PERMEABILITY SEMI-LOG command

Synopsis

The PERMEABILITY SEMI-LOG command is used to specify values for permeability coefficients that vary semi-logarithmically. Such an empirical relationship between the coefficient of permeability and the void ratio was proposed by Taylor [1]. It is particularly applicable to clay soils.

Syntax

The following syntax is associated with the PERMEABILITY SEMI-LOG command:

\[
\text{PERmeability SEMi-log NUMber ## DEScription "string"}
K11 #.# K12 #.# K13 #.# K22 #.# K23 #.# K33 #.#
\text{DENsity #.# INItial void #.# CONstant #.#}
\]

Explanatory Notes

Noting that the expression of Koženy-Carman was applicable only to sands, Taylor [1] proposed the following empirical relationship between the logarithm of the coefficient of permeability \( k \) and the void ratio:

\[
\log_{10} k = \log_{10} k_{in} - \frac{(e_{in} - e)}{C_k}
\]  

where \( C_k \) is the “permeability change index”; i.e., the slope of a straight line in \( e - \log_{10} k \) space, \( k_{in} \) is the in situ permeability, and \( e_{in} \) is the in situ void ratio. Equation (1) is typically re-written in the following form:

\[
k = k_{in}10^{(e-e_{in})/C_k}
\]

(2)
The keywords associated with the **PERMEABILITY SEMI-LOG** command have the following meaning:

**NUMBER:** The integer associated with this keyword is used to specify the (global) number of the semi-logarithmic permeability idealization. The *default* permeability number is one (1).

**DESCRIPTION:** The alphanumeric string associated with this keyword is included to describe the permeability specification. It has no effect on the values used in the specification. The alphanumeric string *must* be enclosed in double quotes (“ ”).

**K11:** The real number associated with this keyword represents the in situ value \( k_{11} \) of the coefficient of permeability \( k_{11} \) (units of \( Lt^{-1} \)). The *default* value of **K11** is equal to one (1.0).

**K12:** The real number associated with this keyword represents the in situ value \( k_{12} \) of the coefficient of permeability \( k_{12} \) (units of \( Lt^{-1} \)). The *default* value of **K12** is equal to zero (0.0).

**K13:** The real number associated with this keyword represents the in situ value \( k_{13} \) of the coefficient of permeability \( k_{13} \) (units of \( Lt^{-1} \)). The **K13** keyword is only applicable to three-dimensional analyses. The *default* value of **K13** is equal to zero (0.0).

**K22:** The real number associated with this keyword represents the in situ value \( k_{22} \) of the coefficient of permeability \( k_{22} \) (units of \( Lt^{-1} \)). The *default* value of **K22** is equal to one (1.0).

**K23:** The real number associated with this keyword represents the in situ value \( k_{23} \) of the coefficient of permeability \( k_{23} \) (units of \( Lt^{-1} \)). The **K23** keyword is only applicable to three-dimensional analyses. The *default* value of **K23** is equal to zero (0.0).

**K33:** The real number associated with this keyword represents the in situ value \( k_{33} \) of the coefficient of permeability \( k_{33} \) (units of \( Lt^{-1} \)). The **K33** keyword is only applicable to three-dimensional analyses. The *default* value of **K33** is equal to one (1.0).

**DENSITY:** The real number associated with this keyword represents the density \( \gamma_f = \rho_f g \) of the pore fluid (units of \( FL^{-3} \)). The *default* value of \( \gamma_f \) is 1.0.

**INITIAL VOID:** The real number associated with this keyword represents the value of the in situ void ratio \( \epsilon_{in} \). The *default* value of \( \epsilon_{in} \) is one (1.0).

**CONSTANT:** The real number associated with this keyword represents the “permeability change index” \( C_k \). The *default* value of \( C_k \) is one (1.0).

---

**Remark**

1. The permeability coefficients have the units of \( Lt^{-1} \). As such, they represent the permeability coefficients commonly specified by civil engineers.
Example of Command Usage

The following command is used to specify a power idealization of the hydraulic conductivity associated with a two-dimensional spatial idealization:

```plaintext
permeability  semi-log  number 2 &
    descr 'semi_log representation after Taylor (1948)' &
    k11 1.25e-04  k22 0.938e-04  density 1.0 &
    initial_void 0.692  constant 1.02
```
References