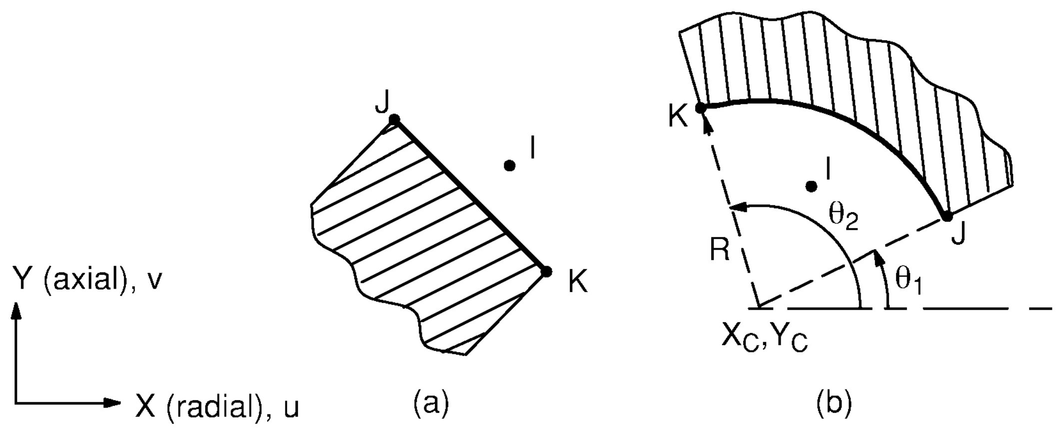
14.26 CONTAC26 — 2–D Point–to–Ground Contact



Matrix or Vector	Shape Functions	Integration Points
Stiffness Matrix	None (nodes may be coincident)	None

14.26.1 Operation of Element

The figure above shows two different ways that CONTAC26 can be used. In each, the dark line connecting nodes J and K is presumed to be the surface where resistance begins (the contact surface). When node I is located in the shaded area, the normal force is negative and the element responds as a linear spring in the normal direction. If contact is maintained and friction is defined (KEYOPT(1) = 1 and $\mu > 0.0$, where μ = input as MU on **MP** command), both normal forces and sticking/sliding forces are active. The sticking/sliding forces act in a direction parallel to the contact surface. If contact is broken (node I is outside of the shaded area), no normal or parallel forces are transmitted.

If friction is not defined (frictionless contact), the functioning of the element is not path dependent. The element operates on the final position of the node I relative to the contact surface and not on the loading history. Thus, the element makes no distinction whether the final location I is reached via path (A–B) or by path (A–C–D–B) as shown in Figure 14.26–1.

Figure 14.26–2 shows the force–deflection relationships for this element in the normal direction. It may be seen from this figure that the element is nonlinear and, therefore, requires an iterative solution. For the straight line contact surface, the normal force acts perpendicular to the surface, and for the circular arc contact surface, the normal force is in the radial direction.

When friction is defined, the functioning of the element is irreversible. As shown in Figure 14.26–3, an elastic–Coulomb friction model acts in the tangential direction. For the straight line contact surface, the tangential direction is parallel to the surface; and for the circular arc contact surface, the tangential direction follows the arc. Corresponding element sticking/sliding forces act in the tangential direction. The usual Coulomb friction applies:

$$|F_s| \leq -\mu F_n \qquad (14.26\text{–}1)$$

where:
- F_s = the tangential force (output quantity FS)
- F_n = the normal force (output quantity FN)
- μ = coefficient of friction (input as MU on **MP** command)

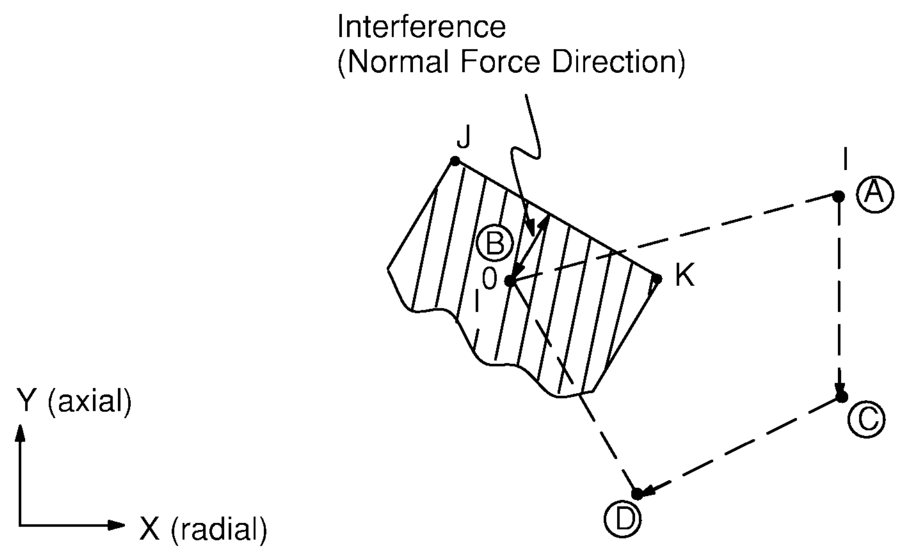


Figure 14.26–1 Element Behavior for Two Different Displacement Paths: (A–B) and A–C–D–B)

