PERMEABILITY EXPONENTIAL command

Synopsis

The PERMEABILITY EXPONENTIAL command is used to specify values for permeability coefficients that can vary in an exponential manner.

Syntax

The following syntax is associated with the PERMEABILITY EXPONENTIAL command:

\[
\text{PERmeability EXPonential NUMber ## DEScription "string"} \\
\text{K11 #.# K12 #.# K13 #.# K22 #.# K23 #.# K33 #.#} \\
\text{DENsity #.# N.Parameter #.#}
\]

Explanatory Notes

During an analysis, the permeability coefficients can be made a function of the current effective stress state (more precisely, of the mean normal pressure) in the following manner (recall that tensile stresses are assumed positive):

\[
k = k_{in} \exp \left[ n \left( \frac{\sigma'_{11} + \sigma'_{22} + \sigma'_{33}}{3} \right) \right] \quad (1)
\]

where \( k_{in} \) is an initial value of \( k \) (perhaps the in situ permeability).
The keywords associated with the **PERMEABILITY EXPONENTIAL** 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 \((k_{in})\) 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 \((k_{in})\) 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 \((k_{in})\) 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 \((k_{in})\) 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 \((k_{in})\) 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 \((k_{in})\) 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.

**N_PARAMETER:** The real number associated with this keyword represents the “permeability change index” \(C_k\). The *default* value of \(C_k\) is zero (0.0). In this case the **EXPONENTIAL** idealization reduces to the **CONSTANT** one.

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**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 an exponential permeability idealization associated with a two-dimensional (spatially) analysis:

```plaintext
permeability exponential number 1 &
descr 'sample permeability coefficients' &
  k1 1.25e-04 k22 0.938e-04 density 1.0 &
n_param 0.85
```