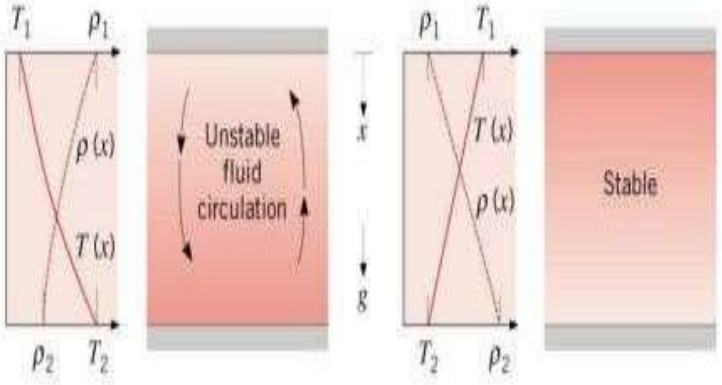
- **Free Convection (or Natural Convection)**
  - ***fluid motion*** induced by ***buoyancy forces***
  - ***buoyancy forces*** arise when there are ***density gradients*** in a fluid and a **body force** **proportional to density arises**

- **Density Gradient**
  - due to **temperature gradient**
- **Body Force**
  - **gravity** (function of mass)

} thermally driven flow

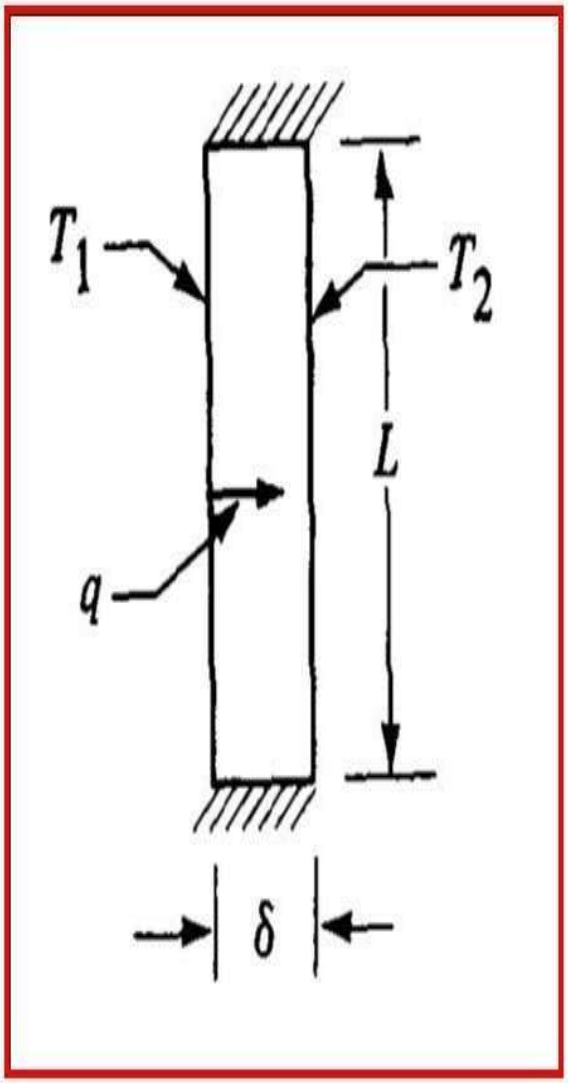
Basic Principle: heavy fluid falls and light fluid rises creating ***vortices***



$\frac{dT}{dx} > 0, \frac{d\rho}{dx} < 0$ (a)

$\frac{dT}{dx} < 0, \frac{d\rho}{dx} > 0$ (b)

Natural Convection in Enclosed Spaces



Two vertical plates separated by a distance. Each plate at a different temperature.

Ends are insulated.

Convective heat transfer occurs in the fluid within the space.

$$N_{Gr,\delta} = \frac{\delta^3 \rho^2 g \beta (T_1 - T_2)}{\mu^2}$$

$$N_{Nu,\delta} = \frac{h\delta}{k}$$

$$\frac{q}{A} = h(T_1 - T_2)$$