

Undrained Shear Strength in Settle3D

The undrained shear strength option allows you to calculate undrained shear strength according to the Shansep method. This is a post-processing feature only.

The basic equation employed is:

$$S_u = A + S_{u_{calc}}$$
$$S_u = A + \sigma'_{vc} S(OCR)^m$$

where

A = initial shear strength (S_{u0}), can be depth-dependent

σ'_{vc} = vertical consolidation stress

S = undrained strength ratio at $OCR = 1$

OCR = overconsolidation ratio (σ'_p/σ'_v)

m = strength rebound exponent

The A , S , and m values are all user inputs. OCR and σ'_{v0} are calculated in Settle3D.

$$OCR = \frac{\sigma'_p}{\sigma'_{vc}} = \frac{\sigma'_{v0} OCR_0}{\sigma'_{vc}}$$

where

OCR_0 = in-situ OCR value in stage 0 (based on user input)

σ'_{v0} = effective stress in Stage 0

σ'_{vc} = $\sigma'_0 + \sigma_l - u_{et}$ (initial effective stress + current loading stress – current excess pore pressure)

For Stage 0, the initial calculated S_u value is:

$$S_{u_0} = \sigma'_0 S(OCR_0)^m$$

In each stage, the calculated pre-consolidation stress, P_c , is compared to the previous maximum P_c . If $P_c > P_{c_{max}}$ then the increased undrained shear strength is calculated as:

$$S_u = A + (S_{u_i} - S_{u_0})$$

Constant S_u in install stage

An “initial” stage other than Stage 0 can also be specified, as a global setting for all materials, and a “constant S_u in initial stage” can be selected on a per material basis.

If the “constant S_u in initial stage” option is selected:

1. In the specified initial stage, and every preceding stage, the undrained shear strength is set equal to A .
2. The values of OCR_0 , P_{c_0} , and σ'_{v0} are those calculated in the specified initial stage.
3. σ'_{vc} calculation does not change.

References:

Ladd, C. (1991). "Stability Evaluation during Staged Construction." *J. Geotech. Engrg.*, 10.1061/(ASCE)0733-9410(1991)117:4(540), 540-615. (The Twenty-Second Karl Terzaghi Lecture)