

MINKLEY – MODEL

Description

The Minkley-Model is a complex elasto-visco-plastic law originally developed to simulate the behaviour of brittle salt types. This model describes the softening-, dilation and creep behavior of salt rocks and is based on a modified Mohr-Coulomb model coupled with a non-linear Burgers creep model.

A detailed description is given in the publication by Minkley et al.: “A visco-elasto-plastic softening model and its application for solving static and dynamic stability problems in potash mining” (in Billaux et al. (eds), *FLAC and Numerical Modeling in Geomechanics – 2001*, Proceedings of the 2nd International Flac Symposium, Lyon, pp. 21-27, Balkema, Lisse). The publication is included in the download file.

Input parameters

Property name	Description	Name in literature	Typical value (exemplary)
Druck	uniaxial compressive strength	σ_D	17.2
Fliess	maximum effective strength	σ_{MAX}	86
sphi	curvature parameter for strength	σ_ϕ	6.7
drtab	number of druck table*		see example
ftab	number of fliess table*		
mtab	number of sphi table*		see example
tan_beta0	slope of the volume- deformation-curve	$\tan\beta^0$	0
spsi	curvature parameter for dilatancy	σ_ψ	1.2
tan_beta0tab	number of tan_beta0 table*		see examples
psitab	number of spsi table*		see example
salztyp	0 : strain hardening /softening 1 : strain softening		0
ten	tensile strength	σ_z	1.16
tentab	number of tension table**		see examples
shear_m	elastic shear modulus	G	4e3
shear_r	residual shear modulus	G_R	100
bulk	elastic bulk modulus	K	6.7e3
bulk_r	residual bulk modulus	K_R	100
fgk	material parameter for reducing elastic moduli	f	100
dens	mass density	ρ	0.0018
shear_k	Kelvin shear modulus	G^K	2e3
vis_k	Kelvin viscosity	η^K	1e4
vis_m	Maxwell dynamic viscosity	η^M	1e7
m2	creep stress exponent	m	0.17

* tables values according to the accumulated plastic shear strain

** tables values according to the accumulated plastic tensile strain

Output parameters

Property name	Description
epdev	accumulated plastic shear strain
epten	accumulated plastic tensile strain
dvof	accumulated plastic volume change

Practical hints

- If creep behavior is neglected, one can set large values for the viscosities (e.g. $\eta^M = \eta^K = 1e20$). The model then coincides with the elasto-plastic law.
- If there are no parameters for residual shear and bulk modulus: set $fgk = 0$.
- Because of the grid dependence of localization you should calibrate the model on a known case.

Included documents / files

Name	Type	Description
minkley_example_1.dat	FLAC-Inputfile	Pillar robbing which leads to creep rupture, see figure 9 in minkley_publication.pdf
minkley_example_2.dat	3DEC-Inputfile	Pillar bearing capacity with / without dilation, see figure 6 in minkley_publication.pdf
minkley.dll	Dynamic link library	Contains the minkley constitutive model
minkley_publication.pdf	Publication	Describes the theoretical background of the model as well as some applications

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