**-Steady and Transient Heat Transfer**

Heat transfer problems are often classified as being **steady** (also called *steady-state*) or **transient** (also called *unsteady*). The term *steady* implies *no change* with time at any point within the medium, while *transient* implies *variation with time* or *time dependence.* Therefore, the temperature or heat flux remains unchanged with time during steady heat transfer through a medium at any location, although both quantities may vary from one location to another (Fig.-1). For example, heat transfer through the walls of a house will be steady when the conditions inside the house and the outdoors remain constant for several hours.



 Figure -1 Steady and transient heat conduction in a plane wall.

**The Thermal Resistance Concept**

**conduction resistance**

--------1

Equation (1) for heat conduction through

a plane wall can be rearranged as



 ------2 Figure -2 Heat Conduction through Wall

Where

**Convection Resistance**



Figure -3 convection resistance

 ------3

**Thermal Resistance Network**

Now consider steady one-dimensional heat flow through a plane wall of thickness *L*, area *A*, and thermal conductivity *k* that is exposed to convection on both sides to fluids at temperatures $T\_{\infty 1}$and $T\_{\infty 2}$ with heat transfer coefficients *h*1 and *h*2, respectively, as shown in Fig. 1. Assuming $T\_{\infty 1}$< $T\_{\infty 2}$, the variation of temperature will be as shown in the figure. Note that the temperature varies linearly in the wall, and asymptotically approaches $T\_{\infty 1}$ and $T\_{\infty 2}$ in the fluids as we move away from the wall.

Under steady conditions we have



Figure 4 thermal network



Figure -5 multi layer wall



Example -1



Example -2



Example -3









