Mathematical Analysis of Carburetor: (or Approximate analysis)

[Neglecting the compressibility of air, e.g. Initial T & P is not given.]

Assumptions:

* Air is Incompressible (Though Pr. depression occurs at venturi-throat)

Applying Bernoulli's energy eqn to section 1-1 & 2-2, the eqn for air flow is given by

$$mgz_1 + \frac{1}{2}mv_1^2 + \frac{P_1}{w} = mgz_2 + \frac{1}{2}mv_2^2 + \frac{P_2}{w}$$

Per unit mass, $gz_1 + \frac{V_1^2}{2} + \frac{P_1}{w} = gz_2 + \frac{V_2^2}{2} + \frac{P_2}{w}$.

* Neglecting the difference in height of the air column at section 1-1 & 2-2,

$$\frac{C_1^2}{2} + \frac{P_1}{\rho_a} = \frac{C_2^2}{2} + \frac{P_2}{\rho_a}$$

Where, ρ_a = air density which is assumed to be unchanged.

C_1 & C_2 → Vel. at sec 1 & 2

P_1 & P_2 → Pr. at sec 1 & 2

$$\frac{C_2^2}{2} = \frac{C_1^2}{2} + \left(\frac{P_1}{\rho_a} - \frac{P_2}{\rho_a}\right)$$

Assuming C_1 to be negligible, i.e. $C_1 \simeq 0$

$$\frac{C_2^2}{2} = \frac{P_1}{\rho_a} - \frac{P_2}{\rho_a}$$

$$= \frac{P_1 - P_2}{\rho_a}$$

$$= \frac{\Delta P_a}{\rho_a} \quad \text{where, } \Delta P_a = P_1 - P_2$$

or

$$\boxed{C_{2_{Th}} = \sqrt{\frac{2\Delta P_a}{\rho_a}}}$$

$$C_{2_{actual}} = C_{da} C_{2_{Th}} = C_{da}\sqrt{2H}$$

where $H = \frac{\Delta P_a}{\rho_a}$