

FLAC^{3D} Version 3.1

FLAC^{3D} (Fast Lagrangian Analysis of Continua in 3D) is an advanced three dimensional continuum modeling tool for Geotechnical Analysis of Rock, Soil, and Structural Support.

FLAC^{3D} Version 3.1 includes a version (in addition to the 32-bit version) that is operable on a 64-bit processor computer running the Windows XP X64 operating system. The 64-bit version will allow a virtually unlimited model size. The new Nodal Mixed Discretization (NMD) technique provides more accurate solutions for plasticity analyses with models composed of linear tetrahedral zones, overcoming the over-stiff behaviour observed during plastic flow with this type of zone. The new embedded liner logic extends the previous single-sided liner interaction to two sides. Mechanical calculations of the main grid are now multithreaded and take advantage of multiple processors (e.g., dual processors or a dual core processor). Parallel processing is a standard feature of *FLAC^{3D} 3.1*; speed increases of approximately 1.8 times have been noted on two processor systems. A compiled help file containing the Command Reference, *FISH* Reference, and Example Applications volumes from the *FLAC^{3D} Manual* is now available on *FLAC^{3D}*'s "Help" menu.

FIELDS OF APPLICATIONS

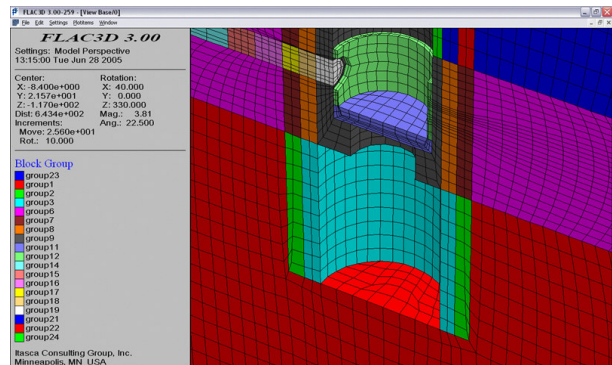
Thanks to its numerous functionalities, *FLAC^{3D}* can be applied to:

- 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
- Modeling of non-linear behaviour and large deformations
- "Continuous-granular" coupling using *PFC^{3D}* code along with *FLAC^{3D}*

GENERAL FEATURES

GRID GENERATION

FLAC^{3D} provides **built-in primitive shapes** allowing the creation of many mesh topologies. **3Dshop**, a new *FLAC^{3D}* option, includes a powerful modeller that can be used to create or import complex models. The *3DShop* automatic hexahedral mesh generator produces multi-material meshes with coinciding nodes at material boundaries. It uses fuzzy-logic block decomposition to subdivide a complex shape into its constitutive blocks and mesh each block according to the parameters specified by the user.



FLAC^{3D} grid using 3Dshop

CONSTITUTIVE MODELS

Many **Constitutive models** are available in *FLAC^{3D}*.

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

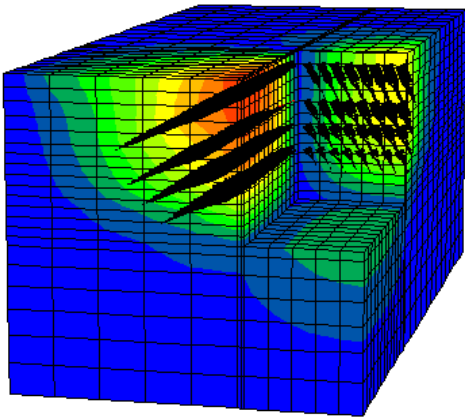
- ✓ **Elasto-plastic** models
 - Drucker-Prager,
 - Hoek-Brown,
 - Mohr-Coulomb,
 - Double yield,
 - Strain-softening,
 - Ubiquitous-joint,
 - Modified Cam-Clay..

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

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^{3D}* 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 ...).



Displacement contours and axial forces in cables, after 5 excavation steps.

STRUCTURAL ELEMENTS

- **Shell Elements** are used to represent a structural member whose loading and bending resistances are important and, in which the displacements caused by transverse-shearing deformation can be neglected (shallow foundation, building floor).
- **Liner Elements** are shell elements with a shear-directed frictional interaction with the host medium (shotcrete-lined tunnels, retaining walls).
- **Geogrid Elements** are shell elements that cannot sustain a bending moment and that have a shear-directed frictional interaction with the host medium (geotextiles, geogrids).
- **Beam elements** are used to represent a structural member in which bending resistance and moments are important (shallow foundation, retaining wall).
- **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.

INITIAL AND BOUNDARY CONDITIONS

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

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.hcitasca.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.



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