**Problem 1.9-2: Bracket (revisited)**

Reconsider the disk-shaped bracket that was discussed in Problem P1.8-7. You have decided to generate a numerical model of the bracket that has three nodes, positioned as shown in Figure P1.9-2.

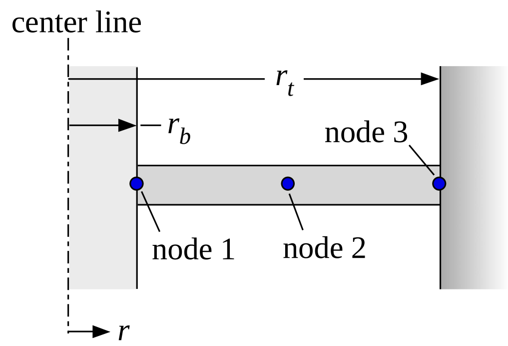


**Figure P1.9-2: A 3-node numerical model of the disk-shaped bracket.**

a.) Derive a system of algebraic equations that can be solved in order to predict the temperatures at each of the three nodes in Figure P1.9-2 ($T_1$, $T_2$, $T_3$). Your equations should include only those symbols defined in the problem statement as well as the radial locations of the three nodes ($r_1$, $r_2$, and $r_3$). Do not solve these equations.

The temperature at node 3 is specified:

$$\boxed{T_3 = T_t} \tag{1}$$

An energy balance on node 2 is shown in Figure P1.9-2(b).

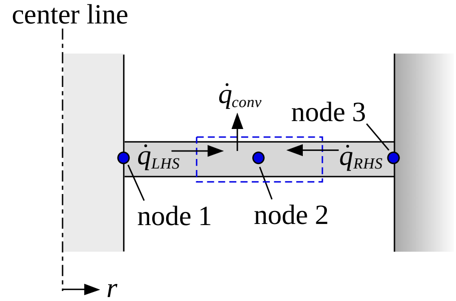


**Figure P1.9-2(b): Energy balance on node 2.**

and leads to:

$$\dot{q}_{LHS} + \dot{q}_{RHS} = \dot{q}_{conv} \tag{2}$$

or

$$\boxed{2\,\pi\,k\,th\frac{\left(T_1-T_2\right)}{\ln\left(\frac{r_2}{r_1}\right)}+2\,\pi\,k\,th\frac{\left(T_3-T_2\right)}{\ln\left(\frac{r_3}{r_2}\right)}=2\,\pi\,\bar{h}\left[\left(\frac{r_2+r_3}{2}\right)^2-\left(\frac{r_2+r_1}{2}\right)^2\right]\left(T_2-T_\infty\right)} \tag{3}$$

An energy balance on node 1 is shown in Figure P1.9-2(c).

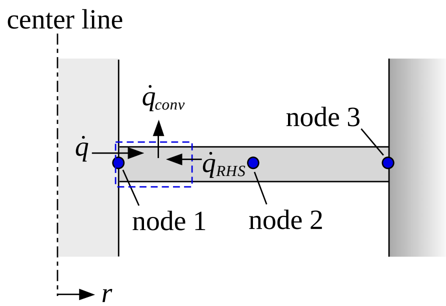


**Figure P1.9-2(c): Energy balance on node 1.**

and leads to:

$$\dot{q}+\dot{q}_{RHS}=\dot{q}_{conv} \tag{4}$$

or

$$\boxed{\dot{q}+2\,\pi\,k\,th\frac{\left(T_2-T_1\right)}{\ln\left(\frac{r_2}{r_1}\right)}=2\,\pi\,\bar{h}\left[\left(\frac{r_1+r_2}{2}\right)^2-r_1^2\right]\left(T_1-T_\infty\right)} \tag{5}$$