Drag Modelling Strategy

Effect of Drag

Drag in rockets is about an **order** of magnitude **lower** than **gravity** and is **tertiary** nonlinear effect.

Therefore, a simple **linearized** drag model based on non-drag trajectory **solution** can be used to predict its **effect.**

Simplified Drag Model

In this regard, a **constant** average deceleration, based on total **energy loss**, gives reasonable performance **estimate**.

Under **vertical** motion assumption, the applicable **equation** is,

$$\boxed{\frac{dV}{dt} = -\frac{g_0 I_{sp}}{m}\frac{dm}{dt} - \tilde{g} - \frac{D}{m} = -\frac{g_0 I_{sp}}{m}\frac{dm}{dt} - \tilde{g} - a_D}$$

Here, $\mathbf{a_D}$ is the constant drag **acceleration** term.

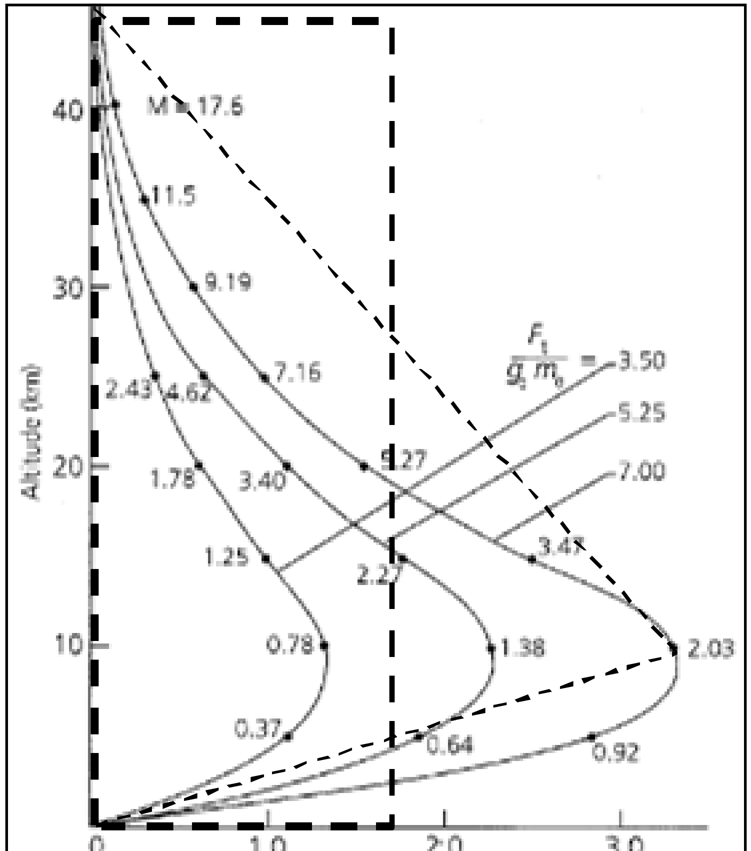
Constant Drag Deceleration Model

Consider the **generic** D Vs. h plot, as presented **earlier**.

We see that a **straight** line model captures the **energy**, which is nothing but the **area** under the **curve**.

Further, as **area** of rectangle is **matched** with area of **triangle**, width of rectangle **denotes** the drag acceleration '$\mathbf{a_D}$'.

Thus, '$\mathbf{a_D}$' is value of '**D/2m**' ~10 km **altitude.**



$$D = \frac{1}{2}\rho V^2 S_{ref} C_D$$

Summary

Therefore, to **summarize**, drag is a smaller **order** effect which can be **captured** from energy consideration.