14.34   LINK34 — Convection Link
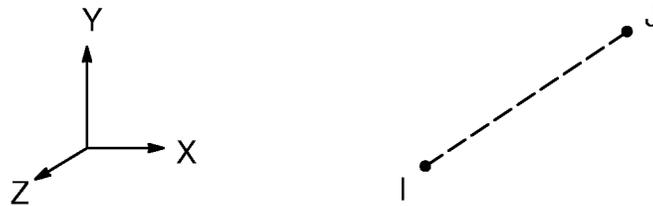
Matrix or Vector	Shape Functions	Integration Points
Conductivity Matrix	None used (nodes may be coincident)	None

14.34.1   Conductivity Matrix

The element conductivity (convection) matrix is

$$\left[K_c^t\right] = A\ h_f^{eff} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \tag{14.34–1}$$

where: A =   area over which element acts (input as AREA on **R** command)

h_f^{eff} =   effective film coefficient, defined by equation (14.34–2)

The effective film coefficient is:

$$h_f^{eff} = \begin{cases} \text{maximum of } \left(h_f', C_c\right) & \text{if KEYOPT(3)} = 3 \\ h_f' + C_c & \text{if KEYOPT(3)} \neq 3 \end{cases} \tag{14.34–2}$$

where: h_f' =   partial film coefficient term defined by equation (14.34–3)

C_c =   input as CC on **R** command

The partial film coefficient term is:

$$h_f' = \begin{cases} F\ h_f & \text{if } n = 0.0 \\ F\ h_f\ |\Delta T_p|^n & \text{if } n \neq 0.0 \text{ and } \Delta T_p \neq 0 \\ 0.0 & \text{if } n \neq 0.0 \text{ and } \Delta T_p = 0 \end{cases} \tag{14.34–3}$$

where:
$$F = \begin{cases} T_B & \text{if } T_B > 0 \text{ and KEYOPT(3)} = 2 \\ 1.0 & \text{if } T_B \leq 0 \text{ or } \text{KEYOPT(3)} \neq 2 \end{cases}$$

T_B = input quantity TBULK (input on **SFE** command)

$$h_f = \begin{cases} H(m_e) & \text{if KEYOPT(3)} \neq 2 \\ & \text{or} \\ & \text{if KEYOPT(3)} = 2 \text{ and } h_f^{in} = 0.0 \\ H\left(-h_f^{in}\right) & \text{if KEYOPT(3)} = 2 \text{ and } h_f^{in} < 0.0 \\ h_f^{in} & \text{if KEYOPT(3)} = 2 \text{ and } h_f^{in} > 0.0 \end{cases}$$

$H(x)$ = input quantity CO on **MP**,HF command for material x

m_e = material number for this element (input on **MAT** command)

h_f^{in} = input quantity VAL1 (**SFE**,,,CONV,1 command)

ΔT_p = $T_{p,J} - T_{p,I}$

$T_{p,J}$ = temperature from previous iteration at node J

n = input quantity EN on **R** command

ΔT_p must be thought of as unitless, even though it is obviously derived from temperatures.

14.34.2   Output

The output is computed as:

$$Q = Ah_f^{eff}\left(T_I - T_J\right) \tag{14.34-4}$$

where: Q = output quantity HEAT RATE

T_I = temperature at node I

T_J = temperature at node J