



## New in *FLAC* 5.0

*FLAC* 5.0 pre-release has the following new features:

### [Hysteretic Damping](#)

A new damping facility for dynamic calculations, hysteretic damping, is now available in *FLAC* 5.0. This form of damping allows strain-dependent modulus and damping functions to be incorporated directly into the *FLAC* simulation. This makes it possible for direct comparisons between calculations made with the equivalent-linear method and a fully nonlinear model, without any compromises in the choice of constitutive model.

In addition, the need to introduce additional damping, such as Rayleigh damping, is greatly reduced, and consequently the solution time is substantially reduced, by using hysteretic damping.

The new dynamics-analysis chapter from the *FLAC* 5.0 Manual is included with the download (the PDF file is named "dynamic.pdf" and is located in the "flac500" folder). See Sections 3.4.3.7 and 3.6.6 for further information and examples using hysteretic damping.

### [Hoek-Brown Constitutive Model](#)

The Hoek-Brown failure criterion is implemented as a built-in constitutive model in *FLAC* 5.0. The failure surface is nonlinear and is based on the relation between the major and minor principal stresses. The model incorporates a plasticity flow rule that varies as a function of the confining stress level. The new constitutive models chapter from the *FLAC 5.0 Manual* is included with the download (the PDF file is named "models.pdf" and is located in the "flac500" folder). See Section 2.4.8 for further information on the Hoek-Brown model.

### [New Structural Element Types](#)

Three new structural element types have been added to *FLAC* 5.0: *Liner Elements* are similar to beam elements, but also include a failure criterion based on both bending stresses and

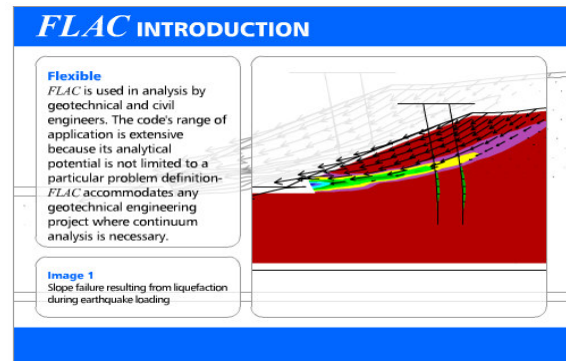
axial thrust. Peak and residual strengths can be specified. *Liner elements* are well suited to simulate concrete and shotcrete tunnel linings. *Rockbolt Elements* are similar to cable and pile elements, but also simulate (1) tensile rupture of the element, (2) the effect of changes in the confining stress around the rockbolt, and (3) strain-softening of the material between the bolt and the grid material. *Strip Elements* represent the behavior of thin reinforcing strips installed in layers within a soil embankment. Strip elements have similar behavior to cable elements, but can also simulate (1) tensile rupture, and (2) shear behavior at the soil/strip interface that is defined by a nonlinear shear failure envelope that varies as a function of confining pressure.

New logic is available to install interfaces between beams or liners and the grid automatically, and also to install layers of beams and/or liners automatically.

Logic is now available to simulate a softening plastic hinge for beam, pile and rockbolt elements.

The spacing property can be used to scale properties for structural elements automatically to account for spaced reinforcement. Actual forces and moments in the spaced structural support are now determined automatically for presentation in output results.

A new structural elements chapter from the *FLAC* 5.0 Manual is included with the download (the PDF file is named "structures.pdf" and is located in the "flac500" folder).



In addition, *FLAC* 5.0 will contain the following new features not yet available in the pre-release version

- Improved calculation for coupled mechanical-flow analysis
- Thermal advection logic for thermal/fluid calculations
- Network key license version