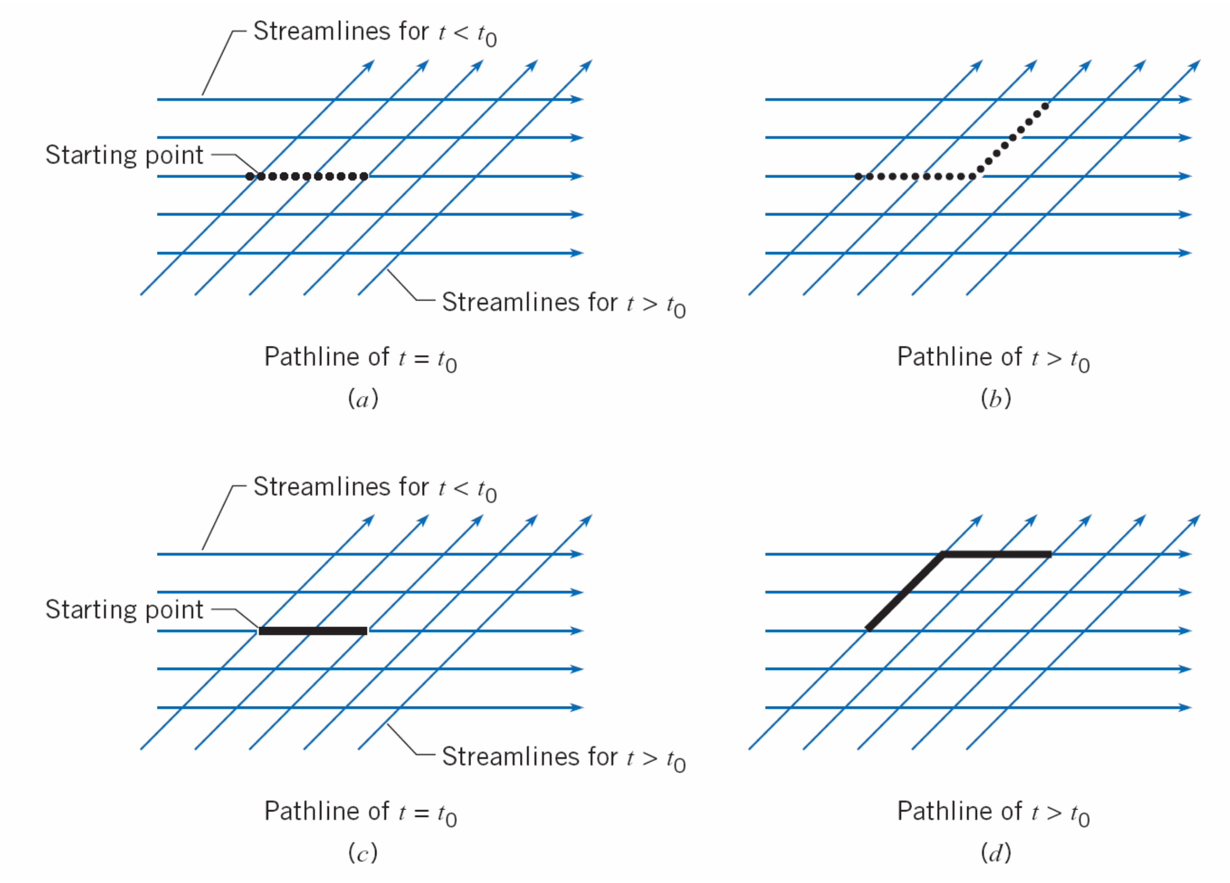
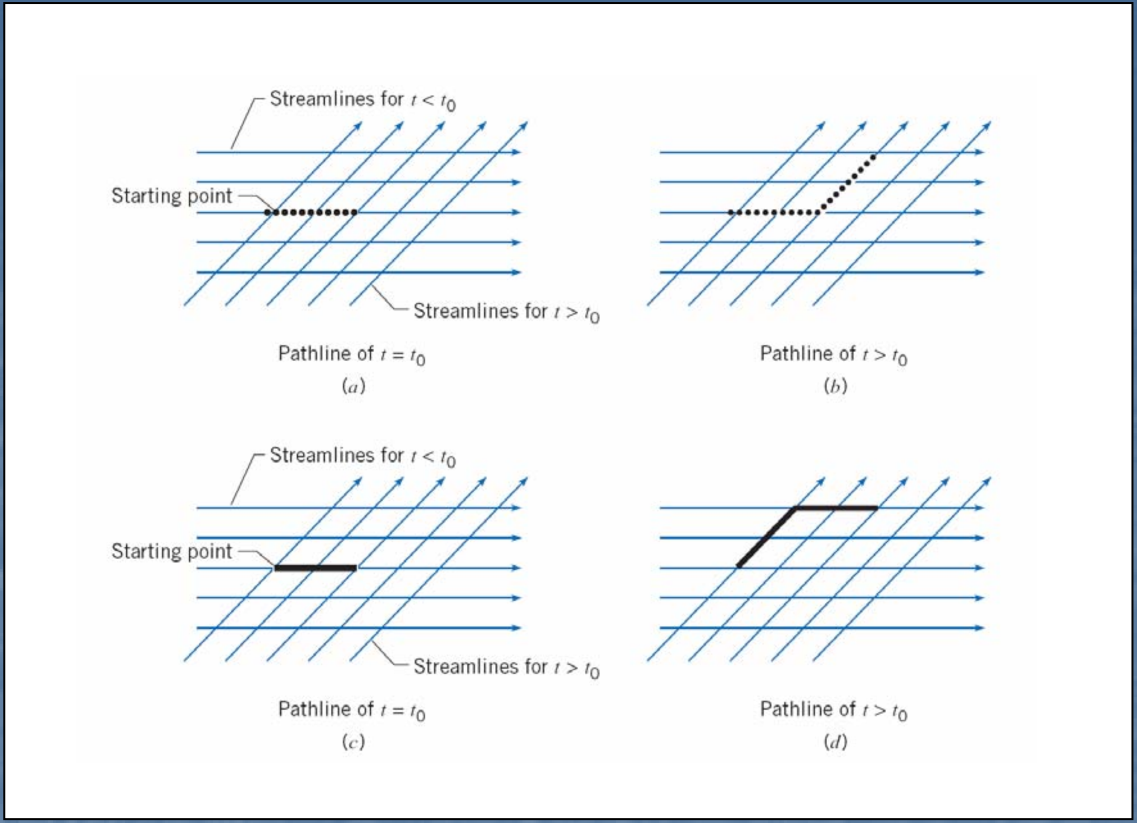
STREAMLINES, STREAKLINES & PATHLINES





