaviors not readily suited to FEM codes, such as problems that consist of several stages, large displacements and strains, non-linear material behavior, and unstable systems.

FEATURES

GENERAL

- Large-strain simulations
- Predict multiple interacting failure mechanisms (failures can propagate)
- No need to specify a slip surface or failure mechanism
- Extensive solution controls and options
- Multi-physics modeling
- Track histories of model properties
- Built-in scripting language (*FISH*)
- 64-bit, multi-threaded solutions
- Licenses: standard, network, and lease
- Standard license can move between computers and with No CPU locks
- Project management tools
- All operations available via the GUI, written command, and *FISH* scripting
- Automatic re-meshing tools

GRIDS and GEOMETRY

- Visual model geometry tools
- Virtual grid manipulation
- Library of pre-built geometries
- Import grid geometry from CAD data

MATERIALS and MODELS

- Seventeen built-in material models

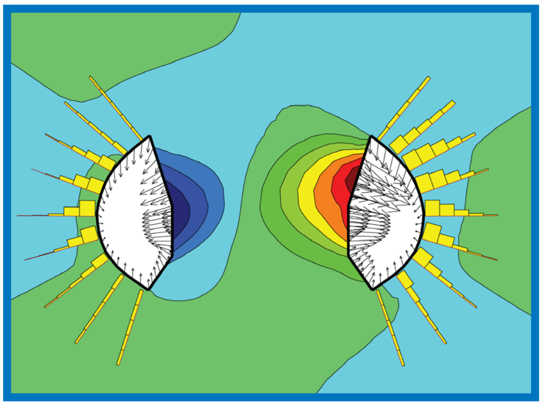
- Null (excavation)
- Elastic, isotropic
- Elastic, transversely isotropic
- Drucker-Prager
- Mohr-Coulomb
- Ubiquitous-joint (UBJ)
- Strain hardening/softening
- UBJ, bilinear strain hardening/softening
- Double yield
- NorSand (liquefaction)
- Hoek-Brown
- Modified Hoek-Brown
- Modified Cam-clay
- Cap-yield soil
- Simplified Cap-yield soil
- UBJ, Elastic Anisotropic
- Swelling
- Plastic Hardening (PH) with small-strain stiffness toggle
- Soft-Soil

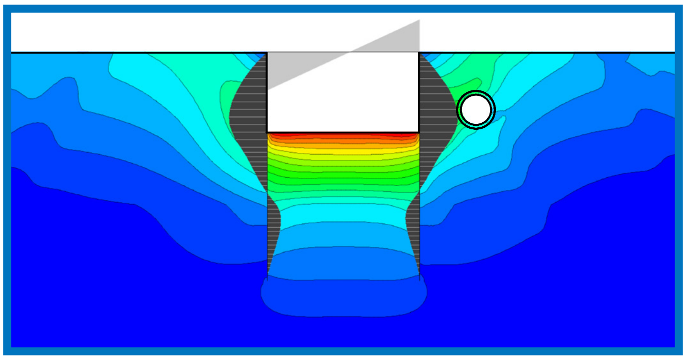
- Null model for sequencing/excavation
- Built-in materials library
- Option to add user-defined models
- Statistical distribution of any property

BOUNDARIES and CONDITIONS

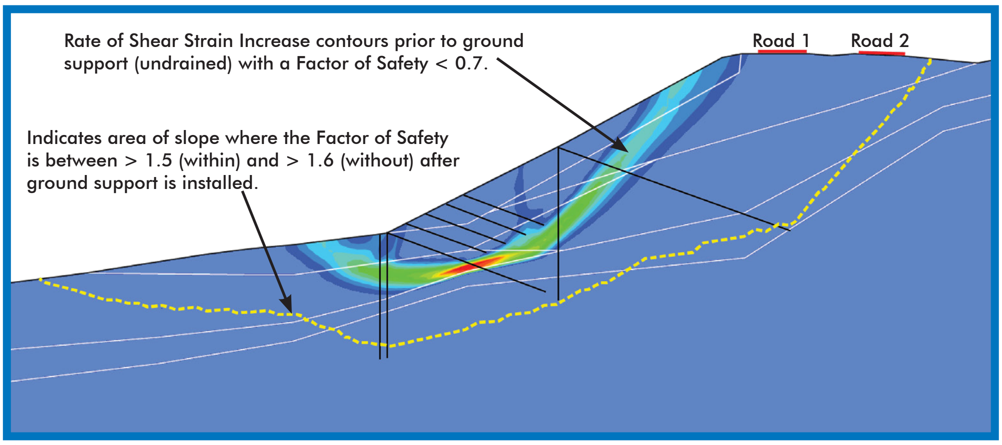
- Displacement and stress boundaries
- Artificial boundaries

