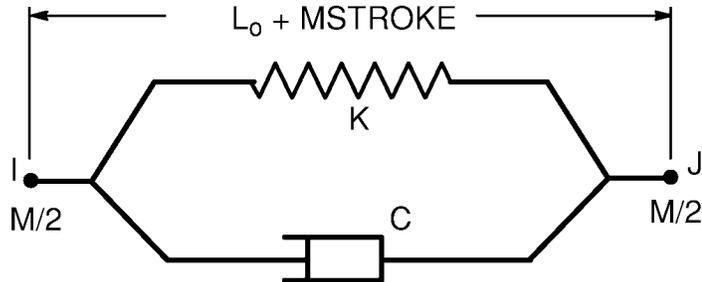


14.11 LINK11 — Linear Actuator



Matrix or Vector	Shape Functions	Integration Points
Stiffness Matrix	Equation (12.2.1-1)	None
Mass Matrix	None (lumped mass formulation)	None
Stress Stiffness Matrix	Equation (12.2.1-2) and (12.2.1-3)	None
Damping Matrix	Same as stiffness matrix	None

14.11.1 Assumptions and Restrictions

The element is not capable of carrying bending or twist loads. The force is assumed to be constant over the entire element.

14.11.2 Element Matrices and Load Vector

All element matrices and load vectors are described below. They are generated in the element coordinate system and are then converted to the global coordinate system. The element stiffness matrix is:

$$[\mathbf{K}_\ell] = \mathbf{K} \begin{bmatrix} 1 & 0 & 0 & \vdots & -1 & 0 & 0 \\ 0 & 0 & 0 & \vdots & 0 & 0 & 0 \\ 0 & 0 & 0 & \vdots & 0 & 0 & 0 \\ \hline -1 & 0 & 0 & \vdots & 1 & 0 & 0 \\ 0 & 0 & 0 & \vdots & 0 & 0 & 0 \\ 0 & 0 & 0 & \vdots & 0 & 0 & 0 \end{bmatrix} \quad (14.11-1)$$

where: \mathbf{K} = element stiffness (input as K on **R** command)

The element mass matrix is:

$$[\mathbf{M}_\ell] = \frac{\mathbf{M}}{2} \begin{bmatrix} 1 & 0 & 0 & \vdots & 0 & 0 & 0 \\ 0 & 1 & 0 & \vdots & 0 & 0 & 0 \\ 0 & 0 & 1 & \vdots & 0 & 0 & 0 \\ \hline 0 & 0 & 0 & \vdots & 1 & 0 & 0 \\ 0 & 0 & 0 & \vdots & 0 & 1 & 0 \\ 0 & 0 & 0 & \vdots & 0 & 0 & 1 \end{bmatrix} \quad (14.11-2)$$

where: \mathbf{M} = total element mass (input as M on **R** command)

The element damping matrix is:

$$[\mathbf{C}_\ell] = \mathbf{C} \begin{bmatrix} 1 & 0 & 0 & \vdots & -1 & 0 & 0 \\ 0 & 0 & 0 & \vdots & 0 & 0 & 0 \\ 0 & 0 & 0 & \vdots & 0 & 0 & 0 \\ \hline -1 & 0 & 0 & \vdots & 1 & 0 & 0 \\ 0 & 0 & 0 & \vdots & 0 & 0 & 0 \\ 0 & 0 & 0 & \vdots & 0 & 0 & 0 \end{bmatrix} \quad (14.11-3)$$

where: \mathbf{C} = element damping (input as C on **R** command)

The element stress stiffness matrix is:

The lengths, shown in the figure at the beginning of this section, are:

$$\begin{aligned}L_0 &= \text{initial length (output quantity ILEN)} \\L_0 + S_M &= \text{current length (output quantity CLEN)}\end{aligned}$$