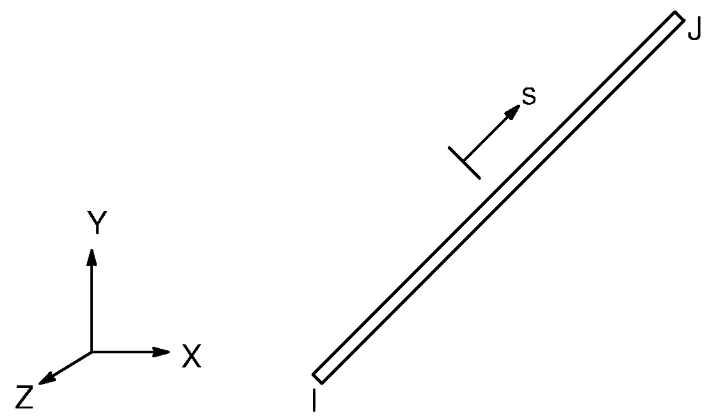
14.33 LINK33 — 3–D Conduction Bar



Matrix or Vector	Shape Functions	Integration Points
Conductivity Matrix	Equation (12.2.1–20)	None
Specific Heat Matrix	Equation (12.2.1–20)	None
Heat Generation Load Vector	Equation (12.2.1–20)	None

14.33.1 Other Applicable Sections

Chapter 6 describes the derivation of thermal element matrices and load vectors as well as heat flux evaluations.

14.33.2 Matrices and Load Vectors

The conductivity matrix is:

$$\left[K_c^t\right] = \frac{AK_x}{L}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \quad (14.33\text{–}1)$$

where: A = area (input as AREA on **R** command)

K_x = conductivity (input as KXX on **MP** command)

L = distance between nodes

The specific heat matrix is:

$$[C_c^t] = \frac{\rho C_p A L}{2} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad (14.33\text{–}2)$$

where: ρ = density (input as DENS on **MP** command)
C_p = specific heat (input as C on **MP** command)

This specific heat matrix is a diagonal matrix with each diagonal being the sum of the corresponding row of a consistent specific heat matrix. The heat generation load vector is:

$$\{Q_c\} = \frac{\ddot{q} A L}{2} \begin{Bmatrix} 1 \\ 1 \end{Bmatrix} \quad (14.33\text{–}3)$$

where: $\ddot{q}$ = heat generation rate (input on **BF** or **BFE** command)

14.33.3 Output

The output is computed as:

$$q = K_x \frac{(T_I - T_J)}{L} \quad (14.33\text{–}4)$$

and

$$Q = qA \quad (14.33\text{–}5)$$

where: q = output quantity THERMAL FLUX
T_I = temperature at node I
T_J = temperature at node J
Q = output quantity HEAT RATE