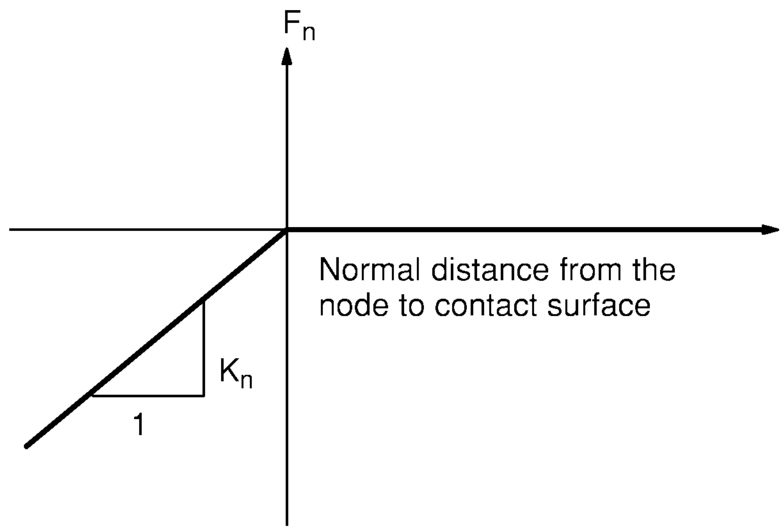


Figure 14.26–2 Force–Deflection Relationship in the Normal Direction

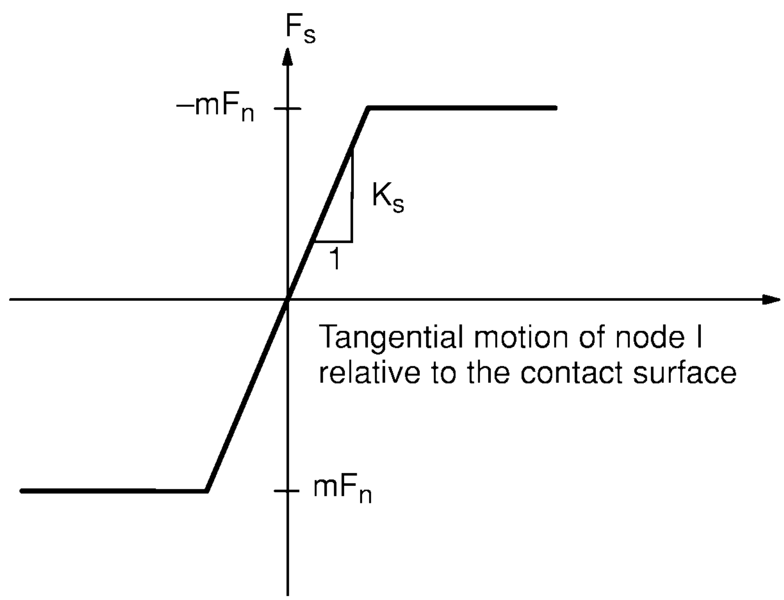


Figure 14.26–3 Force–Deflection Relationship in the Tangential Direction (No Unloading Is Indicated)

14.26.2 Element Matrices

CONTAC26 may have one of two conditions: node I is inside the shaded area or node I is outside the shaded area. The resulting element stiffness matrix in the contact surface coordinate system (x is tangential, y is normal) is:

$$[K_\ell] = \begin{bmatrix} K_s & 0 \\ 0 & K_n \end{bmatrix} \tag{14.26–2}$$

where:

$$K_n = \begin{cases} 0 \text{ if open } (I_s = 3) \\ k^n \text{ if closed } (I_s \le 2) \end{cases}$$

$$K_s = \begin{cases} 0 \text{ if not stuck } (I_s = +2, -2, \text{ or } 3) \\ k^s \text{ if stuck } (I_s = 1) \end{cases}$$

k^n = normal stiffness (input as STIFN on **R** command)

k^s = sliding stiffness (input as STIFS on **R** command)

I_s = output quantity STAT

The Newton–Raphson load vector is:

$$\{F_\ell^{nr}\} = \begin{Bmatrix} F_s \\ F_n \end{Bmatrix} \tag{14.26–3}$$

where:

F_s = force tangential (stick/sliding) to the contact surface

F_n = force normal to the contact surface (from the previous iteration)

14.26.3 Stress Pass

The stress pass output quantities are shown in Figure 4.26–2 of the *ANSYS Elements Reference* and reflect the latest possible information concerning the gap status. Therefore, for nonconverged iterations, it may not agree with reaction forces which are based on the previously calculated stiffness matrix.