AD FALCON API Manual

Brooks & Corey SWRC Model

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1 Brooks & Corey SWRC Model

1.1 Syntax

Specify this model in `% Materials` using `@SWRC::`

```
@SWRC: BrooksAndCorey psi_b <psi_b> lambda <lambda> SW_max <SW_max> SW_min
<SW_min> omega_prime <omega_prime>
```

1.1.1 Parameters

Input keyword	Symbol	Meaning
`psi_b`	ψ_b	Air-entry pressure (at void ratio $e = 1$).
`lambda`	λ	Pore-size distribution parameter (controls curve slope).
`omega_prime`	Ω'	Void-ratio influence used in AE $= \psi_b / e^{\Omega'}$.
`SW_max`	$S_{W_{max}}$	Maximum degree of saturation.
`SW_min`	$S_{W_{min}}$	Minimum degree of saturation.

Modified Brooks and Corey Model

To represent the soil water retention curve using the Brooks and Corey formulation, we define the following parameters:
- ψ_b: the air-entry pressure,
- λ: a parameter related to the pore-size distribution,
- $S_{W_{max}}$ and $S_{W_{min}}$: the maximum and minimum values of the residual degree of saturation, and
- Ω': a parameter that accounts for the effect of the void ratio.

In this model, the total suction is computed as

$$\psi = p_c \tag{1}$$

The air-entry value is defined by the influence of the void ratio as

$$\text{AE} = \frac{\psi_b}{e^{\Omega'}} \tag{2}$$

The effective saturation, S_e, is then determined by comparing ψ with the air-entry value. If $\psi \leq$ AE, the soil is considered fully saturated (i.e., $S_e = 1.0$). Otherwise, the effective saturation

is given by

$$S_e = \left(\frac{\mathrm{AE}}{\psi} \right)^{\lambda} \tag{3}$$

Finally, the water saturation (SW) is obtained by scaling the effective saturation between the minimum and maximum residual saturations:

$$S_w = S_e \left(S_{W_{max}} - S_{W_{min}} \right) + S_{W_{min}} \tag{4}$$

Equation (3) follows the classical Brooks-Corey retention law (Brooks and Corey, 1964). The air-entry update with `omega_prime` is the FALCON-specific extension used to shift the curve with void-ratio changes.

1.2 References

- Brooks, R. H., & Corey, A. T. (1964). *Hydraulic properties of porous media and their relation to drainage design*. Transactions of the ASAE, 7(1), 26-28.