(EQUATION) [B-1-3]

- Mathematically, a pressure gradient, ∇p (grad p), is a scalar transformed to a vector with:
  Magnitude = maximum rate of change of pressure (p) per unit length of the coordinate space at the given point
  Direction = direction of the maximum rate of change of pressure (p) at the given point
- Using the vector quantity of the pressure gradient, directional change of pressure (commonly understood as "**pressure gradient in the direction of the flow**") is given by:
  $$\frac{dp}{ds} = \nabla p \cdot d\hat{s}$$
  (This represents "**how much change of pressure takes place**" in the direction specified by the unit vector $d\hat{s}$ in the tangential direction of a curved "streamline" coordinate s).
- **"Favorable"** pressure gradient: means that the pressure **decreases** in the direction of flow:
  $$\left(\frac{dp}{ds} < 0\right)$$
- **"Adverse"** pressure gradient: means that the pressure **increases** in the direction of the flow:
  $$\left(\frac{dp}{ds} > 0\right)$$
- In general, a basic mathematical operator to represent a vector field is the "**del**" operator:
  $$\nabla = \text{gradient} = \left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right) = \hat{\imath}\frac{\partial}{\partial x}(\quad) + \hat{\jmath}\frac{\partial}{\partial y}(\quad) + \hat{k}\frac{\partial}{\partial z}(\quad)$$
  $$\nabla = \text{gradient} = \left(\frac{\partial}{\partial r}, \frac{1}{r}\frac{\partial}{\partial \theta}, \frac{\partial}{\partial z}\right) = \hat{e}_r\frac{\partial}{\partial r}(\quad) + \hat{e}_\theta\frac{1}{r}\frac{\partial}{\partial \theta}(\quad) + \hat{e}_z\frac{\partial}{\partial z}(\quad)$$
- In 3-D coordinates, pressure gradient can be expressed either in rectangular (Cartesian) or cylindrical coordinate system as:
  $$\nabla p = \text{grad}(p) = \frac{\partial p}{\partial x}\hat{\imath} + \frac{\partial p}{\partial y}\hat{\jmath} + \frac{\partial p}{\partial z}\hat{k}$$
  $$\nabla p = \text{grad}(p) = \frac{\partial p}{\partial r}\hat{e}_r + \frac{1}{r}\frac{\partial p}{\partial \theta}\hat{e}_\theta + \frac{\partial p}{\partial z}\hat{e}_z$$