

3DEC™ VERSION 5.2

Distinct-Element Modeling of Jointed and Blocky Material in 3D

ABOUT 3DEC

3DEC is numerical modeling software for advanced engineering analysis of soil, rock, blocky structures, 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
- Groundwater joint fluid-flow
- Beam and cable structural elements (and liners, optionally), with general coupling to blocks
- Discrete Fracture Network generator
- 64-bit version
- *FISH*, Itasca's built-in scripting language, provides powerful user-control to parameterize, analyze, and modify nearly every aspect of the simulation
- Built-in text editor provides command syntax checking and context sensitive help
- Record model state histories
- Project management tools
- HTML help reference tools
- Network or single-user licensing

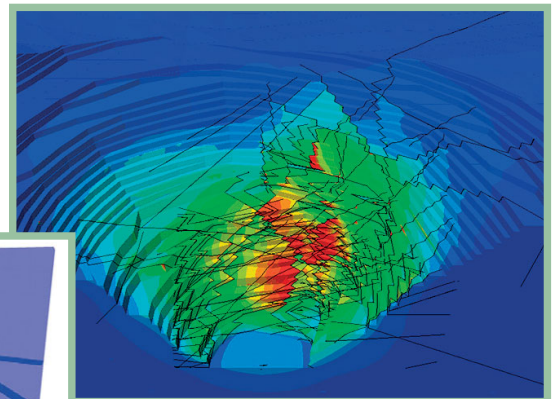
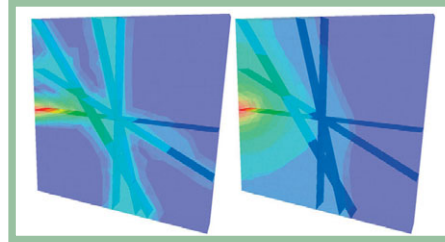
GRAPHICAL USER INTERFACE

- Extensive, fast interactive menu-based OpenGL graphics
- Interactive model view control, model measurement, and plot querying
- Multiple graphical output formats
- Easily export results as tables

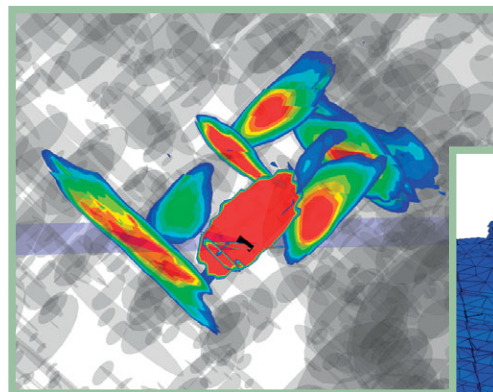
BOUNDARIES/CONDITIONS

- Displacement and stress boundaries
- Quiet and free-field boundaries (dynamic option)
- Fractures (joints, joint sets, and faults) are treated as boundary conditions

Fluid flowing through joints leaking-off into the surrounding rock. Lower-permeability (left) and higher-permeability (right) models are shown after five seconds of simulation time.

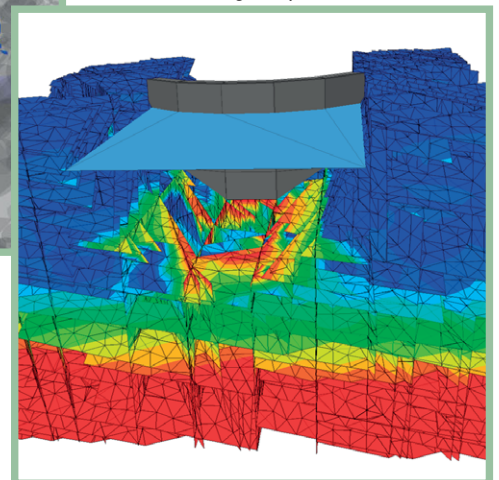


▲ 3DEC model showing displacement contours indicating the location of block movement along the walls of an open pit mine.



3DEC model of a dam showing the water level and the resulting pore pressure in the surrounding rock joints.

▲ Joint property contour plot of a DFN embedded into a 3DEC model. Color contours indicate joint aperture size after nearly one day of fluid injection.



FEATURES (cont.)

