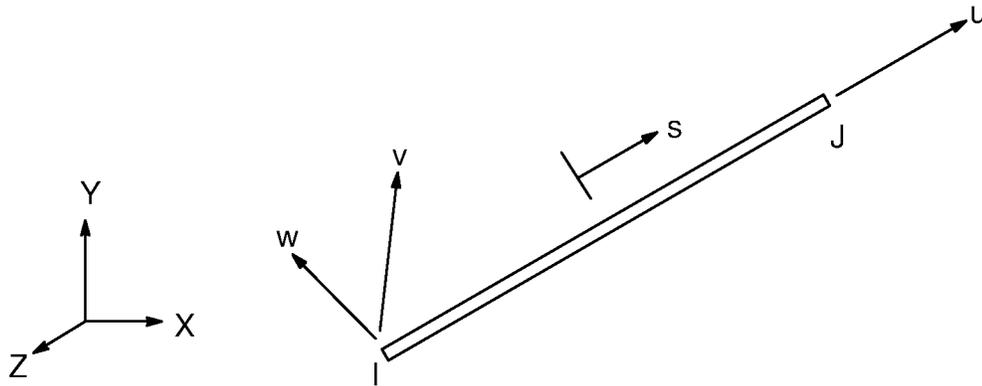


# 14.180 LINK180 — 3-D Finite Strain Spar (or Truss)



Matrix or Vector	Shape Functions	Integration Points
Stiffness Matrix	Equation (12.2.1-1)	1
Mass Matrix	Equations (12.2.1-1), (12.2.1-2), and (12.2.1-3)	1
Stress Stiffening Matrix	Same as mass matrix	1
Thermal Load Vector	Same as stiffness matrix	1
Newton Raphson Load Vector	Same as stiffness matrix	1

Load Type	Distribution
Element Temperature	Linear along length
Nodal Temperature	Linear along length

Reference: Cook et al(117)

### 14.180.1 Assumptions and Restrictions

The theory for this element is a reduction of the theory for BEAM189. The reductions include only 2 nodes, no bending or shear effects, no pressures, and the entire element as only one integration point.

The element is not capable of carrying bending loads. The stress is assumed to be uniform over the entire element.

### 14.180.2 Element Mass Matrix

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

The element mass matrix is:

$$[M_\ell] = \frac{\rho AL}{2} \begin{bmatrix} 1 & 0 & 0 & | & 0 & 0 & 0 \\ 0 & 1 & 0 & | & 0 & 0 & 0 \\ 0 & 0 & 1 & | & 0 & 0 & 0 \\ \hline 0 & 0 & 0 & | & 1 & 0 & 0 \\ 0 & 0 & 0 & | & 0 & 1 & 0 \\ 0 & 0 & 0 & | & 0 & 0 & 1 \end{bmatrix} \quad (14.180-1)$$

where:

- A = element cross-sectional area (input as AREA on **R** command)
- L = element length
- $\rho$  = density (input as DENS on **MP** command)