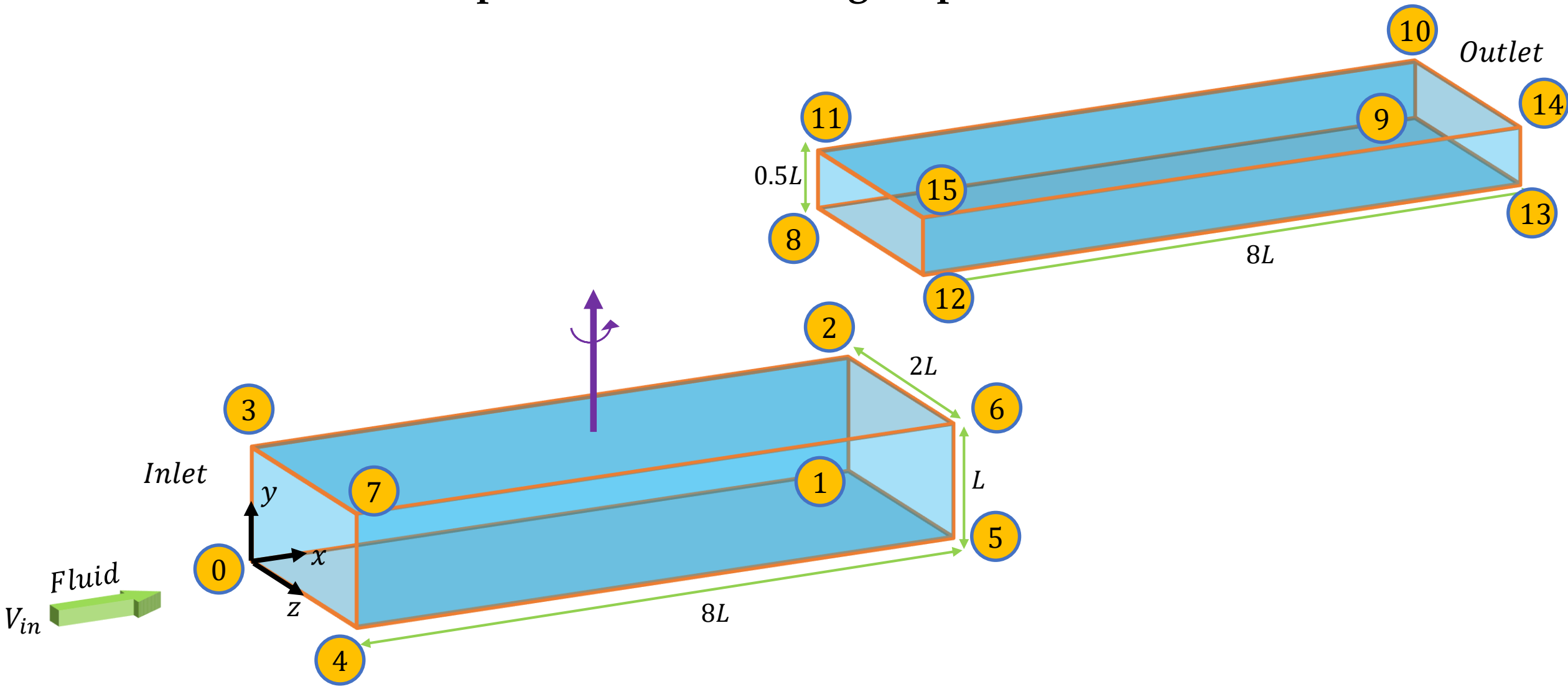
When must a flow be simulated unsteady?

1. B.Cs being a function of time

2. Transient

Example 2: Forward-Facing Step Channel



Assumptions and governing equations

Assumptions: Laminar, incompressible, unsteady, ignore gravity

Mass conservation

$$\nabla . \vec{V} = 0$$

Momentum conservation

$$\rho \frac{\delta \vec{V}}{\delta t} + \rho \nabla . \left(\vec{V} \times \vec{V} \right) = -\nabla P + \nabla . \left(\mu \nabla \vec{V} \right)$$

Symbols

$\vec{V}$: Velocity vector $(\frac{m}{s})$

P: Pressure (Pa)

ρ: Density $(\frac{kg}{m^3})$

μ: Dynamic viscosity $(\frac{kg}{m.s})$

t: Time (s)

Boundary conditions

Abbreviations

BC: Boundary conditions

B.Cs of Velocity

	Inlet	Outlet	Walls
Type	Uniform	Hydrodynamically developed	No slip
Value	$\vec{V}.\hat{n} = V_{in}$	$\nabla\vec{V}.\hat{n} = 0$	$\vec{V}$=0

B.Cs of Pressure

	Inlet	Outlet	Walls
Type	developed	atmosphere	Zero gradient
Value	$\nabla P.\hat{n} = 0$	$P = 0$	$\nabla P.\hat{n} = 0$