Streamlines: **Is defined as the line or trace of a fluid particle in time within a flow as shown in Fig.12 .**

Pathlines: **Is defined as the line traced out by a particle of a fluid a flow as shown in Fig.12b.**

Streaklines: **Is defined as the line produced by a die introduced at a point in the field as shown in Fig.12d.**

Note

Streamline, Pathlines and Streaklines are coincident for a steady flow only

Acceleration

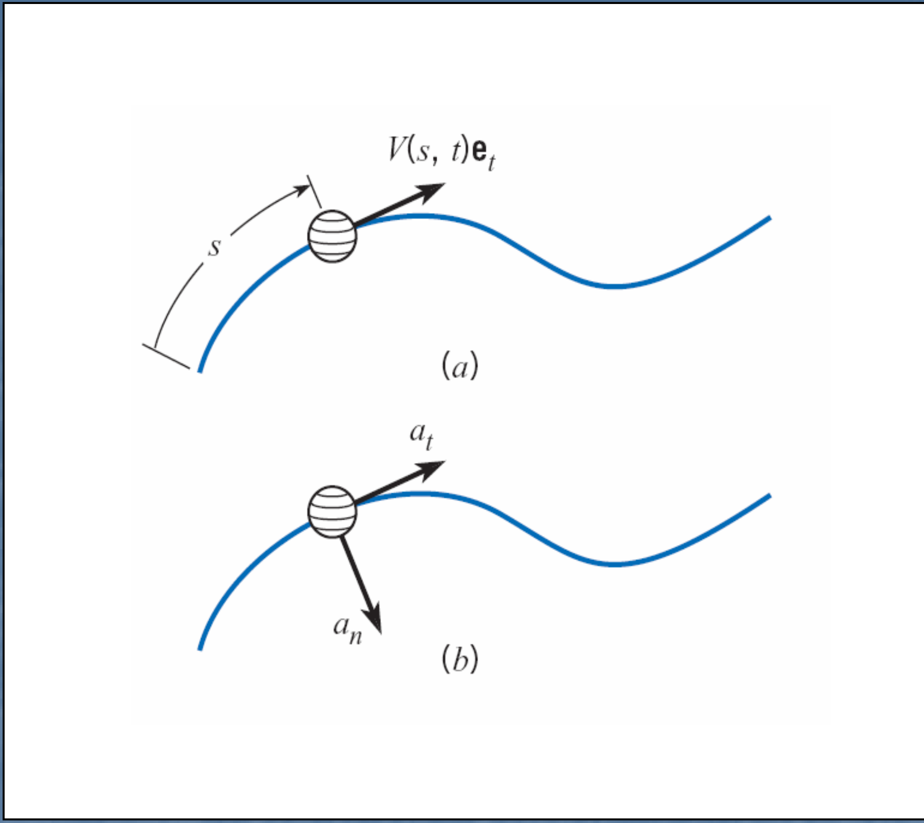
Lagrangian Approach where

the velocity is a function of time only.

The velocity of fluid particle

can be expressed as

$$V = V(s,t)e_t$$



Fluid particle moving on a pathline

$V(s,t)$

Where: e_t is the speed of particle.

is the unit vector of velocity direction.

Fluid Motion

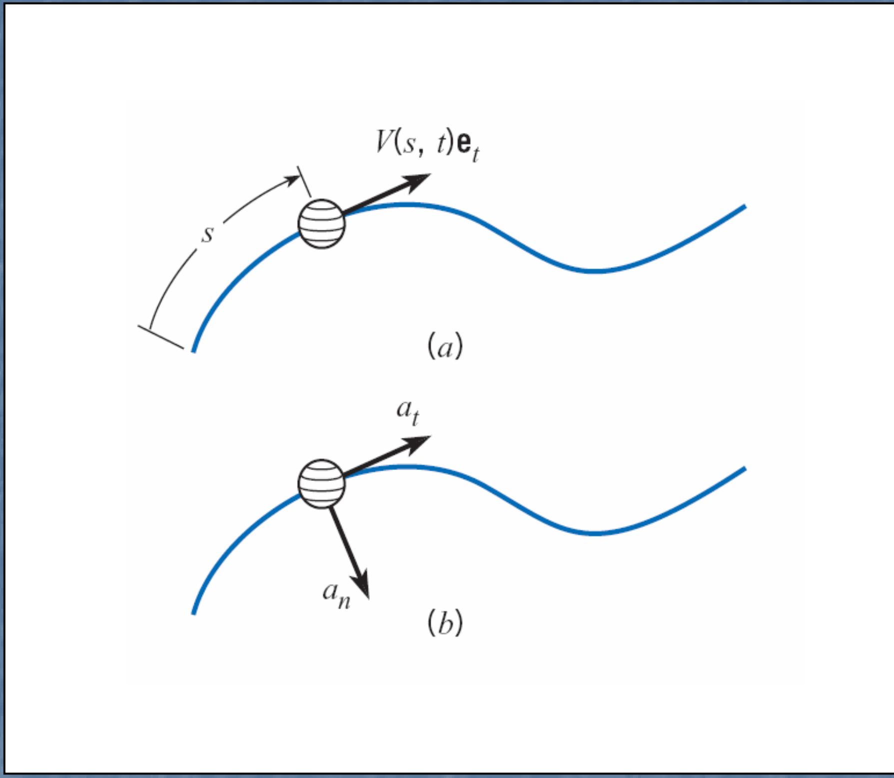
The velocity of fluid particle can be expressed as

