## Given:

Consider steady heat transfer through a 5 m by 7 m brick wall with a thickness of 30 cm. On on side of the wall, the room temperature of a house is  $27^{\circ}$ C; the outside temperature on the other side is  $0^{\circ}$ C. The temperature of the inner and outer surfaces are  $20^{\circ}$ C and  $5^{\circ}$ C, respectively, and the rate of heat transfer is measured to be 1035 W.

$$h := 5m$$
  $w := 7m$   $t := 30cm$  
$$T_{room} := 27 \,^{\circ}C \qquad T_{outside} := 0 \,^{\circ}C$$
 
$$T_{inner} := 20 \,^{\circ}C \qquad T_{outer} := 5 \,^{\circ}C \qquad Q' := 1035W$$

## Required:

Deteremine the rate of entropy generation in the wall and the rate of total entropy generation associated with the heat transfer process.

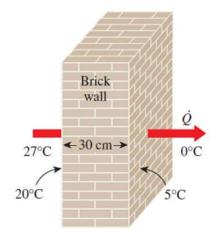
## Solution:

Starting with an entropy balance with no mass transfer shows

$$\frac{d}{dt}S_{sys} = \Sigma S'_{in} - \Sigma S'_{out} + S'_{gen}$$

$$0 = \Sigma S'_{in} - \Sigma S'_{out} + S'_{gen}$$

$$S'_{gen} = \Sigma S'_{out} - \Sigma S'_{in}$$



The entropy rate in and out are determined by the heat transfer at the particular boundaries so

$$S'_{gen} := \frac{Q'}{T_{outer}} - \frac{Q'}{T_{inner}} = 0.1904 \cdot \frac{W}{K}$$

To determine the rate of entropy generation for the entire process, the process can be repeated but with a change of boundaries. Starting with an entropy balance with no mass transfer shows

$$\frac{d}{dt}S_{sys} = \Sigma S'_{in} - \Sigma S'_{out} + S'_{gen}$$

$$0 = \Sigma S'_{in} - \Sigma S'_{out} + S'_{gen}$$

$$S'_{gen} = \Sigma S'_{out} - \Sigma S'_{in}$$

The entropy rate in and out are determined by the heat transfer at the particular boundaries so

$$S'_{gen} := \frac{Q'}{T_{outside}} - \frac{Q'}{T_{room}} = 0.3409 \cdot \frac{W}{K}$$