MATERIAL VISCOELASTIC

Synopsis:
The **MATERIAL VISCOELASTIC** command is used to describe a linear viscoelastic material characterization.

Syntax:

```
MATerial VIScoelastic NUMber ##
   ( DEScription “string”)  
   ( ALPHA0 #.# ) ( ALPHA1 #.# ) ( BETa1 #.#)
```

Explanatory Remarks:
The **MATERIAL VISCOELASTIC** command is commonly used in conjunction with a finite deformation (L2FD0) line element. In the past, such elements have been used to model the time dependent behavior of geogrid reinforcement [1]. The linear viscoelastic constitutive law for the material is assumed to be of the form

\[
\sigma(t) = \int_0^t \phi(t - \tau) \frac{\partial \varepsilon}{\partial \tau} d\tau
\]

where the relaxation function has the following simple form

\[
\phi(t) = \alpha_o + \alpha_1 e^{-\beta_1 t}
\]

In the above equation, \(\alpha_o\) and \(\alpha_1\) have units of stress (FL\(^{-2}\)), and \(\beta_1\) has units of time\(^{-1}\). For plane strain idealizations, \(\phi(t)\) must represent the “effective” relaxation function; i.e., it must include the Poisson stiffening due to the plane strain constraint. For axisymmetric idealizations, it is assumed that the Poisson’s effect is negligible. As readily evident from the syntax of the **MATERIAL VISCOELASTIC** command, the keywords ALPHA0, ALPHA1 and BETa1 correspond to the parameters \(\alpha_o\), \(\alpha_1\) and \(\beta_1\), respectively. The default values for these parameters are \(\alpha_o = 1.0\) and \(\alpha_1 = \beta_1 = 0.0\).
To gain insight into the parameters $\alpha_0$, $\alpha_1$ and $\beta_1$, note the following:

- At time $= 0$, the stress in the one-dimensional element is equal to $\alpha_0 + \alpha_1$.

- The slope of the relaxation curve (i.e., stress or force vs. time) is influenced by changes in $\beta_1$. This is better understood from the following figure, in which “normalized stress” is equal to the current stress divided by the initial stress.

- Larger values of $\beta_1$ result in more rapid stress relaxation.

- Larger values of $\alpha_1$ result in more rapid stress relaxation. This is better understood from the following figure.
Example:
To specify a viscoelastic material idealization with $\alpha_o = 5.0e+04$, $\alpha_1 = 1.0e+04$ and $\beta_1 = 0.10$, enter the following command:

```
mat viscoelastic number 1 &
  desc 'elastic material for bar elements' &
  alpha0 5.0e+04 alpha1 1.0e+04 beta1 1.0e-01
```

See also:
The NONLINEAR, DIMENSION and the remaining MATERIAL commands.
References