

ABOUT 3DEC

3DEC is numerical modeling software for advanced engineering analysis of soil, rock, blocky structures, ground water, and structural support in three dimensions. 3DEC simulates the response of discontinuous media (such as jointed rock or masonry structures) that are subject to either static or dynamic loading.

A discontinuous medium is modeled as an assemblage of polyhedral blocks that may be rigid or made deformable through zoning. Fractures are treated as boundary conditions between blocks. Motion along discontinuities is governed by linear and nonlinear force-displacement relations for movements in both the normal and shear directions.

FEATURES

GENERAL

- Uses an explicit solution that provides a realistic path-dependent post-peak failure behavior in joints and zones, as well as simulation of large displacements
- Blocks may be rigid or deformable
- Joints may be assigned their own constitutive models and properties
- Joint and/or matrix fluid flow with flow between joints and matrix
- Structural elements with general coupling to blocks
- Discrete fracture network generator
- Simulate synthetic microseismicity
- FISH and Python scripting languages provide powerful user-control to parameterize, analyze, and modify nearly every aspect of the simulation
- Built-in text editor checks FISH syntax and allows context sensitive help
- Record model state histories
- Project management tools
- USB key, network, and web licenses
- Annual subscription or perpetual licenses

GRAPHICAL USER INTERFACE

- Flexible and efficient user interface (UI)
- Interactive model plot views and measurement and querying tools
- Multiple plot export formats
- · Easily export tables and charts as CSV files

BOUNDARIES/CONDITIONS

- Displacement and stress boundaries
- Fractures or joints between blocks are treated as boundary conditions
- Quiet (non-reflecting) and free-field boundaries (option)



▲ 3DEC model (left) indicating the factor of safety calculated for a faulted open pit mine (red < 1.0 and gray > 1.3) and (right) showing the collapse mechanism for an ancient stone masonry tower subjected to seismic forces.



3DEC model of an underground tunnel in a joint rock mass. The tunnel is supported by rock bolts which are simulated using Hybrid bolts, which provide a more realistic resistance to fracture shear displacement of a rockbolt in a jointed rock mass.

www.ltascaCG.com/3DEC



MODEL CONSTRUCTION

- Automatic tetrahedral mesh generation in fully deformable blocks
- Build models directly from closed geometry surfaces (e.g. DXF)
- Cut blocks with DXF geometry
- Create blocks from VRML files
- Built-in voronoi block generator
- Convert tetrahedral zones into bonded block models (BBMs)
- Automatic tunnel region generator
- Import structural element geometry from CAD data
- Define groups using geometric and property-based ranges
- Built-in tools to statistically generate discrete fracture networks (DFNs)
- Import 3DEC grids created by Griddle Seismic wizard to pre-process ground motion

CONSTITUTIVE MODELS

- 19 standard constitutive models
- 10 creep constitutive models
- Standard joint models:
 - Elastic
 - Mohr-Coulomb
 - Nonlinear
 - Continuously yielding
 - Softening healing Mohr-Coulomb
 - Bilinear Mohr-Coulomb
 - Power Law Creep
- User-Defined Models (UDM option)

SOLUTIONS / SEQUENCING

- Continuous or sequenced solutions
- Bonded block modeling (BBM) to
- simulate intact rock fragmentation
- Automatic time-step calculation
- Automatic factor of safety (FOS) based on the Shear Strength Reduction method for Mohr-Coulomb, Hoek-Brown, and Ubiquitous joints
- Nodal mixed discretization for even more accurate plastic solutions
- Effective stress (pore-pressure)
- Mechanical models can be coupled with both fluid-flow and thermal (option) models

FLUID FLOW

- Fluid flow through fractures and matrix (blocks between fractures)
- Fracture fluid pressure and matrix fluid pressures are also coupled
- · Mechanical-fluid coupling
- Simulate the mechanical effects and transport of proppant in joints

STRUCTURAL ELEMENTS

TASCA

- Non-linear structural elements for ground support
- Elastic finite element blocks (20 or 28-noded hexahedral)
- Hybrid bolts add dowel segments to cable bolts to resist shearing and opening across joints
- All structural elements are compatible for dynamic (option) simulations

COMMANDS AND SCRIPTING

- Commands are intuitive, easy to learn, and easy to apply
- Automatic conversion tool to translate 3DEC 5.2 data files to current syntax
- Powerful, built-in text editor
- A record of all events modifying the model (commands, FISH, mouse) for undo and repeatable functionality
- Inline FISH (within a command)
- FISH management control set displays the current values of FISH variables and functions, even during cycling
- Multi-threaded FISH for much faster iterative calculations
- Integrated Python scripting UPDATED

HELP

- HTML-based documentation
- Access Help at the command prompt or within a data file [F1]
- Access Keyword Help [? + Enter] at the command prompt to list the possible commands/keywords given the preceding command input
- Access Inline Help [Ctrl + Spacebar] to auto-complete commands UPDATED

OPTIONS

DYNAMICS

- Permits three-dimensional, fully dynamic simulation of wave propagation for the analysis of earthquakes, blasts, impulse loading, rock bursts, and particle flow
- May be coupled to structural elementsDynamic boundaries include non-
- reflecting (quiet) and free-field

USER-DEFINED C++ MODELS (UDM)

 Permits users to create their own 3DEC constitutive model written in C++ for zones and joints

Exchange of user-defined 3DEC models for can be found at:

www.ltascaCG.com/UDMS

THERMAL

- Simulation of transient heat conduction in materials
- Development of thermally induced displacements and stresses
- Couple to mechanical and fluid models

IMASS

- Unique Itasca constitutive model
- Captures progressive failure and disintegration of the rock mass due to induced stress changes
- Underground/surface mining applications, including caving
- · Available as an annual lease

WHAT'S NEW

SOLVE SERIOUSLY FASTER

- Steady state models up to 10x faster
- Dynamic time steps up to 3x larger
- Save/restore models up to 4x faster
- Plotting is up to 5x faster

HIGHSPEED DYNAMICS

• Maxwell damping for accurate models solved 10x to 200x faster for practical 3D site response and ground-structure interaction

IMPROVED JOINTS AND BBM

- Specify joining based on contacts
- Cutting doesn't unjoin existing joints
- Cut blocks via range logic
- Random BBM tetrahedral block size
- Faster BBM models by disabling vertexto-vertex contacts

LOOK AND FEEL

- More flexible UI and more efficient plotting
- Split the UI into different workspaces

CONSTITUTIVE MODELS

- Concrete Model
- Columnar-Basalt
- Von-Mises

NON-LINEAR STRUCTURAL ELEMENTS

- Non-linear beams, piles/rockbolts, shells, geogrids, and liners for ground support
- Plastic hinges are calculated based on a numerical integration scheme

• Couple 3DEC v9 to FLAC3D v9

Timoshenko beams

ONLINE RESOURCES

Demonstration Software

www.ltascaCG.com/DEMOS

FORUM.ItascaInternational.com

ACADEMY.ItascaInternational.com

ITASCA Software can be purchased on-

line by visiting our e-commerce site:

www.ltascaSoftware.com/3DEC

Or let's start a conversation:

SALES@ItascaSoftware.com

Itasca's Software Forum

Itasca Software Academy

www.ltascaCG.com/HELP

Technical Support

SALES

Log-normal DFN distributions

· Better plotting and new examples

AND MORE ...