$$\rho_\infty \mathbf{V}.\nabla\left(\frac{1}{2}|\mathbf{V}|^2\right) = -\frac{u\partial(\mathrm{p})}{\partial \mathrm{x}} - \frac{w\partial(\mathrm{p})}{\partial z}$$ 5

$$\rho_\infty \mathbf{V}.\nabla\left(e + \frac{1}{2}|\mathbf{V}|^2\right) = -\frac{\partial(\mathrm{pu})}{\partial \mathrm{x}} - \frac{\partial(\mathrm{pw})}{\partial z}$$ 4

4 – 5

$$\rho_\infty \mathbf{V}.\nabla(e) = -\mathrm{p}\left[\frac{\partial(\mathrm{u})}{\partial \mathrm{x}} + \frac{\partial(\mathrm{w})}{\partial z}\right]$$

$$\rho_\infty \mathbf{V}.\nabla(e) = -\mathrm{p}\nabla.\mathbf{V}$$

RHS = ZERO (incompressible continuity eqn)

$$\rho_\infty \mathbf{V} . \nabla(e) = 0$$

$$\mathbf{V} . \nabla(e) = 0$$

Possibility #1

$$\mathbf{V} = 0$$

Hydrostatics

Possibility #2

$$e = \text{constant}$$

Isothermal (if fluid is calorically perfect)

Possibility #3

$\mathbf{V}$ and $\nabla(e)$ are orthogonal

Flow aligned with isotherms

Error in Lecture (at 18:47 mark): Only the isothermal possibility was assumed in the lecture. Hat-tip to Prakash Singh for pointing this out.