UDEC Version 4.0

***UDEC* (*Universal Distinct Element Code*) is a two-dimensional discontinuum code well suited for problems involving jointed rock systems or assemblies of discrete blocks subjected to either quasi-static or dynamic loading.**

UDEC 4.0 can now perform joint fluid flow simulations of two immiscible and slightly compressible fluids. This has important applications in fields as diverse as the oil industry, agriculture, pollution control, waste disposal, gas storage, and slope stability. Cables and beams were updated in order to take into account hydrostatic pressures and heat. With *UDEC* 4.0, data can be passed rapidly between two or more Itasca codes running on the same machine. One possible application would be embedding PFC^{2D} particles inside an excavation in *UDEC* thus providing an efficient boundary condition for the ball assembly. A new graphical user interface, the *GIIC* (Graphical Interface for Itasca Codes), makes all features in *UDEC* available by using graphical tools. Features in the *GIIC* help users for graphically defining the geometry, the geology, the jointing systems and the boundary conditions of the model. Menu access to *UDEC*'s extensive plotting facilities is also provided. Finally, a factor of safety calculation was included.

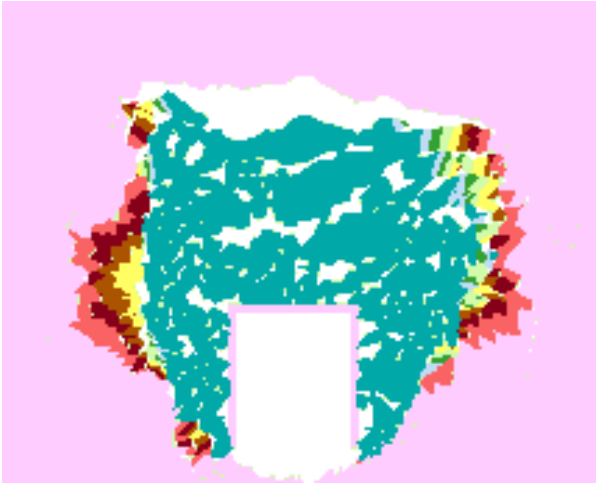
APPLICATIONS IN THE FOLLOWING FIELDS

- **Stability analysis of slopes, retaining walls, or open pits;**
- **Study of fractured media or masonry structures subjected to monotonous or cyclic loading;**
- **Stability analysis of dams on jointed rock foundations under hydraulic and/or dynamic conditions;**
- **Thermo-hydro-mechanical studies of fractured media dedicated to host nuclear waste.**

GENERAL FEATURES

MODEL GENERATION

The discontinuous medium is represented by an assembly of **rigid and/or deformable blocks**. These latter blocks are made of elements that behave according to stress/strain laws. UDEC 4.0 contains two automatic joint generators that create joint patterns described in terms of angle of joint track to x-axis, trace length of joint segment, gap length between joint segments, spacing normal to joint tracks … The following commands "arc", "tunnel", "crack" and "jset" allow an easy creation of boundary shapes.



Rock mass failure around an excavation

CONSTITUTIVE MODELS

Several block and joint material built-in constitutive models are provided in *UDEC*:

Blocks:

- **Elastic models**
  - Null (excavated material)
  - Isotropic
- **Elasto-plastic models**
  - Drucker-Prager
  - Mohr-Coulomb
  - Ubiquitous-joint
  - Strain hardening/softening
  - Double yield
- **Thermal models**
- **Creep models (with C++ option)**
  - Classical viscoelastic
  - Power law
  - WIPP, WIPP modified
  - Burger
  - Crushed-Salt

Joints:

- Coulomb slip (point contact or joint area contact)
- Continuously yielding
- Barton-Bandis (optional model)

Possibility to **develop one's own constitutive model in C++** (*available as an option)*. This CPPUDM option also gives access to more than 15 block material constitutive models (Cam-Clay, double-yield, Drucker-Prager, Finn, orthotropic, and creep models).

STRUCTURAL ELEMENTS

They provide the ability to model support.

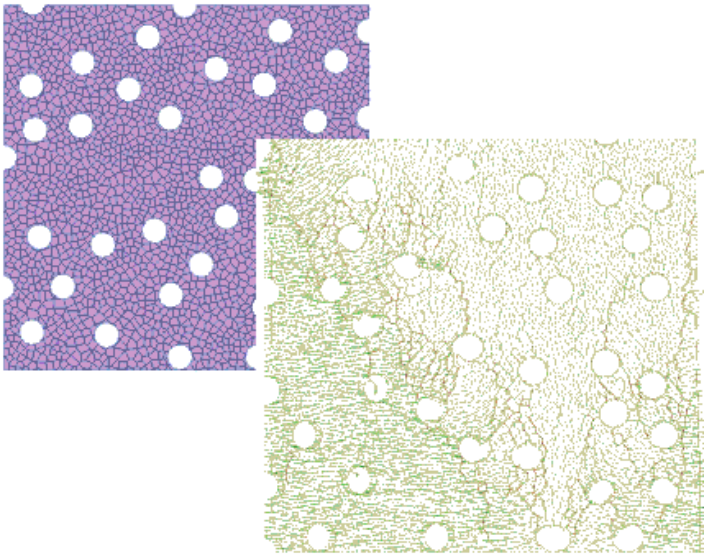
- **Beam elements,** used to represent a structural member in which bending resistance and limited bending moments are important (concrete lining, steel sets …).
- **Support members,** intended to model hydraulic or wooden props or packs.
- **Cables,** reinforcement elements that cannot sustain a bending moment (nails, rock bolts, cable bolts and tiebacks - pre-tensioned or not).

INITIAL CONDITIONS

Certain gridpoint and zone variables can be initialized: stress state, pore pressures, saturation, velocity, temperature, mechanical pressure …

BOUNDARY CONDITIONS

Certain gridpoint and zone variables can be fixed: stress state, pore pressures, saturation, velocity, temperature, mechanical pressure, absorbing boundaries …



Top : Idealized volcanic tuff.
Bottom : Damage (fractures in red; displacement vectors in green)

LOADING

- **Mechanical**: simulation of an excavation, a stress field, a surface load …
- **Hydraulic**: modeling of fluid-flow through fractured media, possibly coupled to mechanical and thermal processes.
- **Thermal**: 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 the visco-plastic behaviour of certain materials.
- **Dynamic**: 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 block generation sequences are example uses of *FISH*.

ASSISTANCE

UDEC is delivered with an electronic copy and a paper copy of the user's manual (7 volumes). Users receive regularly *Groundworks*, ITASCA's software electronic newsletter, containing news, tips, development plans, and example applications.

Free assistance (phone/fax/email) helps you in the choice of the code, then in the installation of the program. Training courses, general or tailored to users' needs, are regularly organized by ITASCA. Latest updated are available for free download from our website **www.hcitasca.com.**

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