FLAC model of a supported tunnel constructed in several stages. Horizontal ground displacement, displacement-vectors, and rock bolt loads are shown. ▶





◀ *FLAC* model of an excavation constructed in saturated ground. The excavation is dewatered during construction and is supported by diaphragm walls that are braced at the top by horizontal struts. Total displacement contours, wall moments, and strut horizontal displacements are shown.



▲ *FLAC* model results of a soil slope subjected to the load of two new highways (red lines) near the crest before and after a ground support design is installed. Different soil materials are delineated by the solid white lines and the ground support is represented by black lines. The final support design consisted of a combination of drilled shafts, pre-tensioned grouted anchors, and fiberglass soil nails.

FEATURES (continued)

- Structural support elements (beams, liners, cables, piles, rockbolts, strips, support members, and shells)
- Axisymmetrical shell structural elements
- Boundary relaxation tool to simulate the 3D effect of an advancing tunnel
- Water table to get effective stress
- Interfaces for faults, joints, and artificial boundaries

SOLUTIONS and SEQUENCING

- Continuous or sequenced solutions
- Project tree and clone models make for easy parametric analyses
- Automatic Factor of Safety calculations, including water, structural support elements, and material properties
- Safety mapping using the built-in automatic Factor of Safety analysis
- Groundwater flow calculation
- Coupled calculations
- Multi-threaded mechanical calculations
- *FLAC/Slope* is included

POST PROCESSING

- Multiple graphical output formats
- Easily export results tables
- Export plot histories as CSV data
- Extensive visual plotting facilities
- Plot charts and tables, including moment-thrust diagrams
- Export bitmap image series from any view to generate videos

NEW IN VERSION 8.1

- Improved tools:
  - Enhanced movie plotting
  - New commands and keywords
  - New and updated *FISH* intrinsics
  - Improved automatic rezoning
  - TABLE/HISTORY/PROFILE updates
  - Factor of Safety contouring update
  - Improvements to structural elements
- New and updated constitutive models:
  - NorSand liquefaction model
  - Soft-Soil model for soils undergoing significant compression
  - Soft-Soil-Creep model (creep option)
  - Plastic-Hardening Model updated to account for small-strain stiffness
- User interface enhancements and a number of other new capabilities

AVAILABLE OPTIONS

DYNAMIC

- Permits two-dimensional, plane-strain, plane-stress, or axisymmetric, fully dynamic analysis
- Can be coupled to structural elements, groundwater flow, and optional thermal model
- Applications include earthquake engineering, seismology, and mine rockbursts
- Seismic Wizard to pre-process signals for dynamic analyses

TWO-PHASE FLOW

- Allows modeling of the flow of two immiscible fluids through a porous media where one fluid displaces another with no mass transfer between them (e.g., reservoir simulation)

CREEP

- Used to simulate materials that exhibit time-dependent material behavior
- Includes nine creep models: viscoelastic, power-law, WIPP, Burgers-creep viscoplastic, power-law viscoplastic, power-law viscoplastic with ubiquitous joints, WIPP-creep viscoplastic, crushed-salt, and Soft-soil-creep.

THERMAL

- A conduction model allows simulation of transient heat conduction in materials and the development of thermally induced displacements and stresses
- An advection model takes into account the transport of heat by convection to simulate temperature-dependent fluid density and thermal advection in the fluid

USER-DEFINED C++ MODELS (UDM)

- Permits users to create their own *FLAC* constitutive model. The model must be written in C++ and compiled as a DLL file; it can be loaded as needed
- A website for exchange of user-defined *FLAC* models for can be found at:

www.itascacg.com/udms

TRY THE DEMO

Itasca is pleased to offer free demo versions of all software for download. There is no restriction to the length of time you can use the demos, but some model size restrictions apply.