$$a = \frac{dV}{dt} = \left(\frac{dV}{dt}\right)e_t + V\left(\frac{de_t}{dt}\right)$$

$$\left(\frac{dV}{dt}\right)e_t = \frac{dV(s,t)}{dt} = \left(\frac{\partial V}{\partial s}\right)\left(\frac{\partial s}{\partial t}\right) + \left(\frac{\partial V}{\partial t}\right)$$

$$\frac{dV}{dt} = V\left(\frac{\partial V}{\partial s}\right) + \left(\frac{\partial V}{\partial t}\right)$$

$$\left(\frac{de_t}{dt}\right) = \left(\frac{V}{r}\right)e_n$$



Where:

r = radius of local curvature

e_n = unit vector that is perpendicular to the pathline

Fluid Motion

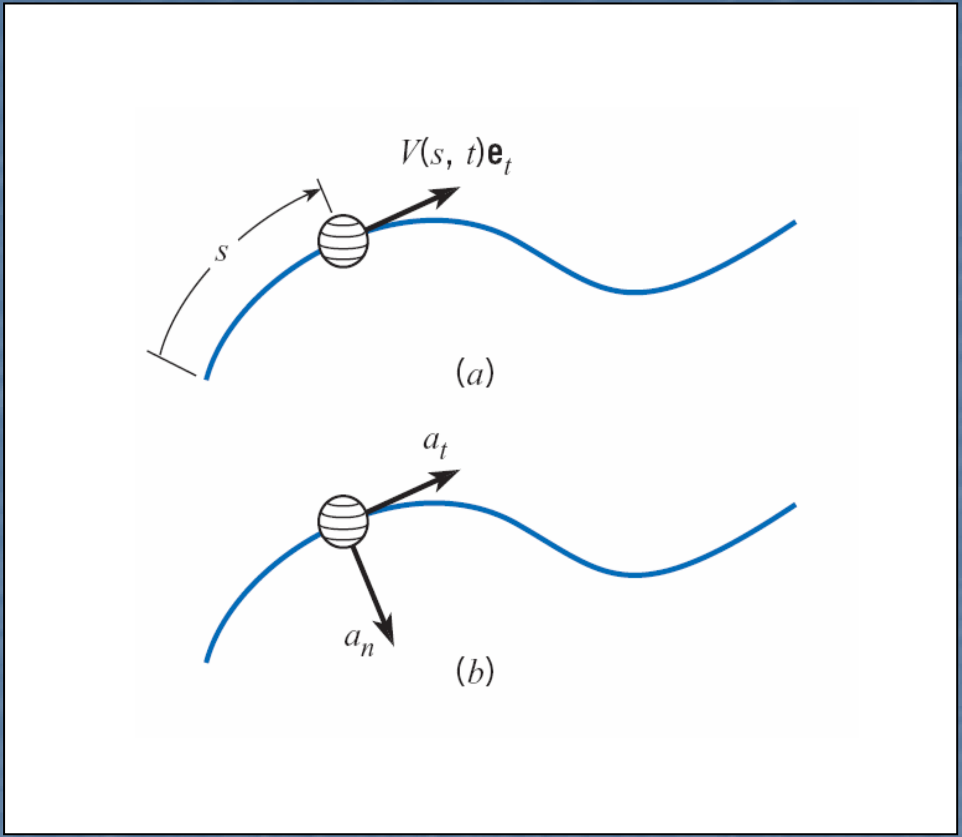
$$a = \left(V\frac{\partial V}{\partial s} + \frac{\partial V}{\partial t} \right) e_t + \left(\frac{V^2}{r} \right) e_n$$

$$a = a_t + a_n$$

Where:

$$a_t = \left(V\frac{\partial V}{\partial s} + \frac{\partial V}{\partial t} \right)$$

$$a_n = \left(\frac{V^2}{r} \right)$$



END OF LECTURE (2)