



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,

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

Here, **a_D** is the constant drag **acceleration** term.



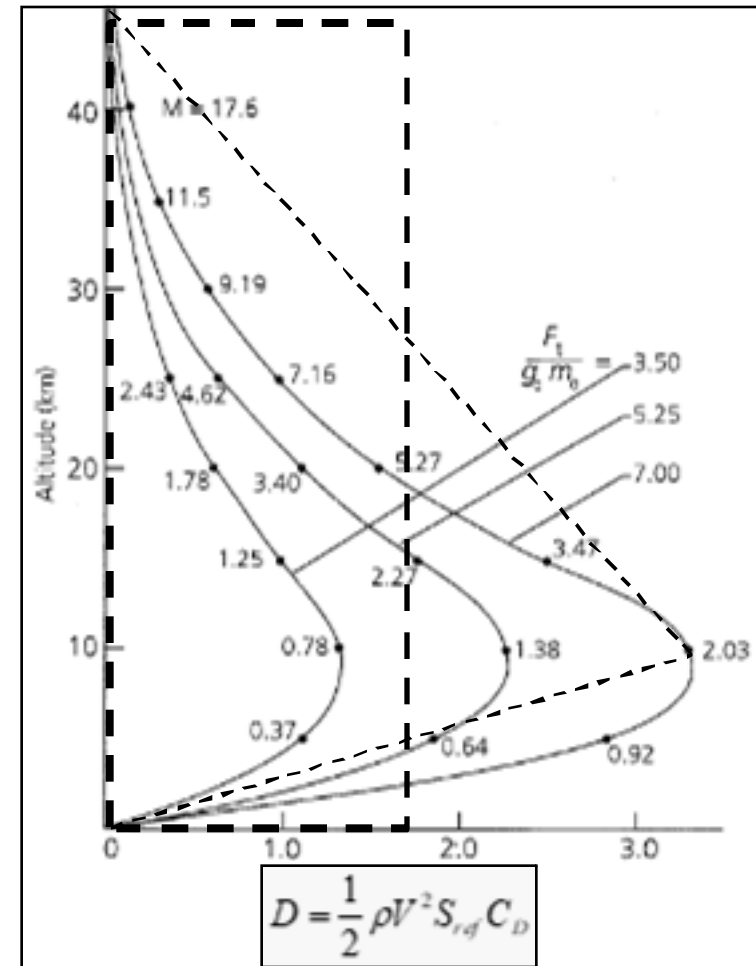
Constant Drag Deceleration Model

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 ' a_D '.

Thus, ' a_D ' is value of ' $D/2m$ ' ~10 km altitude.





Summary

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