

SYSTEM AND CONTROL VOLUME APPROACH

The simplest thermodynamic formulation is for an isolated system: during its evolution, mass, momentum and energy do not change, and entropy increases (exergy decreases). Further, we considered control mass systems that may exchange energy (and momentum) with the environment, but not mass. Now we are to analyse control volume systems, also known as open systems, i.e. systems that may exchange mass (and energy and momentum) with the environment.

Flow patterns:

Fluid mechanics is a highly visual subject. The pattern of flow can be visualized in a dozen of different ways. Four basic type of patterns are :

1. Stream line- A streamline is a line drawn in the flow field so that it is tangent to the line velocity field at a given instant.
2. Path line- Actual path traversed by a fluid particle.
3. 3. Streak line- Streak line is the locus of the particles that have earlier passed through a prescribed point.
4. Time line – Time line is a set of fluid particles that form a line at a given instant .

Streamlines, streaklines and pathlines are field lines in a fluid flow. They differ only when the flow changes with time, that is, when the flow is not steady. Considering a velocity vector field in three-dimensional space in the framework of continuum mechanics, we have that:

Streamlines

A family of curves whose tangent vectors constitute the velocity vector field of the flow. These show the direction in which a massless fluid element will travel at any point in time.

Streaklines

The loci of points of all the fluid particles that have passed continuously through a particular spatial point in the past. Dye steadily injected into the fluid at a fixed point extends along a streakline.

Path lines

The trajectories that individual fluid particles follow. These can be thought of as "recording" the path of a fluid element in the flow over a certain period. The direction the path takes will be determined by the streamlines of the fluid at each moment in time.

Timelines

are the lines formed by a set of fluid particles that were marked at a previous instant in time, creating a line or a curve that is displaced in time as the particles move.



