



AD FALCON API Manual

# Constitutive Models Overview

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## Contents

<b>1</b>	<b>Constitutive Models Overview</b>	<b>3</b>
1.1	Syntax	3
1.2	Model inventory	3
1.3	Availability and input summary	3
1.3.1	Notes and references	5



## 1 Constitutive Models Overview

This page lists the mechanical (constitutive) models documented in this manual and summarises how they are used in example input sets.

### 1.1 Syntax

Mechanical behavior is defined inside `% Materials` using `@UMAT`: with category `Mechanical`. General conventions and examples are listed in [Material Models: Syntax & Conventions](#).

### 1.2 Model inventory

- [Mohr Model](#)
- [Generalised Cam-Clay \(GCC\) Model](#)
- [Unified Clay and Sand \(CASM\) Model](#)
- [MIT-S1 Model](#)
- [SANICLAY Model](#)
- [SANISAND Model](#)
- [Nonlinear Elastic Model](#)
- [Linear Elastic Model \(LinearElasticUMAT\)](#)
- [Clay Elasticity Model \(ClayElasticityUMAT\)](#)



### 1.3 Availability and input summary

Model (UMAT)	Noncoupled analyses	Coupled analyses	Fully coupled analyses	Key parameters exposed in inputs	Custom variables tracked
Mohr-Coulomb (MohrModel)	Yes	Yes	Yes	E, Nu, Phi, Cohesion, Psi, Beta1, Beta2, Rounding Param (Rf), STOL, FTOL	NegDFailureFlag, BracketingFailureFlag, DriftFailureFlag
Drucker-Prager with tension cut-off (DruckerPragerModel)	Yes	Yes	No	E, Nu, DP_A, DP_K, DP_AG, T, STOL, FTOL, LTOL	None

Model (UMAT)	Noncoupled analyses	Coupled analyses	Fully coupled analyses	Key parameters exposed in inputs	Custom variables tracked
Generalised Cam-Clay (GCCModel)	Yes	Yes	Yes	Phi, Lambda, Nu, Kappa, Alpha, Beta_prime, OCRControlled, DefaultIsoHardening, v_N, P_min, patm, STOL, FTOL, LTOL (optional: Beta, c1, c2, OBN)	Isotropic Hardening, Delta_vN
Unified Clay and Sand (CASModel)	Yes	Yes	No	Phi, Lambda, Nu, Kappa, Alpha, SSC, SPR, P_min, DefaultIsoHardening, v_N, STOL, FTOL, LTOL	Isotropic Hardening (optional: OCR, failure flags)
MIT-S1 (MIT_S1Model)	Yes	Yes	Yes	Pa, rho_c, p_ref, theta, Cb, KoNC, nuo, omega, omega_s, phi_cs, phi_mr, p, m, psi, D, r, h, P_min, FTOL (optional: stressRelTol, maxSubsteps, integrationScheme, enableOCMapping)	Alpha, b_, <i>alphao_star</i> , <i>alphao_i</i> , <i>p_srp</i> , <i>srp_has_reversal</i> , <i>eta_srp</i> , <i>eps_srp_*</i>
SANICLAY (SANICLAYModelUMAT)	Yes	Yes	Yes	Nu, Kappa, Lambda, Mc, Me, N, x, C, P_min, STOL, FTOL, LTOL	Po, Pa, OCR, initialvoidratio, Alpha_, Beta_

Model (UMAT)	Noncoupled analyses	Coupled analyses	Fully coupled analyses	Key parameters exposed in inputs	Custom variables tracked
SANISAND (SANISANDModel)	Yes	Yes	Yes	Go, Ko, Mc, Me, Lambda, N_c, alpha_c, n_b, ch, n_d, ho, Ao, cz, zmax, Patm, P_min, STOL, LTOL	AlphaXX...AlphaXY, ZXX...ZXY, AlphaInitial XX...AlphaInitialXY, eps_p_q (optional diagnostics)
Nonlinear Elastic (Nonlinear Elastic Model)	Yes	Yes	Yes	Go, Ko, PATM, P_min, STOL	None
Linear Elastic (Linear Elastic UMAT)	Yes	Yes	Yes	E, Nu	None
Clay Elasticity (Clay Elasticity UMAT)	Yes	Yes	Yes	kappa, Nu, P_min	None

### 1.3.1 Notes and references

- The availability flags reflect what is currently described or exercised in the manual and associated examples.
- SANISAND requires the full set of kinematic hardening and fabric tensors as custom variables. Initialise them consistently with the chosen density state.
- Mohr-based models expose optional diagnostic flags through CustomVariable= to help catch integration failures during nonlinear solution steps.