GEOMETRY

- Automatic tunnel region generator
- Automatic mesh generation in fully deformable blocks
- DXF import for visualization

CONSTITUTIVE MODELS

- Null model for sequencing, backfill, and excavations
- Option to add user-defined models
- Standard block material models include:
 - Elastic
 - Anisotropic
 - Mohr-Coulomb
 - Hoek-Brown
 - Modified Hoek-Brown
 - Ubiquitous joints
 - Bilinear plasticity
 - Strain-softening
 - Visco-plastic creep
 - Visco-elastic creep
- Standard joint models include:
 - Elastic
 - Mohr-Coulomb (including User-Defined Model DLL)
 - Continuously Yielding

SOLUTIONS / SEQUENCING

- Continuous or sequenced solutions
- Automatic time-step calculation
- Automatic factor of safety (FOS) calculation based on the Shear Strength Reduction method for:
 - Mohr-Coulomb
 - Hoek-Brown
 - Ubiquitous Joint
- Nodal Mixed Discretization for even more accurate solutions
- Effective stress based on pore-pressure
- Mechanical models can be coupled with both fluid-flow and thermal (optional) models

NEW IN 5.2

VASTLY IMPROVED PERFORMANCE

- Solve simulations up to 2x faster
- Unjoining and deleting blocks; most block-construction and joint-set commands now execute faster
- Fluid flow calculations are multithreaded for faster solutions

BONDED BLOCKS MODELING

- Convert block zones into new blocks and assign properties
- Easy tetrahedral generation; intelligent, automatic, tetrahedral block densification; and fragment (broken blocks) tracking

MATRIX FLUID FLOW ADDED

- Fluid flow through blocks, between fractures, is now possible
- Mechanical-fluid coupling is available

- Fracture fluid pressure and matrix fluid pressures are also coupled

ENHANCED CABLE BOLT SUPPORT

- Cable grout strength may depend on confining stress
- New FACEPLATE keyword connects the first node of the cable to the grid
- FISH intrinsic added to access cable node, element, and property data
- Cables can now be used in dynamic (optional) simulations
- Improved cable plotting and querying
- Force can now be applied to cable nodes

PROPPANT SIMULATION ADDED

- Simulate the transport and mechanical effects of proppant fluid-filled joints
- Proppant can carry load and resist further fracture closing
- Gravity and slurry concentration affects buoyance forces (convection)
- Slurry concentration changes fluid viscosity
- Proppant settles due to gravity

OTHER NEW FEATURES

- Track the start of block slipping
- More robust handling of negative volume zones
- Improved cell space logic
- Added partial mass density scaling for rigid blocks
- Set the maximum flow timestep size
- Fluid discharge boundary condition can now be given a history
- Uncracked flow zones can be hidden in a flow plane plot
- Color blocks by excess shear stress (or factor of safety) for a given set of hypothetical joints
- Can specify a different set of properties for every subcontact

OPTIONS

DYNAMIC

- Permits 3D, fully dynamic simulation of wave propagation for the analysis earthquakes, blasts, impulse loading, rock bursts, and particle flow
- May be coupled to structural elements
- Several damping options, including Rayleigh damping
- Dynamic boundaries include non-reflecting and free-field

USER-DEFINED C++ MODELS (UDM)

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

A website for exchange of user-defined 3DEC models for can be found at:

www.itascacg.com/udms

STRUCTURAL LINERS

- Interior support (linings, steel sets, etc.) placed on excavation interiors
- May act to truly support, in whole or part, the weights of individual blocks isolated by discontinuities or zones

CAD-based BLOCK GENERATION

- *Griddle* and *BlockRanger* both generate 3D blocks that can be seamlessly imported into 3DEC
- For complicated geometry, *Griddle* can create hexahedral-dominant or all-tetrahedral block grids
- *BlockRanger* provides an economical option for filling simpler geometry with blocks
- The blocks produced conform to material, group, or region boundaries with fractures being converted to joints or contact surfaces in 3DEC

www.itascacg.com/CADmesh

THERMAL

- Simulation of transient heat conduction in materials
- Development of thermally induced displacements and stresses

TRY THE DEMO

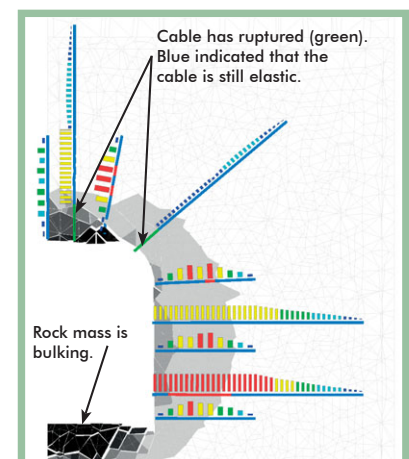
Itasca is pleased to offer free demo versions of all software for download. There is no restriction to the length of time you can use the demos, but some model size restrictions apply.

www.itascacg.com/demos

SALES

Itasca sales offices and agents vary geographically. To locate or contact the agent for your region, visit:

www.itascacg.com/sales



▲ Mechanical response of a tunnel undergoing relaxation for a Bonded Block Model (BBM). Displacement contours (gray-scale) support cable state, and cable axial forces are