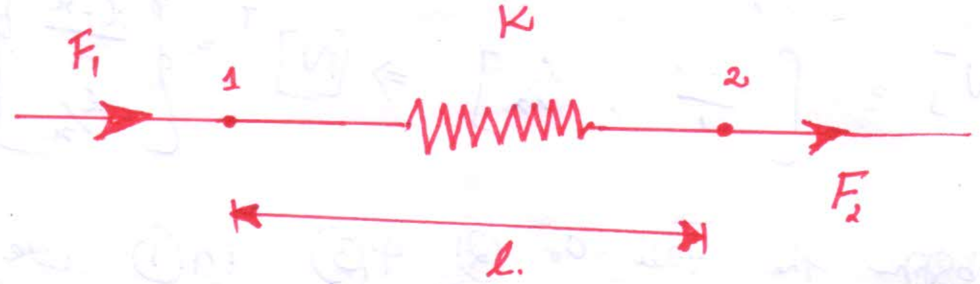
Springs:



Let us Consider a Spring element with nodes 1, 2 as Shown in the figure. Let K be the Spring Constant and l be the length of the Spring. F_1 & F_2 are the nodal forces acting at node 1 and 2 respectively. u_1 & u_2 be the displacement at the respective nodes.

By the Sign Convention for nodal forces & equilibrium

$F_1 = -T_1$ & $F_2 = T_2$ where T is the tension force.

$T = K \cdot \Delta u$

K → Spring Constant N/m

Δu → Change in deformation.

$F_1 = -K \Delta u$

$= -K(u_2 - u_1)$

$F_2 = K \Delta u$

$= K(u_2 - u_1)$

$$F_1 = k[u_1 - u_2]$$
$$= ku_1 - ku_2$$

$$F_2 = k[u_2 - u_1]$$
$$= k[-u_1 + u_2]$$
$$= -ku_1 + ku_2$$

$$\begin{Bmatrix} F_1 \\ F_2 \end{Bmatrix} = \begin{bmatrix} k & -k \\ -k & k \end{bmatrix} \begin{Bmatrix} u_1 \\ u_2 \end{Bmatrix}$$

$$\begin{Bmatrix} F_1 \\ F_2 \end{Bmatrix} = [k] \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \begin{Bmatrix} u_1 \\ u_2 \end{Bmatrix}$$