www.itascacg.com/demos

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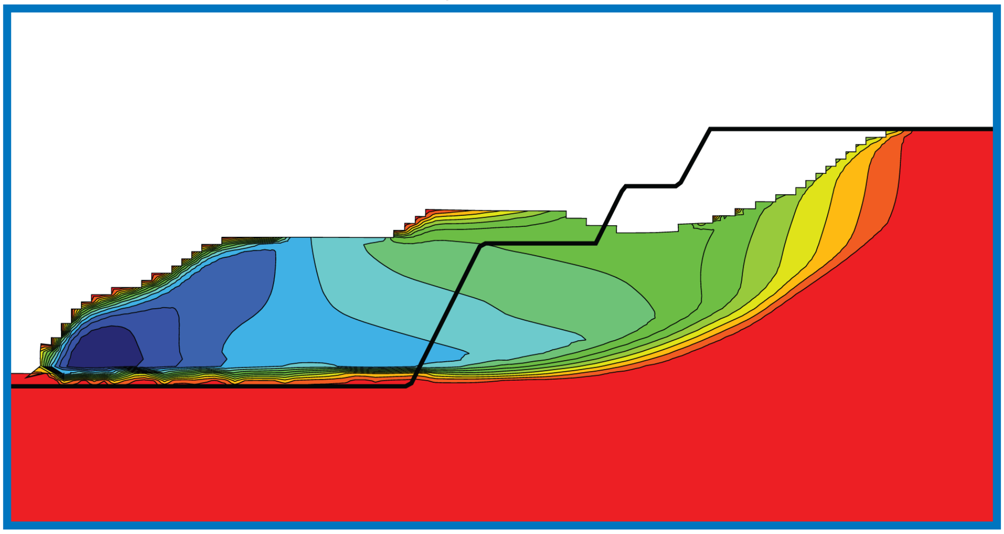
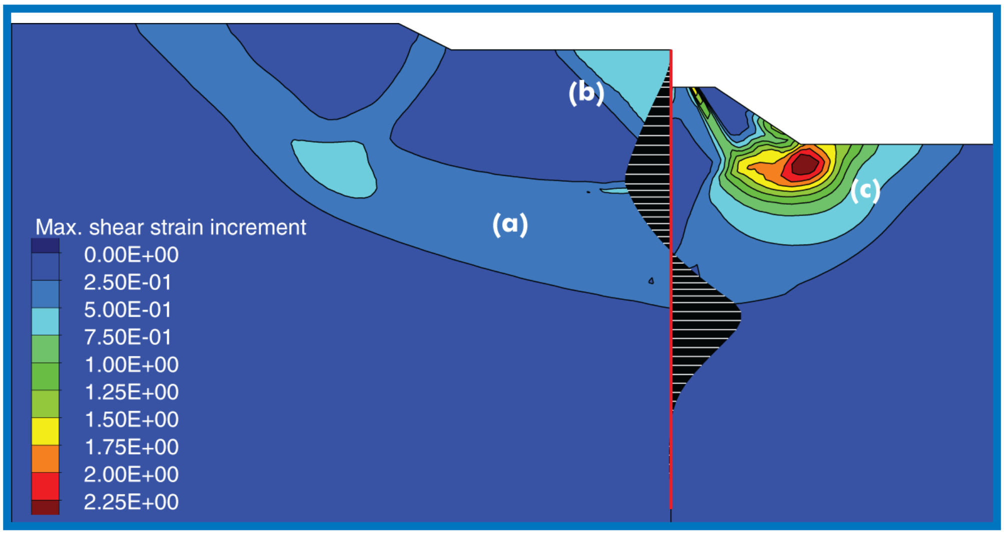
▼ Large-strain *FLAC* slope model (circular inset) using automatic rezoning logic to map existing stresses, velocities, and displacements onto a new, more regular grid. This allows the simulation to continue with numerical stability and estimate the extent of failure. Horizontal displacements are shown.





▲ *FLAC* is capable of modeling multiple physical failure mechanisms as they evolve naturally. In this example, a slope is reinforced with a sheet pile wall (SPW), shown in red. A factor of safety less than 1 is determined due to (a) global deep seated shear failure, (b) an active wedge behind the SPW, and (c) the bearing capacity of the lower-most slope toe. The bending moments of the SPW are also shown in black.